OPERATION PLAN
STORMWATER TREATMENT AREA-3/4

MAY 2004

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

West Palm Beach, Florida

Contact Info
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I. PROJECT DESCRIPTION

Location. Stormwater Treatment Area - 3/4 (STA-3/4) is a primary component of the Everglades Construction Project mandated by the 1994 Everglades Forever Act (Section 373.4592, Florida Statutes). STA-3/4 is located within the following sections of Palm Beach and Broward counties:

Palm Beach County:	35-36, Township 46 South, Range 35 East
	31-36, Township 46 South, Range 36 East
	31, Township 46 South, Range 38 East
	18, 19, and 30-36, Township 46 South, Range 37 East
	1-16 and 22-24, Township 47 South, Range 37 East
	5-8 and 13-22, Township 47 South, Range 38 East
Broward County:	25-30, Township 47 South, Range 37 East
	28-30, Township 47 South, Range 38 East
	7-12, Township 48 South, Range 36 East

STA-3/4 is positioned immediately east (and north) of the Holey Land Wildlife Management Area, north of Water Conservation Area 3A (WCA-3A) and west of Highway US 27. See Figure 1.1.

STA-3/4 (Figure 1.2) provides a total effective treatment area of 16,543 acres to treat stormwater runoff originating within the S-2/7, S-3/8, S-236 and C-139 Basins and Lake Okeechobee, all located generally north of the project. STA-3/4 is divided into 3 flow-ways with a total of 5 cells as shown in Table 1.1.

Table 1.1 STA-3/4 Effective Treatment Area

Flow-way	Cell No.	Effective Treatment Area (ac)
Eastern	1A	3039
	1B	3488
Central	2A	2542
	2B	2894
Western	3	4580

Figure 1.1 Overview of the Everglades Construction Project.

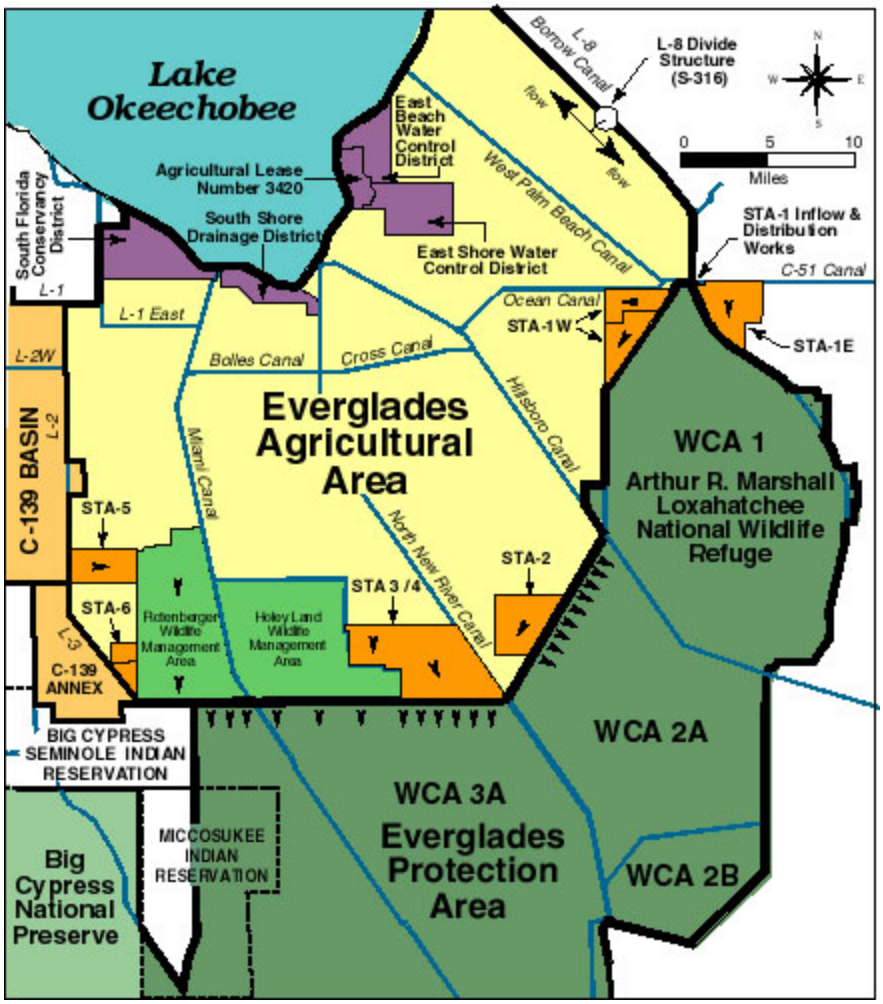
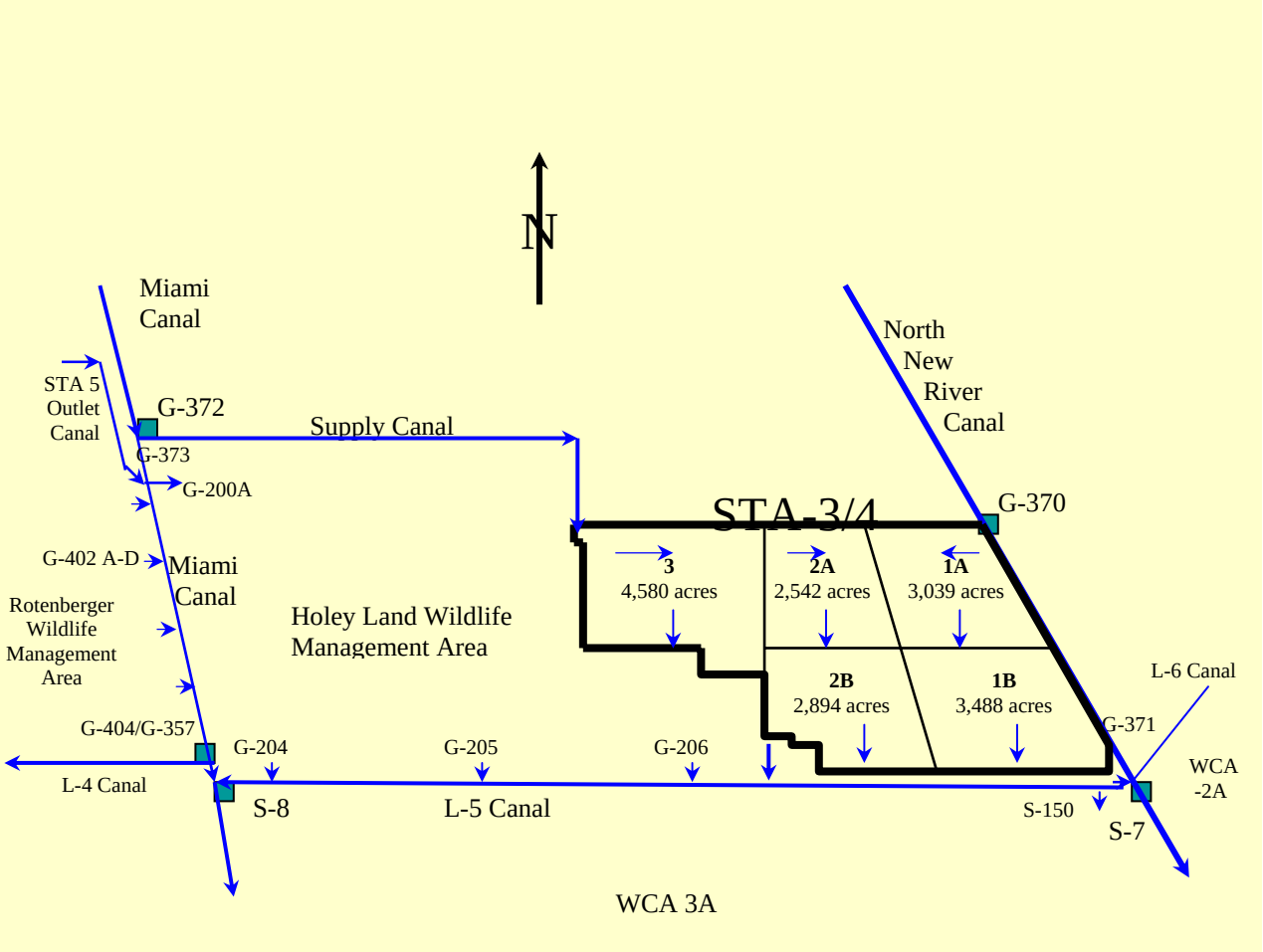


Figure 1.2 - Schematic of STA-3/4 & Surrounding Area (not to scale)



A. STA-3/4 FLOW PATTERNS

The basic flow pattern in STA-3/4 is presented in Figure 1.2. Additional detail on internal control structure locations and designations is presented in Figure 2.1. Untreated waters from the North New River (S-2/7 Basins and Lake Okeechobee) and the Miami Canals (S-3/8 Basins and C-139 Basins, SFCD/SSDD[1], and Lake Okeechobee) are directed into the STA at its northern boundary by means of pump stations, G-370 and G-372; and Diversion Structure G-371, located on the North New River Canal at the southeast corner of the STA.

Under normal STA operating conditions, Diversion Structures G-371 and G-373 will be closed, and the pump stations will lift untreated water from the North New River and Miami Canals to the Supply/Inflow Canal. The Supply Canal is adjacent to the north boundary of the Holey Land Wildlife Wildlife Management Area and joins the Inflow Canal at the northwest corner of the STA. The Inflow Canal borders the north side of the STA. Structure G-383 is located in the Inflow Canal at Interior Levee 1 that separates Cell 1A from Cell 2A. It is intended to control the amount of flow that enters either Cells 1A, 2A or Cell 3 from either or both pump stations. Normally this structure will be closed, requiring all flow from pump station G-370 to pass through Cell 1A and flow from pump station G-372 to be divided between Cells 2A and 3. Thus STA-3/4 has three flow-ways, with inflow and outflow control structures, as shown in Table 1.5 and Figure 2.1.

Table 1.2 STA-3/4 Flow-ways

Flow-way	Cells	Inflow Control Structures	Outflow Control Structures
Eastern	1A	G-374 A-F	*G-375 A-F
	1B	*G-375 A-F	G-376 A-F
Central	2A	G-377 A-E	*G-378 A-E
	2B	*G-378 A-E	G-379 A-E
Western	3	G-380 A-F	G-381 A-F

* Flow-way intermediate control structures

Inflow to the northern cells is controlled by a series of gated hydraulic structures, G-374 A-F, G-377 A-E and G-380 A-F, which allow water to pass from the Inflow Canal to the treatment cells. The hydraulic gradient is such that water flows in a southerly direction within the cells. Water that passes through Cell 1A and Cell 2A, then enters the southern cells, Cells 1B and 2B, passing through a series of structures (G-375 A-F and G-378 A-E) located on Interior Levees 2 and 3. From this point, water travels through Cells 1B and 2B for additional treatment, and then exits along the southern boundaries of the cells into the Discharge Canal by passing through another series of structures (G-376 A-F and G-379 A-E).

Provision for transferring flows between flow paths is accomplished by two structures, G-382A and G-382B located along Interior Levees 2 and 3.

[1] Two Chapter 298 Drainage Districts which discharge to STA-3/4 are the South Shore Drainage District and South Florida Conservancy District, both of which drain into the Miami Canal.

Flow that passes through Cell 3 exits (via gated structures G-381 A-F) into the Cell 3 Discharge Canal, which runs along the southern edge of the cell, where it then flows into two existing interconnected borrow pit excavations before discharging into the modified L-5 Borrow Canal.

Within the STA, the vegetative communities will provide water quality treatment through an emergent macrophyte community (predominately cattail) as well as submerged aquatic vegetation (SAV). Stages in the Discharge Canal are influenced by discharges from the STA and by the capacity of the S-7, S-8 and G-404 pump stations, and some additional control capability is provided by Structure S-150.

The treated water in the L-5 Borrow Canal will be pumped into the Water Conservation Areas by means of existing pump stations S-7 on the North New River Canal and S-8 and G-404 on the Miami Canal. Pump station S-7 discharges to WCA-2A, and pump stations S-8 discharges to WCA-3A. Pump Station G-404 and Structure G-357 discharge to WCA-3A via the L-4 Borrow Canal and the L-3 extension. In addition, Structure S-150 will be used to discharge flow to WCA-3A when stages in the conservation area are lower than those in L-5.

B. PROJECTED OPERATING SCHEDULE

Between now and December 2006 STA-3/4 will undergo several enhancement projects to improve treatment. Flow-through operation of treatment cells 1A and 1B commenced on February 25, 2004, and flow through operations in Cell 3 are anticipated to begin early 2004. See section III (H) of this plan for a description of operations during this time.

C. PRINCIPAL REFERENCES

This *Operation Plan* for STA-3/4 was developed based upon the requirements of the March 1997 Department of the Army Regulatory Division Everglades Construction Project Permit No. 199404532, and the Florida Department of Environmental Protection STA-3/4 Construction, Operation and Maintenance Permit. Reference documentation utilized extensively in the preparation of this Plan include the February 15, 1994 *Conceptual Design, Everglades Protection Project*; April 4, 1996 General Design Memorandum; September 20, 1999 *Alternatives Analysis*; June 30, 2000 *Plan Formulation* Document; August 23, 2000 *Plan Implementation* Document; October 11, 2000 *Design Criteria* Document; October 27, 2003 *Final Report Everglades Protection Area Tributary Basins Long Term Plan for Achieving Water Quality Goals*; and the various STA-3/4 *Design Analysis* Reports. In addition, detailed design (i.e. construction) documents for the various components of the STA-3/4 Works, dated between October 2000 and May 2001, were utilized for this Plan. Any subsequent documents to this operating plan, particularly for future projects that will impact STA-3/4 operations, including permits and regulations, will likely require this plan to be reviewed, and modified if necessary.

II. STRUCTURES AND CANALS DESCRIPTIONS

Introduction. This section describes the structures and other facilities associated with STA-3/4, and are as classified as follows:

1. Inflow Control Facilities
2. Interior Control Structures
3. Outflow Control Facilities
4. Seepage Control Facilities
5. Diversion Structure
6. Related Structures

Where applicable, the structures are described in terms of low and maximum design stage, which is the range for normal operations, and Standard Project Storm stage, which is the maximum allowable during flood conditions, to preserve structure integrity.

A. INFLOW CONTROL FACILITIES

Pump stations G-370 and G-372 are the primary inflow structures for the overall STA-3/4 project. Stormwater runoff and lake releases pass through G-370 and G-372 into the inflow and distribution works for Stormwater Treatment Area 3/4.

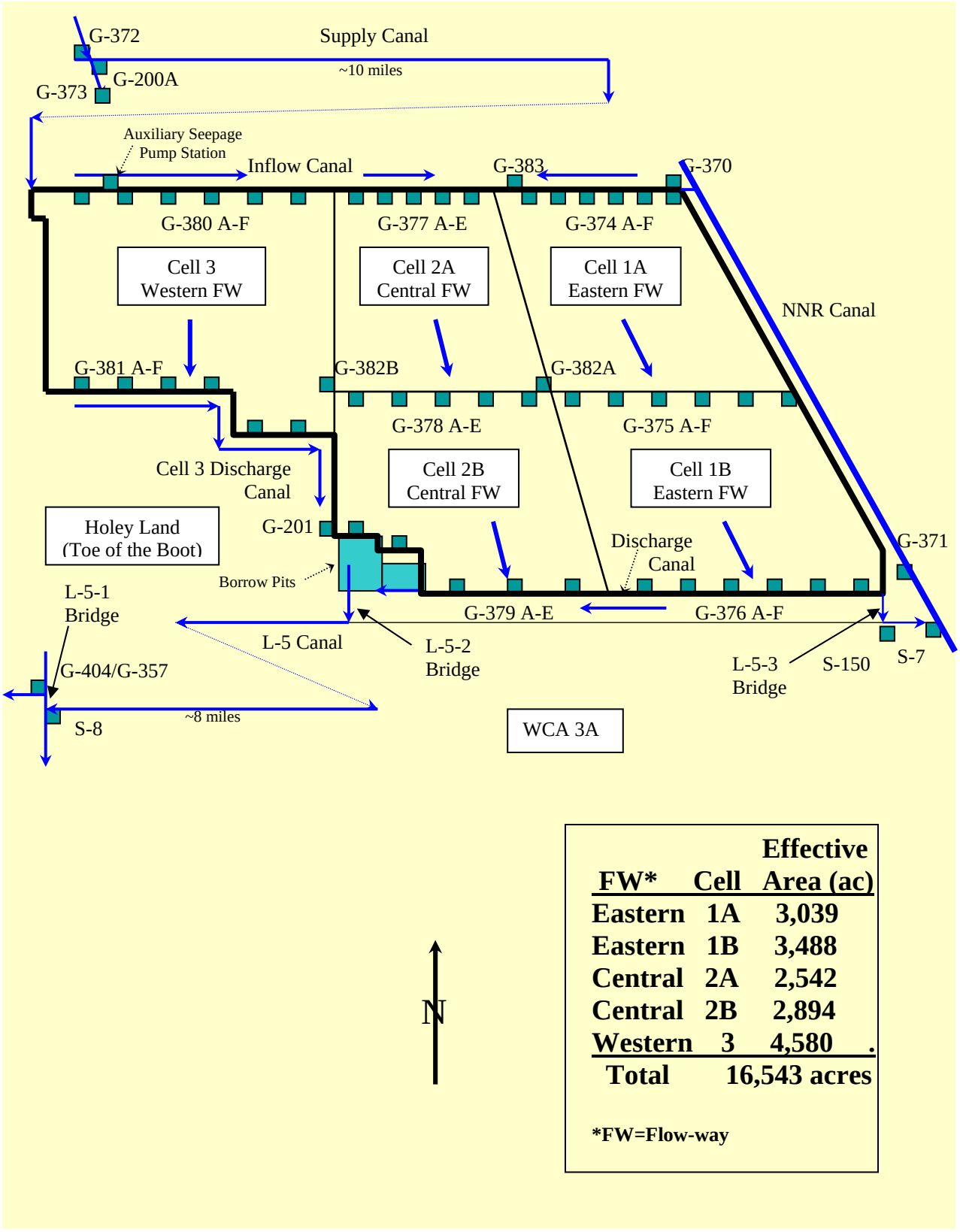
After passing through G-372, inflow from the Miami Canal is carried in the Supply and Inflow Canals and distributed to the central and western treatment flow-ways (Cells 2A and 3) through Inflow Control Structures G-377 A-E and G-380 A-F. After passing through G-370, inflow from the North New River Canal is distributed to the eastern treatment flow-way via the Inflow Canal and Inflow Control Structures G-374 A-F. Control Structure G-383, generally closed, separates the eastern and central/western flow-ways. Refer to Figure 2.1 for these structures and flow-ways locations.

The following sections describe the inflow control facilities – Pump Stations G-370, G-372, the Supply/Inflow Canal, Structures G-374 A-F, G-377 A-E, G-380 A-F, and G-383.

1. <u>Pump Station G-370</u>

Pump Station G-370 provides flood protection to the upstream agricultural basins that total approximately 222 square miles. The removal of stormwater runoff from the upstream basins will be the primary function of Pump Station G-370. In addition to flood control for the S-2/7 Basin, G-370 will be used to convey regulatory releases and supplemental flows from Lake Okeechobee [i.e. releases to the downstream environment (WCAs and ENP) and releases sent the STA to maintain minimum depth in the treatment cells]. This structure is a three-unit pumping plant (with seepage pumping capabilities described in Section II.D.) located on the west side of Highway US 27 and the North New River Canal about 25 miles south of Belle Glade. The factory test report for these pumps are contained in the project files. Performance curves resulting from those tests are presented in Figure 2.2.

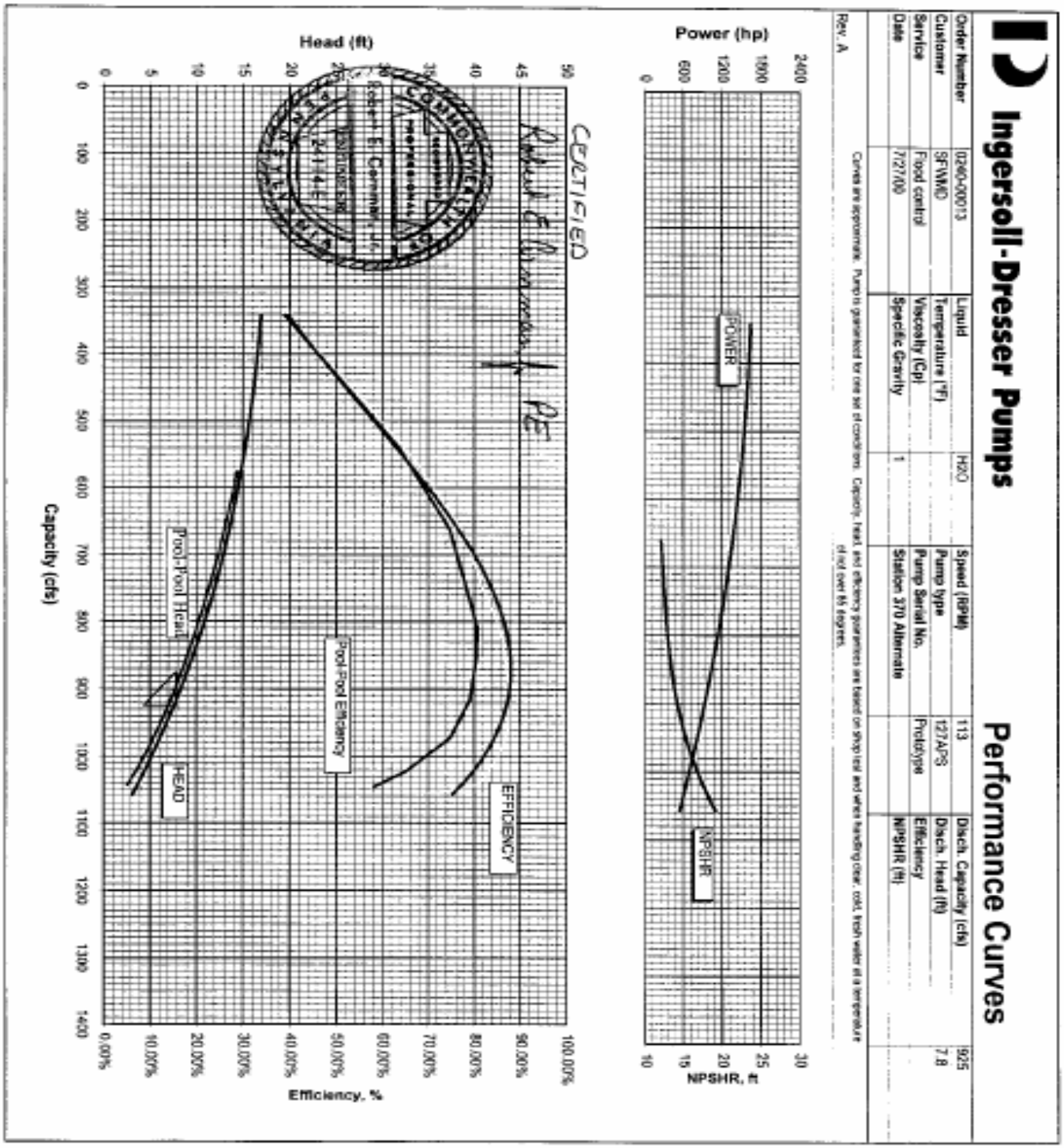
Figure 2.1 - Schematic of STA-3/4 Flows (not to scale)



FW*	Cell	Effective Area (ac)
Eastern	1A	3,039
Eastern	1B	3,488
Central	2A	2,542
Central	2B	2,894
Western	3	4,580
Total		16,543 acres

*FW=Flow-way

Figure 2.2 – G-370 Performance Curve



Normal operations include irrigation/drainage phases as a special designation, which indicates if the dominant agricultural activity is irrigation or drainage. The irrigation phase generally occurs in the winter and the drainage phase generally occurs in the summer. Brief periods of very wet or very dry weather at any time of year can initiate a change from one phase to the other. The goal is to hold stages in the North New River canal at a relatively constant level; though during the irrigation phase, it is not uncommon for stages to fall below the desired level. Pump and hydraulic descriptions are shown in Table 2.1.

Table 2.1: Pump Station G-370

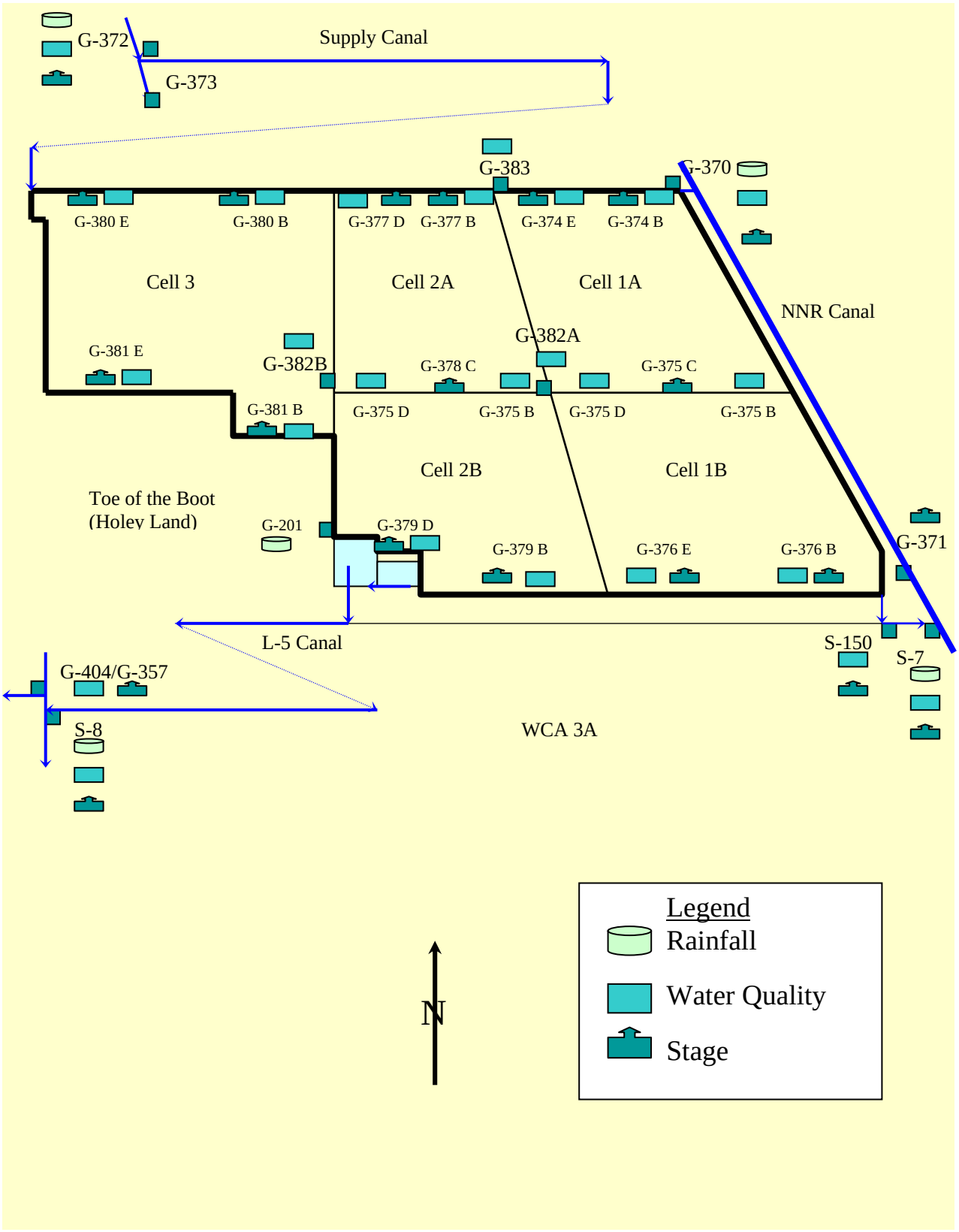
Pump Station Description		Other Notes
Number of Pumps	3	Inflow pumps
Discharge Capacity (each pump)	925 cfs	Pool-to-pool Hd 7.0 ft. Bk HP 1182
Design Headwater Elevation	10.0 ft NGVD	HW varies from +8.0ft to 14.0ft NGVD
HW Start Up Condition	8.0 ft NGVD	50% flow @ 23 ft head w/o vacuum sys.
Design Low Water (HW) Elevation	8.0 ft NGVD	in front of trash screen
Max. High Water (HW) Elevation	14.0 ft NGVD	
Max. Screen Loss to TW@ El 18.0' NGVD	5.0 ft NGVD	50% flow @ 13 ft Hd. Bk HP @ 1315
Design Tailwater Elevation	15.0 ft NGVD	
Maximum Tailwater Elevation	18.0 ft NGVD	
Minimum Tailwater Elevation	14.5 ft NGVD	
Nominal Pump Operation Speed	113 RPM	
Nominal "On Elevation"	as needed to maintain headwater at or below 10.0 ft NGVD	
Nominal "Off Elevation"	as needed to maintain headwater at or below 10.0 ft NGVD	
Motor/Engine Size	935 hp	brake horsepower @ rated condition
Motor/Engine Size	1467 hp	brake horsepower @ start-up condition
Motor/Engine Speed	720 RPM	naturally aspirated 2 cycle diesel engine
Centerline Discharge Connection	24.0 ft NGVD	Discharge Sill Elev. @ 20.0 ft NGVD
Pump Station Floor Elevation	31.0 ft NGVD	
Intake Floor Elevation	-8.5 ft NGVD	At entrance to Formed Suction Intake tunnel
Discharge Floor Elevation	-4.0 ft NGVD	At exit of discharge. Tunnel height 12.0ft

Structure Operations:
Pump station headwater stage of 10.0 ft NGVD is maintained as much as possible.

Data Acquisition and Telemetry:
Both local and remote operation of this pump station are possible although it is anticipated that all operations will be done locally based on directions received from the West Palm Beach Control Room. Meteorological, hydrologic, and pump operation data are transmitted to the Control Room via telemetry, while headwater/tailwater staff gauges are available for local operation.

Water Quality Sampling:
Flow proportional, automatic sampling equipment will be installed at Pump Station G-370 for the purpose of monitoring inflow water quality (See Figure 2.3).

Figure 2.3 - STA-3/4 Monitoring Locations (not to scale)



2. Pump Station G-372

Pump Station G-372 provides flood protection to the upstream agricultural basins totaling approximately 277 square miles. The removal of stormwater runoff from the upstream basins will be the primary function of Pump Station G-372. In addition to flood control for the S-3/8 Basins, G-372 will be used to remove excess flows from the C-139 and Chapter 298 Basins as well, and to convey regulatory releases and supplemental flows from Lake Okeechobee [i.e. releases to the downstream environment (WCAs and ENP) and releases sent the STA to maintain minimum depth in the treatment cells]. In addition, G-372 can directly release some water into the Holey Land Wildlife Area at the District's discretion. This structure is a four-unit pumping plant (with seepage pumping capabilities described in Section II.D.) located on the east side of Miami Canal about 25 miles southwest of Belle Glade, and 7 miles north of Pump Station S-8. The factory test report for these pumps are contained in the project files. Performance curves resulting from those tests are presented in Figure 2.4.

Like Pump Station G-370, normal operations include irrigation/drainage phases as a special designation, which indicates if the dominant agricultural activity is irrigation or drainage. Again, the goal is to hold stages in the Miami Canal at a constant level, though during the irrigation phase, it is not uncommon for stages to fall below the desired level. Pump and hydraulic descriptions are shown in Table 2.2.

Table 2.2: Pump Station G-372

Pump Station Description		Other Notes
Number of Pumps	4	inflow pumps
Discharge Capacity (each pump)	925 cfs	pool-to-pool Hd 9.0 ft. Brake HP 1182
Design Headwater Elevation	10.0 ft NGVD	HW varies +8.0 to +14.0 ft NGVD
Design Low Water (HW) Elevation	8.0 ft NGVD	HW level in front of screen
Start-Up (HW) Elevation	8.0 ft NGVD	50% Flow at 16.0 ft pool-to-pool Hd.
Max. High Water (HW) Elevation	14.0 ft NGVD	
Max. Screen Loss (HW) Elevation	5.0 ft NGVD	50% Flow with TW El. 19.0 ft NGVD
Design Tailwater Elevation	17.0 ft NGVD	
Maximum Tailwater Elevation	19.0 ft NGVD	
Minimum Tailwater Elevation	14.5 ft NGVD	
Nominal Pump Operation Speed	119 RPM	
Nominal "On Elevation"	as needed to maintain headwater at or below 10.0 ft NGVD	
Nominal "Off Elevation"	as needed to maintain headwater at or below 10.0 ft NGVD	
Motor/Engine Size	1663 hp	Start-Up condition
Motor/Engine Speed	720 RPM	2 Cycle Diesel Naturally Aspirated
Centerline Discharge Connection	24.0 ft NGVD	Discharge Sill Elevation at 20.0 ft NGVD
Pump Station Floor Elevation	31.0 ft NGVD	
Intake Floor Elevation	-8.5 ft NGVD	At FSI Tunnel Entrance
Discharge Floor Elevation	-4.0 ft NGVD	At exit of discharge. Tunnel height 12.0ft

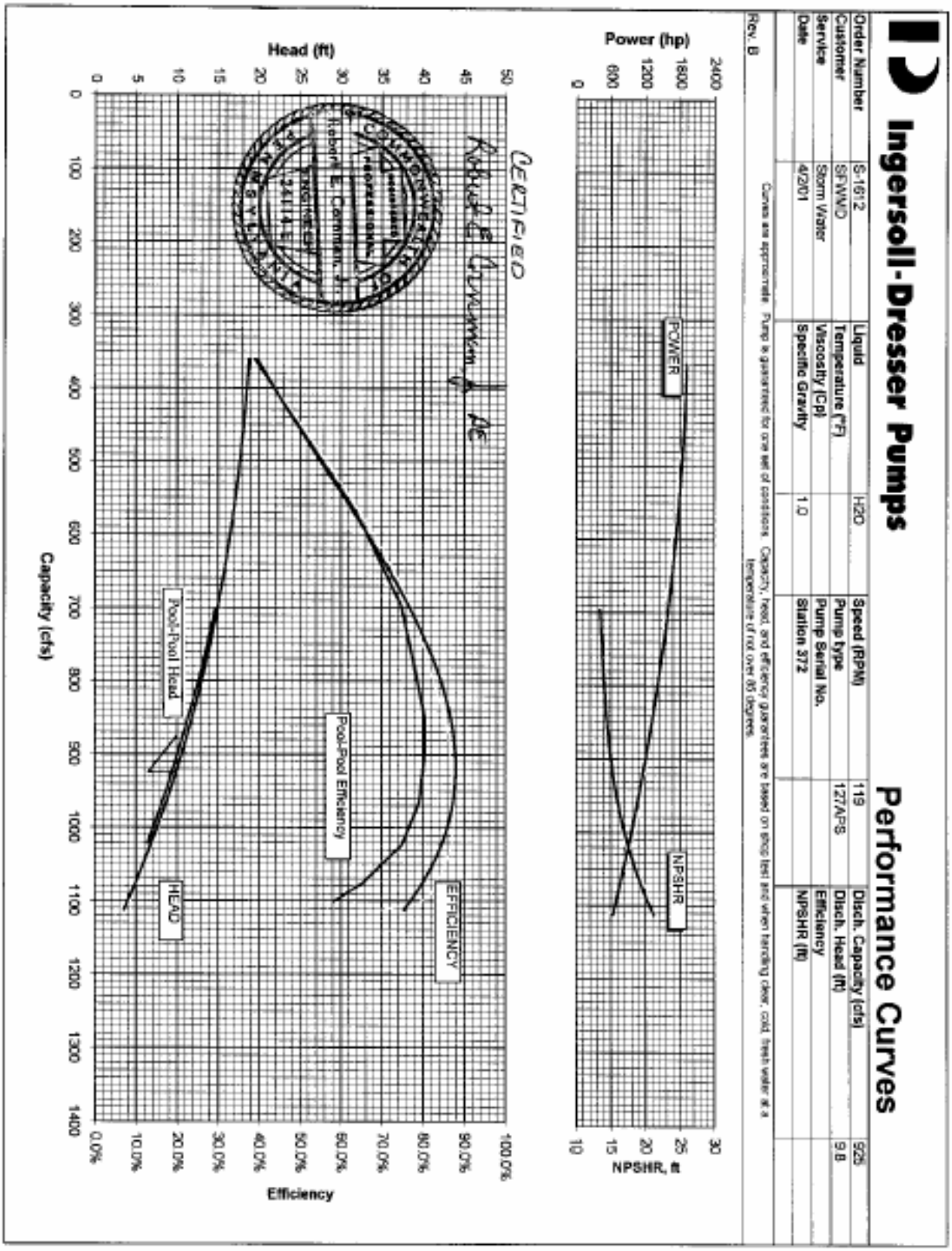
Structure Operations:
Pump station headwater stage of 10.0 ft NGVD is maintained as much as possible.

Data Acquisition and Telemetry:
As described previously for G-370, both local and remote operation of this pump station are possible, but it is anticipated that all operations will be done locally based on

directions received from the West Palm Beach Control Room. Meteorological, hydrologic, and pump operation data are transmitted to Control Room via telemetry, while headwater/tailwater staff gauges are available for local operation.

Water Quality Sampling:
Flow proportional, automatic sampling equipment will be installed at Pump Station G-372 for the purpose of monitoring inflow water quality (See Figure 2.3).

Figure 2.4 – G-372 Performance Curve



3. Inflow/Supply Canal

The Inflow/Supply Canal system conveys discharges from G-370 and G-372 to STA-3/4. The Supply Canal is located adjacent to the northern boundary of the Holey Land and extends from G-372 eastward (7.7 miles) and then southward (2.7 miles) before intersecting the Inflow Canal at the northwest corner of the STA. The Inflow Canal borders the northern portion of STA-3/4 from the intersection of the Supply Canal to G-370 (6.2 miles). Structure G-383 is located in the Inflow Canal adjacent to the western limit of Cell 1A and serves to control the commingling of discharges from the two pump stations. Under normal conditions, this structure will be closed and all G-372 discharges will be diverted to Cells 2A and 3, and all G-370 discharges will be diverted to Cell 1A.

The Supply Canal is flanked on both sides by levees to contain water levels that are expected to be as much as 8 feet above surrounding grade elevations. The existing Holey Land Levee was modified to protect the Holey Land, and the Exterior Levee serves to protect farming areas located north of the canal. For the Inflow Canal, an Inflow Control Levee serves to separate the canal from the STA, while an Exterior Levee protects the farming areas to the north. Maintenance berms exist between the canal and both levees along the entire length of the Inflow/Supply Canal. Canal, levee, and hydraulic parameters are shown in Table 2.3.

Table 2.3 Inflow and Supply Canal

Canal Description	Inflow Canal	Supply Canal
Canal Length	6.2 miles	10.4 miles
Canal Invert	-5.5 ft NGVD	-5.5 ft NGVD
Canal Bottom Width	30 - 45 ft	45 ft
Canal Side Slopes	2.5H:1V	2.5H:1V
Exterior Levee Height	19.0 ft NGVD	23.0 ft NGVD
Holey Land Levee Height	-	22.0 ft NGVD
Inflow Control Levee Height	19.5 ft NGVD	-
Berm Heights	14.0 ft NGVD	14.0 ft NGVD
Design Maximum Flow	2,775 cfs	3,670 cfs
Design Water Surface Elev.	15.0 ft NGVD	17.0 (15.0*) ft NGVD
Design Max. Canal Velocities	0.29 to 1.71 fps	0.32 to 1.88 fps
Standard Project Storm Flow	2,775 cfs	3,670 cfs
SPS Water Surface Elev.	18.0 ft NGVD	20.0 (18.0*) ft NGVD
SPS Canal Velocities	< Design Velocity	< Design Velocity

*Inflow Canal Section from G-380F to G-383

4. Inflow Control Structures G-374 A-F, G-377 A-E, and G-380 A-F

Control Structures G-374 A-F, G-377 A-E and G-380 A-F are a series of six, five, and six gated concrete box culverts, respectively, located along the Inflow Canal that serve to control inflow to the Eastern, Central, and Western flow-ways. Untreated water is conveyed through these structures to the upstream end of each STA's flow-way and distributed across the treatment area by means of a spreader canal aligned east-to-west. A description of these structures is shown in Table 2.4.

Table 2.4 Inflow Control Structure G-374, G-377 and G-380

Control Structure Description	G-374 A-F	G-377 A-E	G-380 A-F
Number of Culverts	6	5	6
Culvert / Gate Size (H x W)	8' x 10'	9' x 10'	7' x 7'
Culvert Length (including wingwalls)	115 ft	115 ft	111 ft
Culvert Invert	2.0 ft NGVD	1.0 ft NGVD	3.0 ft NGVD
Design Inflow (each culvert)	362 cfs	396 cfs	282 cfs
Design Max. Headwater Elevation	14.9 ft NGVD	14.9 ft NGVD	15.1 ft NGVD
Design Low Water (HW) Elevation	11.0 ft NGVD	11.0 ft NGVD	11.0 ft NGVD
Standard Project Storm (HW) Elev.	18.0 ft NGVD	18.0 ft NGVD	18.0 ft NGVD
Design Max. Tailwater Elevation	14.4 ft NGVD	14.4 ft NGVD	14.0 ft NGVD
Design Low Water (TW) Elevation	10.6 ft NGVD	10.9 ft NGVD	11.0 ft NGVD
Standard Project Storm (TW) Elev.	17.4 ft NGVD	17.4 ft NGVD	17.0 ft NGVD
HW/TW Data via Telemetry	G-374 B & E	G-377 B & D	G-380 B & E

Structure Operations:
Both manual and remote operation of these structures are possible. Remote operation (telemetry) is from the SFWMD's Operations Control Center located in West Palm Beach. In the event of loss of electrical power at the site, these structures can be manually operated with hydraulic or electric wrenches. These structures will be operated, fully or partially closed, to provide appropriate flows to their respective flow-ways.

Data Acquisition and Telemetry:
Headwater and tailwater data (G-374B/E, G-377B/D, G-380B/E) are available via telemetry to the remote operators while headwater/tailwater staff gauges are also available at these locations. Gate position at each structure is monitored remotely; gate position indication is also available at each structure. See Figure 2.3 for monitoring information.

Water Quality Sampling:
No operating permit water quality sampling is anticipated to be required at this site. However, in an effort to further enhance the treatment area effectiveness through operational refinements structures G-374 B & E, G-377 B & D, and G-380 B & E are being monitored.

5. G-383 (Inflow Control Structure)

Control Structure G-383 is a double-barreled gated concrete-box culvert structure located in the Inflow Canal at the intersection of Interior Levee 1 and Inflow Control Levee. This normally closed structure serves to maintain separation between inflows from the North New River Canal and the Miami Canal. The primary function of G-383 is to provide operational flexibility, such as allowing large flow differences between the Eastern flow-way and the Central and Western flow-ways to equalize. Under some circumstances, it might be desirable to pass up to approximately 50% of North New River Canal peak inflow of 2,775 (1,390 cfs) through G-383 to Cells 2 and 3, or up to approximately 40% of Miami Canal peak inflow of 3,670 cfs (1,470 cfs) through G-383 to Cell 1. A description of this structure is shown in Table 2.5.

Table 2.5 Control Structure G-383

Control Structure Description	
Number of Culverts	2
Culvert / Gate Size (H x W)	10' x 10'
Culvert Length (including wingalls)	114 ft
Culvert Invert	0.0 ft NGVD
Design Inflow (each culvert)	735 cfs
Design Max. Water Elevation	15.0 ft NGVD
Design Low Water Elevation	11.0 ft NGVD
Standard Project Storm Elev.	18.0 ft NGVD
Maximum Differential Head	1.4 ft
HW/TW Data via Telemetry	G-374 E & G-377 B

Structure Operations:
Both manual and remote operation of this structure is possible. Remote operation is from the SFWMD's Operations Control Center located in West Palm Beach. In the event of loss of electrical power at the site, G-383 can be manually operated with hydraulic or electric wrenches. G-383 will normally be closed, but can be operated to provide appropriate flows to flow-ways 1, 2, or 3.

Data Acquisition and Telemetry:
Headwater/tailwater data for G-383 at Inflow Control Structures G-374E and G-377B are available to the Control Room via telemetry. Headwater/tailwater staff gauges are available at G-374E and G-377B. Gate position is remotely monitored and information (for manual operation) is available at this structure. See Figure 2.3 for monitoring information.

Water Quality Sampling:
No operating permit water quality sampling is anticipated to be required at this site. However, in an effort to further enhance the treatment area effectiveness through operational refinements structures G-374 E and G-377 B are being monitored.

B. INTERIOR FLOW CONTROL STRUCTURES

After passing through Cell 1A, flow is redistributed in the Eastern flow-way through Interior Control Structures G-375 A-F onto Cell 1B. Likewise, after passing through Cell 2A, flow is redistributed in flow-way 2 through Interior Control Structures G-378 A-E onto Cell 2B. Control Structures G-382A and G-382B will normally be closed, and will be used to transfer water between cells during periods of low flow, if desired. (See Figure 2.1)

The following section describes these interior control facilities – Structures G-375 A-F, G-378 A-E, G-382 A and G-382 B.

1. Interior Control Structures G-375 A-F and G-378 A-E

Structures G-375 A-F and G-378 A-E are a series of six and five gated concrete box culverts, respectively, located between the "A" and "B" Cells, and serve as interior

control for the Eastern and Central flow-ways, respectively. These structures are situated along Interior Levee 2/3 adjacent to the collection canal in each cell. Water flows from the upstream treatment areas into the collection canals, is conveyed through these structures, and is redistributed across the downstream treatment cells by means of a spreader canal aligned east-to-west. A description of these structures is shown in Table 2.6.

Table 2.6 Interior Control Structure G-375 and G-378

Control Structure Description	G-375 A-F	G-378 A-E
Number of Culverts	6	5
Culvert / Gate Size (H x W)	8' x 10'	10' x 10'
Culvert Length (including wingwalls)	115 ft	123 ft
Culvert Invert	2.0 ft NGVD	0.0 ft NGVD
Design Inflow (each culvert)	362 cfs	396 cfs
Design Max. Headwater Elevation	13.8 ft NGVD	13.8 ft NGVD
Design Low Water (HW) Elevation	10.6 ft NGVD	10.9 ft NGVD
Standard Project Storm (HW) Elev.	16.8 ft NGVD	16.8 ft NGVD
Design Max. Tailwater Elevation	13.3 ft NGVD	13.5 ft NGVD
Design Low Water (TW) Elevation	10.6 ft NGVD	10.9 ft NGVD
Standard Project Storm (TW) Elev.	16.3 ft NGVD	16.5 ft NGVD
HW/TW Data via Telemetry	G-375 C	G-378 C

Structure Operations:
Both manual and remote operations of these structures are possible. Remote operation is from the SFWMD's Operations Control Center located in West Palm Beach. In the event of loss of electrical power at the site, these structures can be manually operated with hydraulic or electric wrenches. These structures will normally be fully open, but can be closed as required to maintain stage in Cells 1A and 2A at desired levels or to facilitate transfer of water through Control Structures G-382A and G-382B.

Data Acquisition and Telemetry:
Headwater and tailwater data (at G-375C, C-378C) are available via telemetry to the remote operators while headwater/tailwater staff gauges are also available at these locations. Gate position at each structure is monitored remotely; gate position indication is also available at each structure. See Figure 2.3 for monitoring information.

Water Quality Sampling:
No operating permit water quality sampling is anticipated to be required at this site. However, in an effort to further enhance the treatment area effectiveness through operational refinements structures G-375 B & E and G-378 B & D are being monitored.

2. G-382 A-B (Interior Control Structures)

Flow Control Structures G-382 A and B are gated concrete box culvert structures located in the collection canals along Interior Levees 2 and 3. G-382A is located on Interior Levee 1 separating the Eastern flow-way from the Central flow-way, and G-382B is located on Interior Levee 4 separating the Central flow-way from the Western flow-way. The primary function of G-382 A and B is to provide operational flexibility for transfer of water between cells under low flow conditions to prevent cell dryout. More detailed

operational description of these structures will be provided upon the revised 2D modeling. A description of these structures is shown in Table 2.7.

Table 2.7 Control Structure G-382

Control Structure Description	G-382 A	G-382 B
Number of Culverts	1	1
Culvert / Gate Size (H x W)	10' x 10'	10' x 10'
Culvert Length (including wingwalls)	127 ft	119 ft
Culvert Invert	0.0 ft NGVD	0.0 ft NGVD
Design Inflow (each culvert)	Variable	Variable
Design Max. Headwater Elevation	13.8 ft NGVD	13.8 ft NGVD
Design Low Water (HW) Elevation	10.9 ft NGVD	11.0 ft NGVD
Standard Project Storm (HW) Elev.	16.8 ft NGVD	16.8 ft NGVD
Design Max. Tailwater Elevation	13.5 ft NGVD	13.5 ft NGVD
Design Low Water (TW) Elevation	10.6 ft NGVD	10.9 ft NGVD
Standard Project Storm (TW) Elev.	16.3 ft NGVD	16.3 ft NGVD
Maximum Differential Head (Low Flow)	0.1 ft	0.1 ft
HW/TW Data via Telemetry	G-375 C & G-378 C	G-378 C & G-381 B

Structure Operations:
Both manual and remote operations of these structures are possible. Remote operation is from the SFWMD's Operations Control Center located in West Palm Beach. In the event of loss of electrical power at the site, the G-382 structures can be manually operated with hydraulic or electric wrenches. G-382 A and B will normally be closed, but can be operated to facilitate transfer of flows to any of the flow-ways.

Data Acquisition and Telemetry:
Headwater and tailwater data (at G-375C, G-378C, G-381B) are available via telemetry to the remote operators while headwater/tailwater staff gauges are also available at these locations. While gate position is remotely monitored, information (for manual operation) is also available at these structures. See Figure 2.3 for monitoring information.

Water Quality Sampling:
No operating permit water quality sampling is anticipated to be required at this site. However, in an effort to further enhance the treatment area effectiveness through operational refinements structures G-382 A & B are being monitored.

C. OUTFLOW CONTROL FACILITIES

After passing through Cells 1B and 2B, discharges are conveyed through Outlet Control Structures G-376 A-F and G-379 A-E, respectively, to the Discharge Canal. The Discharge Canal extends east 4.9 miles along the southern boundary of Cells 1B and 2B from the former Griffin rock pits. The canal conveys discharges from structures G-376A-F and G-379 A-C. The Griffin pits are approximately one-mile in width with depths ranging from 30' to 50' below land surface (-20 to -40 ft NGVD). Structures G-379 D and E are located in the South Exterior Levee along the north border of the pits and discharge directly to them. A 300-ft. long canal section that has the same cross section dimensions as the Discharge Canal connects the two pits.

After passing through Cell 3, discharges are conveyed through Outlet Control Structures G-381 A-F to the Cell 3 Discharge Canal. The Cell 3 Discharge Canal is located along the southern boundary of Cell 3 and the western border of Cell 2B and extends from Structure G-381F to the Griffin pits. All discharges are then conveyed to the L-5 Borrow Canal. (See Figure 2.1)

The following section describes these outflow control facilities – the Discharge Canal, the L-5 Canal, Structures G-376 A-F, G-379 A-E, and G-381 A-F.

1. Outflow Control Structures G-376 A-F, G-379 A-E and G-381 A-F

Control Structures G-376 A-F, G-379 A-E and G-381 A-F are a series of six, five, and six gated concrete box culverts, respectively, located along the Discharge Canal (Cell 3 Discharge Canal for G-381 structures) and serve as outflow control for the Eastern, Central, and Western flow-ways respectively. These structures are situated along the South Exterior Levee (Cell 3 Exterior Levee for G-381 structures). Water is conveyed from these structures south to the Discharge or Cell 3 Discharge Canals. A description of these structures is shown in Table 2.8.

Table 2.8 Outflow Control Structure G-376, G-379, and G-381

Control Structure Description	G-376 A-F	G-379 A-E	G-381 A-F
Number of Culverts	6	5	6
Culvert / Gate Size (H x W)	8' x 10'	10' x 10'	8' x 8'
Culvert Length (including wingwalls)	115 ft	123 ft	102 ft
Culvert Invert	2.0 ft NGVD	0.0 ft NGVD	2.0 ft NGVD
Design Inflow (each culvert)	362 cfs	396 cfs	282 cfs
Design Max. Headwater Elevation	12.8 ft NGVD	12.9 ft NGVD	13.8 ft NGVD
Design Low Water (HW) Elevation	10.6 ft NGVD	10.9 ft NGVD	11.0 ft NGVD
Standard Project Storm (HW) Elev.	15.8 ft NGVD	15.9 ft NGVD	16.8 ft NGVD
Design Max. Tailwater Elevation	12.3 ft NGVD	12.6 ft NGVD	13.1 ft NGVD
Design Low Water (TW) Elevation	10.0 ft NGVD	10.0 ft NGVD	10.0 ft NGVD
Standard Project Storm (TW) Elev.	15.3 ft NGVD	15.6 ft NGVD	16.1 ft NGVD
HW/TW Data via Telemetry	G-376 B & E	G-379 B & D	G-381 B & E

Structure Operations:
Both manual and remote operations of these structures are possible. Remote operation is from the SFWMD's Operations Control Center located in West Palm Beach. In the event of loss of electrical power at the site, these structures can be manually operated by means of a portable generator or hydraulic/electric powered maintenance equipment. In anticipation of a major storm event, portable generators will be set up at these structures to ensure continued operation if electrical power is lost for a significant time period. The generators will remain on site to operate these structures until permanent power is restored. The structure control gates will be modulated as required to maintain the design low headwater elevation (i.e. static water level) until the structures are fully open. The gates will remain fully open until stages in the Discharge Canal falls below the static

water level in each cell, at which time the gates will again be modulated to maintain the static water level.

Data Acquisition and Telemetry:
Headwater and tailwater data at (G-376B and E, G-379B and D, G-381B and E) are available via telemetry to the remote operators while headwater/tailwater staff gauges are also available at these locations. Gate position at each structure is monitored remotely; gate position indication is also available at each structure. See Figure 2.3 for monitoring information.

Water Quality Sampling:
Operating permit water quality samples are being collected at G-376 B & E, G-379 B & D, and G-381 B & E.

2. Discharge and Cell 3 Discharge Canals

Under average conditions (discharges <1170 cfs), STA-3/4 discharges will be directed to the West L-5 Borrow Canal and S-8. Under higher flow conditions, discharges will be more evenly split between the East and West L-5 Borrow Canals. Canal and levee descriptions are shown in Table 2.9.

Table 2.9 Discharge and Cell 3 Discharge Canals

Canal Description	Discharge Canal	Cell 3 Discharge Canal
Canal Length	4.9 miles	4.3 miles
Canal Invert	-7.0 ft NGVD	-5.0 to -6.0 (2.0*) ft NGVD
Canal Bottom Width	18 ft	10 ft
Canal Side Slopes	2.5H:1V	2.5H:1V
Exterior Levee Height	18.5 ft NGVD	18.5 to 19.25 ft NGVD
Berm Heights	13.0 ft NGVD	13.0 ft NGVD
Design Maximum Flow	4755 cfs**	1690 cfs
Design Water Surface Elev.	12.1 to 12.6 ft NGVD	12.6 to 13.2 ft NGVD
Design Max. Canal Velocities	0 to 0.99 fps	0.65 to 1.83 fps

*Cell 3 Discharge Canal is shallower from G-381F to the transition area near G-381C
** Flow is in two directions – East to L-5 and west to the Griffin pits.

3. East and West L-5 Borrow Canals

The East and West L-5 Borrow Canal are enlargements of the original L-5 Borrow Canal whose former dimensions include a bottom width of approximately 30 ft and an invert elevation of approximately 0.0 ft NGVD.

The East L-5 Borrow Canal Enlargement starts at its intersection with the east end of the Discharge Canal, near the L-5-3 bridge (Figure 2.1), and extends under US 27 to Pump Station S-7. The canal normally conveys water from the Discharge Canal to S-7 when STA discharges are above 1170 cfs, although S-7 can be operated at any time in response to regional needs for water supply and distribution. At its origin near the L-5-3 Bridge, the south side of the canal enlargement includes a 10-ft wide bottom at invert –6.0 ft

NGVD. The north side of the canal was also subsequently enlarged, providing a total bottom width of approximately 50 feet at elevation –1.0 ft NGVD in addition to the 10-ft wide south side enlargement. When the Hwy US 27 bridges were built in 1996, the canal beneath the highway was sufficiently enlarged; its elevation ranges from –2.1 to -5.7 feet NGVD, with an average side slope of 1.1H:1V, and an approximate 70-foot bottom width. East of Hwy US 27, the East L-5 Borrow Canal is transitioned into the North New River Canal at an invert of –2.0 ft NGVD.

The West L-5 Borrow Canal starts at the Griffin pits and conveys the majority of STA discharge volumes westward to the Miami Canal and Pump Stations S-8 and G-404. The canal has a bottom width of 24 feet from the borrow pits to the L-5-2 bridge, and west of L-5-2 Bridge (Figure 2.1), its bottom width is approximately 50 feet (including a 10-ft wide section at –5.0 ft NGVD). Between the L-5-1 (Figure 2.1) Bridge and Miami Canal, the canal is five feet narrower, and it has a bottom width of nearly 45 feet. Canal and levee descriptions are shown in Table 2.10.

Table 2.10 East and West L-5 Borrow Canal

Canal Description	East L-5 Canal	West L-5 Canal*
Canal Length	0.6 miles	8.9 miles
Canal Invert	-1.0 to -6.0 ft NGVD	0.0 to -5.0 ft NGVD
Canal Bottom Width	approx. 70 ft	Approx. 50 ft (24 ft)*
Canal Side Slopes	1.1H to 2.0H:1V	2.5H:1V
South L-5 Levee Height	18 to 21 ft NGVD	20 to 26 ft NGVD
Berm Heights	14.0 ft NGVD	14.0 ft NGVD
Design Maximum Flow	3495 cfs	2950 cfs
Design Water Surface Elev.	12.0 to 12.1 ft NGVD	10.0 to 12.6 ft NGVD
Design Max. Canal Velocities	1.49 to 2.31 fps	1.96 to 2.44 fps

*Includes strip near borrow pit

D. SEEPAGE CONTROL FACILITIES

Potential seepage impacts to adjacent farmlands north of the project have been minimized by installation of facilities including seepage collection canals and pumps. Seepage pumps are provided at pump stations G-370 & G-372, facilities for installation of an auxiliary seepage pump station have been provided, and a seepage collection canal extends along the full length of the Inflow and Supply Canals. The installed facilities have the capacity to return approximately 450 cfs, if needed (See Figure 2.1.)

1. Seepage Collection Canal

The seepage collection canal is located along the northern boundaries of STA-3/4 and the Supply Canal, and it has been designed to intercept seepage and convey it to the pumping stations at either end of the canal. The seepage collection canal is located between the exterior levees and adjacent properties, and extends from Station G-370 to Station G-372.

During normal operations, seepage pumps at G-372 will control water levels in the western portions of the seepage canal located adjacent to the east-west segment of the

Supply Canal (approx. 8 miles) and the G-370 pumps will control water levels in the remainder of the canal adjacent to the Supply and Inflow Canals (approx. 8.4 miles).

Seepage estimates and hydraulic analyses described in the Plan Formulation Document indicate that the seepage canal has sufficient capacity to convey seepage to the pumps under design maximum conditions (150 cfs to each station). The design water levels are 6.5' NGVD at each station and 8.0' at the midpoint of the canal. The operational data for the seepage canal should be reviewed periodically once the project is fully functional, and if necessary, further hydraulic analyses are recommended to determine actual seepage rates. These analyses may result in recommendations to modify the operational guidelines for the seepage facilities. Canal descriptions are shown in Table 2.11

Table 2.11 Seepage Collection Canal

Canal Description	
Canal Length	16.0 miles
Canal Invert	0.0 ft NGVD
Canal Bottom Width	10 ft
Canal Side Slopes	2.0H:1V
Flow Description	-
Design Maximum Flow*	150 cfs
Design Water Surface Elev.	6.5 - 8.0 ft NGVD
Design Max. Canal Velocities	1.0 fps

* flow rate to each station

2. <u>G-370 and G-372 Seepage Pumps</u>

Seepage return pumps at Stations G-370 and G-372 maintain water levels in the seepage collection canal. These pumps are located within the superstructure also housing the large inflow pumps at both stations (see Figure 2.1). The pumps are designed to return seepage collected in the adjacent canal and return it to the Supply or Inflow Canals. The pumps have been designed to operate continuously, if required. Seepage collected at G-372 can also be directed to the Holey Land, and this option will be exercised when necessary for special or unusual operational needs, such as supplying water to the Holey Land.

The flow capacity for each station has been established at 150 cfs. Each station has been equipped with three 75-cfs pumps; two pumps are used at any one time with the third pump acting as a stand-by, or backup pump, in case of equipment failure. The hydraulic capacity of the seepage canal is limited to the estimated maximum flow rate of approximately 150 cfs (see Figure 2.1). However, under extreme hydrologic conditions, it may be possible to operate all three pumps at each station for a short time due to elevated stages in the canal. The factory test report for these pumps are contained in the project files. Performance curves resulting from those tests are presented in Figure 2.5. Pump and hydraulic descriptions are shown in Table 2.12.

Table 2.12 Seepage Pumps G-370 and G-372

Pump Station Description	G-370	G-372
Number of Pumps	3	3
Discharge Capacity (each pump) at Max. Static Head	75 cfs/13.0ft	75 cfs/14.0ft
Discharge Capacity (each pump) at Min. Static Head	75 cfs/8.0 ft	75 ft/9.0 ft
Design Headwater Elevation	6.9 ft NGVD	6.5 ft NGVD
Design Low Water (HW) Elevation	5.0 ft NGVD	5.0 ft NGVD
Design Tailwater Elevation	15.0 ft NGVD	17.0 ft NGVD
Maximum Tailwater Elevation	18.0 ft NGVD	19.0 ft NGVD
Maximum Head Loss Across Screen	5.0 ft	5.0 ft
Nominal Pump Operation Speed*	Unknown	Unknown
Nominal "On Elevation"	8.0 ft NGVD	8.0 ft NGVD
Nominal "Off Elevation"	5.0 ft NGVD	5.0 ft NGVD
Motor/Engine Size*	Unknown	Unknown
Motor/Engine Speed*	Unknown	Unknown
Centerline Discharge Connection	22.0 ft NGVD	22.0 ft NGVD
Pump Station Floor Elevation	16.33 ft NGVD	16.33 ft NGVD
Intake Floor Elevation	-6.0 ft NGVD	-6.0 ft NGVD

*info will be provided upon construction completion of STA-3/4 project

Structure Operations:
The pumps at each station will operate as required to maintain desired levels in the seepage canal. It is highly likely that one pump at each station will operate 18 to 24 hours per day during normal operation. Operation of a second pump will likely occur only during periods of elevated stages in the Supply and Inflow Canals.

Data Acquisition and Telemetry:
Both local and remote operation of the seepage pumps is possible and it is anticipated that the pumps will typically be operated by the West Palm Beach Control Room. Meteorological and hydrologic data are collected at each station and are transmitted to the Control Room by telemetry. Headwater and tailwater staff gauges are available for local operation.

Water Quality Sampling:
As stated in the discussion for the main pumps of Stations G-370 and G-372, flow proportional, automatic sampling equipment will be installed at these pump stations for the purpose of monitoring inflow water quality (See Figure 2.3).

Figure 2.5 – G-370 Seepage Pump Performance Curve

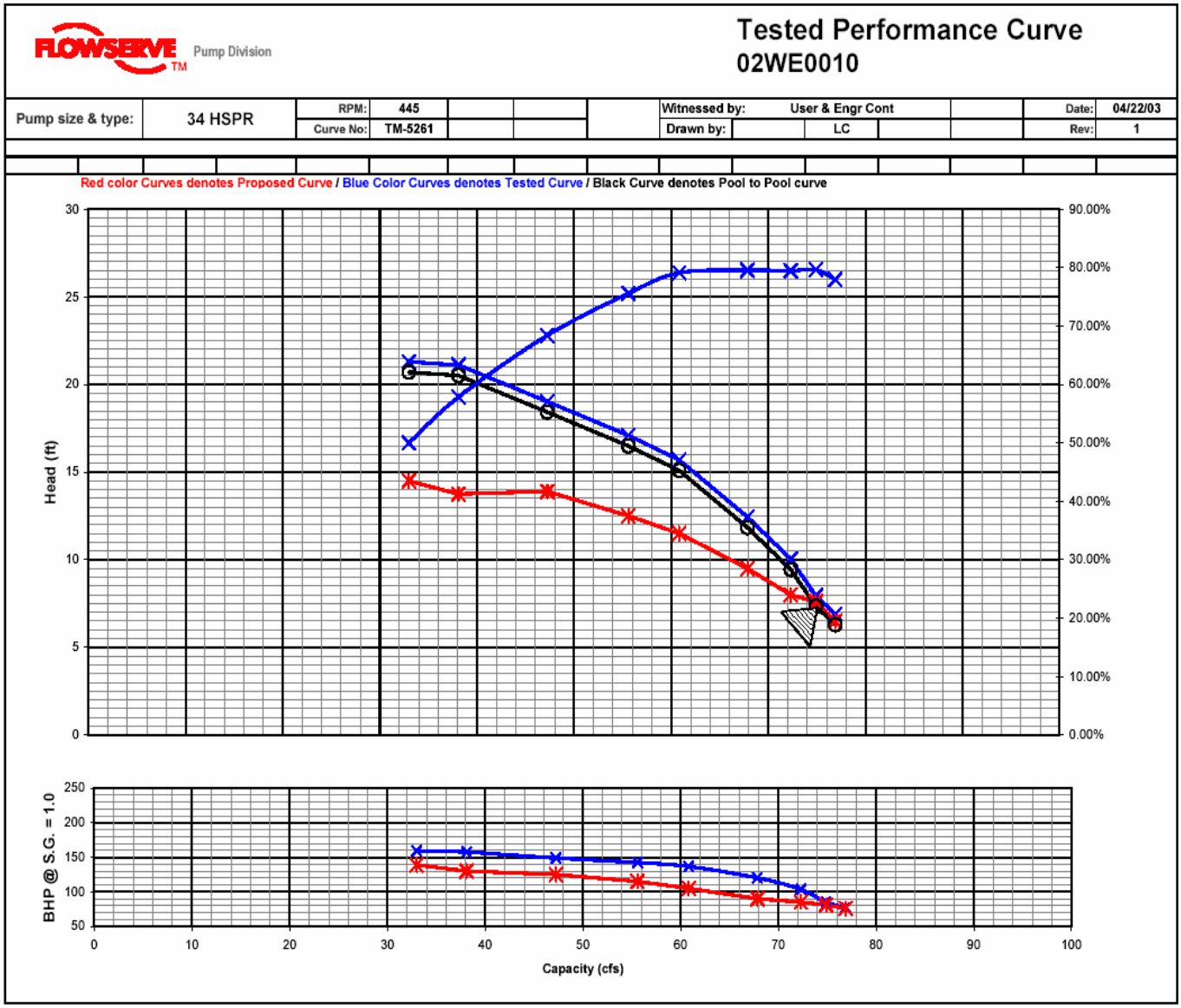
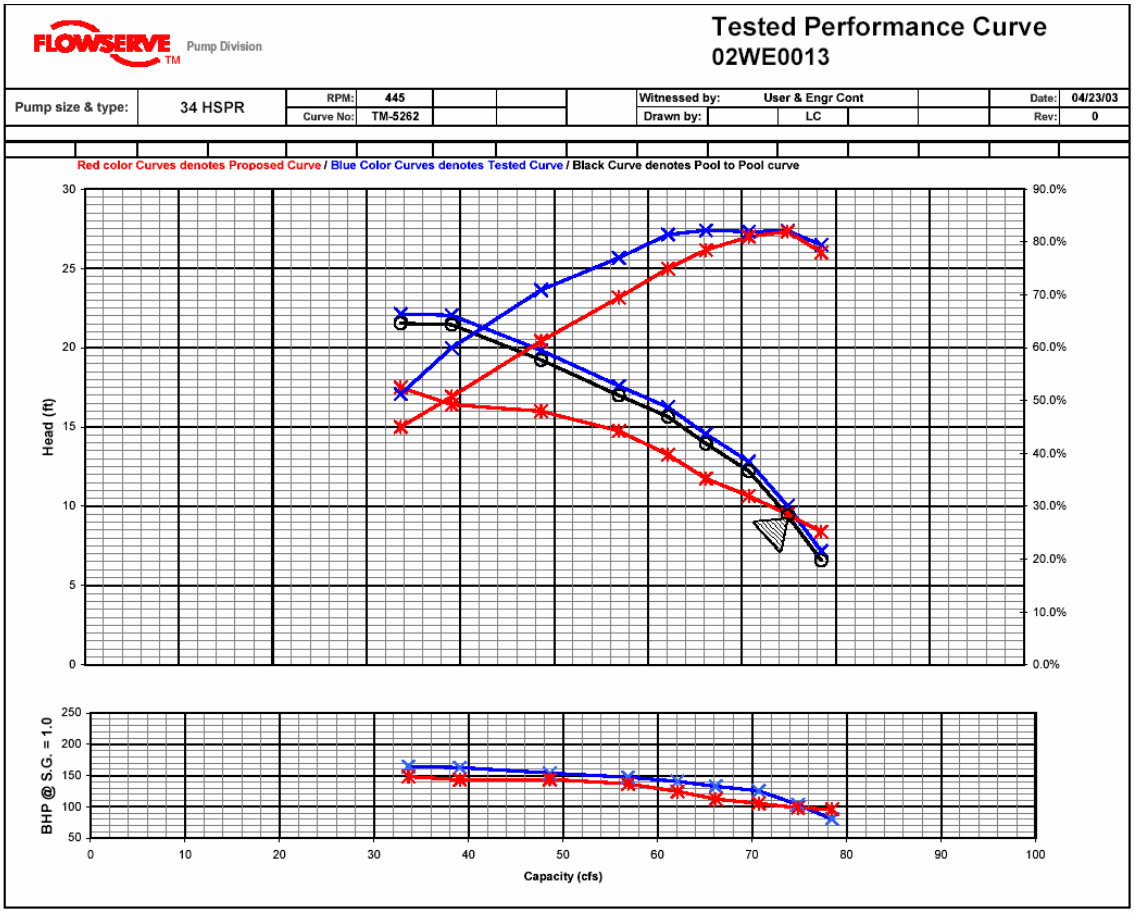


Figure 2.6 – G-372 Seepage Pump Performance Curve



3. Auxiliary Seepage Pump Station

In the event that observed seepage rates exceed those estimated in the Plan Formulation Document, facilities have been constructed as part of STA-3/4, which provide for the installation of auxiliary seepage pumps to maintain water levels (max 8.0 ft NGVD) in the seepage collection canal. The facilities include two 42"-diameter steel discharge pipes and an equipment pad for installation of District-furnished portable hydraulic pumps (100 cfs each). The facilities are located in the western section of the Inflow Canal near Structure G-380E (see Figure 2.1).

Structure Operations:
If required, the auxiliary pumps will be installed by the District and operated only in the event that the G-370/G-372 seepage pumps cannot maintain the desired maximum stage of 8.0-ft NGVD at any point in the Seepage Collection Canal. The pumps will be operated locally by District O&M staff.

Data Acquisition and Telemetry:
Remote data acquisition of water levels in the seepage canal and the inflow canal at this location will not be required whether or not the auxiliary pumps are installed.

Water Quality Sampling:
No operating permit water quality sampling is anticipated to be required at this site. However, the site may be monitored for operations support.

E. DIVERSION STRUCTURES

1. G-371

G-371 serves as a diversion control structure for the North New River Canal inflows to STA-3/4. G-371 will normally be closed, and will serve to separate untreated waters in the North New River Canal from the treated STA discharges. Direct runoff from the S-2/7 basins and Lake Okeechobee supplementary flows will be directed to STA-3/4 for treatment via pump station G-370 [i.e. releases to the downstream environment (WCAs and ENP) and releases sent the STA to maintain minimum depth in the treatment cells]. Under normal operation conditions, G-371 will be opened only when necessary to transfer water supply releases to S-7 for delivery to the North New River Canal and downstream urban areas. In the unlikely event that pump station G-370 must be taken off-line, G-371 will be opened and it will pass flows up to the capacity of S-7 less historic discharges from L-5 (2170 cfs). The structure is located in the North New River Canal about 750 feet north of Pump Station S-7, and immediately north of the canal's intersection with the East L-5 Borrow Canal. The structure also has the capacity to pass regulatory releases and BMP make-up water releases from Lake Okeechobee without affecting stages in the canal, but it is currently envisioned that all regulatory releases and BMP make-up water releases will be passed through the STA and G-371 will not be operated for this purpose.

Structure G-371 consists of a reinforced concrete broad-crested weir spillway with two 20' x 10.5' control gates, and wing walls constructed of sheet piling projecting a 45-degree angle from its corners. A 14-ft wide service bridge is provided for access across the spillway. The bridge is designed for an HS20-44 truckload. G-371 is designed to pass 2,170 cfs with minimal headloss across the structure, but it is capable of discharging up to 4,065 cfs for a short duration if the gates are opened suddenly when significant differences in headwater and tailwater are present. Therefore, operational guidelines are prescribed in Part III of this Plan to prevent excessive discharges and scouring of the downstream channel. A description of this structure is shown in Table 2.13.

Table 2.13 Diversion Structure G-371

Control Structure Description	
Number of Spillway Culverts	2
Spillway Culvert / Gate Size (H x W)	10.5' x 20'
Spillway Culvert Length	49 ft
Spillway Culvert Invert	-2.0 ft NGVD
Regulatory Releases (both culverts)	1,600 cfs
Regulatory Releases Headwater Elevation	10.0 ft NGVD
Regulatory Releases Tailwater Elevation	9.5 ft. NGVD
Bypass Releases (both culverts)	2,170 cfs
Bypass Headwater Elevation	10.9 ft NGVD
Bypass Tailwater Elevation	10.0 ft NGVD
HW/TW Data via Telemetry	G-371 HW/TW

Structure Operations:
Both manual and remote operations of this structure are possible. Remote operation is from SFWMD's Operations Control Center located in West Palm Beach. In the event of loss of electrical power at the site, the G-371 structure is equipped with an emergency generator that has sufficient capacity to provide for full operation of the structure. See Part III of this Plan for operational guidelines.

Data Acquisition and Telemetry:
Headwater and tailwater data are available via telemetry to the remote operators, while headwater/tailwater staff gauges are available for local operation. See Figure 2.3 for monitoring information.

Water Quality Sampling:
No operating permit water quality sampling is anticipated to be required at this site. However, monitoring may be conducted pursuant to the EAA requirements.

2. G-373

G-373 serves as a diversion control structure for the Miami Canal inflows to STA-3/4. G-373 will normally be closed, and will serve to separate untreated waters in the Miami Canal from the treated STA discharges. Direct runoff from the S-3/8, S-236 and C-139 basins and Lake Okeechobee supplementary flows will be directed to STA-3/4 for treatment via pump station G-372. Under normal operation conditions, G-373 will be opened only when necessary to transfer water supply releases to S-8 for delivery to the

Miami Canal and downstream urban areas. In the unlikely event that pump station G-372 must be taken off-line, G-373 will be opened and it will pass flows up to the capacity of S-8 less the permitted discharges that enter the Miami Canal between the structure and the pump station, and an allowance for lands converted for use as STA-5 (3670 cfs). The structure is located in the Miami Canal about 7 miles north of Pump Station S-8. The structure also has the capacity to pass regulatory releases and BMP make-up water releases from Lake Okeechobee without affecting stages in the canal, but it is currently envisioned that all regulatory releases and BMP make-up water releases will be passed through the STA and G-373 will not be operated for this purpose.

Structure G-373 consists of a reinforced concrete broad-crested weir spillway with three 22' x 12.5' control gates, and wing walls constructed of sheet piling projecting a 45-degree angle from its corners. A 15-ft wide service bridge is provided for access across the spillway. G-373 is designed to pass 3,670 cfs with minimal headloss across the structure, but it is capable of discharging up to 9,250 cfs for a short duration if the gates are opened suddenly when significant differences in headwater and tailwater are present. Therefore, operational guidelines are prescribed in Part III of this Plan to prevent excessive discharges and scouring of the downstream channel. A description of this structure is shown in Table 2.14.

Table 2.14 Diversion Structure G-373

Control Structure Description	
Number of Spillway Culverts	3
Spillway Culvert / Gate Size (H x W)	12.5' x 22'
Spillway Culvert Length	66 ft
Spillway Culvert Invert	-2.0 ft NGVD
Regulatory Releases (all culverts)	2,000 cfs
Regulatory Releases Headwater Elevation	10.15 ft NGVD
Regulatory Releases Tailwater Elevation	9.98 ft. NGVD
Bypass Releases (all culverts)	3,670 cfs
Bypass Headwater Elevation	11.9 ft NGVD
Bypass Tailwater Elevation	11.5 ft NGVD
HW/TW Data via Telemetry	G-373 HW/TW

Structure Operations:
Both manual and remote operations of this structure are possible. Remote operation is from SFWMD's Operations Control Center located in West Palm Beach. In the event of loss of electrical power at the site, the G-373 structure is equipped with an emergency generator that has sufficient capacity to provide for full operation of the structure. See Part III of this Plan for operational guidelines.

Data Acquisition and Telemetry:
Headwater and tailwater data are available via telemetry to the remote operators, while headwater/tailwater staff gauges are available for local operation.

Water Quality Sampling:
No operating permit water quality sampling is anticipated to be required at this site. However, monitoring may be conducted pursuant to the EAA requirements.

F. RELATED STRUCTURES

STA-3/4 affects and is affected by many structures and facilities located outside of its immediate area. Immediately to the west of STA-3/4 area is the Holey Land Wildlife Management Area, which is surrounded and affected by various STA-3/4 components. The North New River and Miami Canal contain several structures critical to their operations. Discharges from STA-3/4 are directed toward Water Conservation Areas (WCA) 2A and 3A through a variety of pump station and culverts. All of these structures as well as other facilities are described in this section.

1. North New River and Miami Canals

The Eastern flow-way (Cell 1) of STA-3/4 receives untreated water from the North New River Canal, and treated STA-3/4 discharges are returned to this canal just upstream of the S-7 pump station. The North New River Canal extends from Lake Okeechobee (at Pump Station S-2) through Pump Station S-7, bordering Water Conservation Areas 2A and 3A, and on eastward to Ft. Lauderdale. The North New River Canal is the primary drainage feature of the S-2 and S-7 basins in the Everglades Agricultural Area. Currently, the North New River Canal capacity is constrained by the capacity of Pump Station S-7, which is 2,490 cfs.

The STA-3/4 flow-ways (Cells 2 and 3) receive untreated water from the Miami Canal, and treated discharges are returned to this canal at S-8. The Miami Canal extends from Lake Okeechobee (at Pump Station S-3) through Pump Station S-8, into Water Conservation Area 3A, and southeast to Miami-Dade County. The Miami Canal is the primary drainage component of the S-3 and S-8 basins, the South Chapter 298 Drainage Districts, and C-139 basin (via G-136). The Miami Canal capacity is limited to the historic flood flow, or 3,670 cfs.

During operation of STA-3/4, water levels in both canals are controlled by Pump Stations G-370 and G-372, which have been designed to duplicate current operational criteria for control of upstream water levels.

2. Pump Station S-7

Pump Station S-7 will be used to provide a hydraulic gradient for discharges from STA-3/4. This pumping station is located in the alignment of the North New River Canal at the northwestern corner of WCA-2A, about 30 miles southeast of the town of Belle Glade and immediately east of Hwy U.S. 27. The pumping station is equipped with three pumps rated for a total capacity of 2,490 cfs. The station also has an adjacent gated spillway that allows water to enter WCA-2A via gravity when downstream stages are low. In addition to moving water from STA-3/4, S-7 may also be used (when G-371 is open) to bypass North New River Canal flows around STA-3/4, either for water supply deliveries to the Lower East Coast or in the event of excessively high water in STA-3/4 during extreme events. Pump and hydraulic descriptions are shown in Table 2.15.

Table 2.15 Pump Station S-7

Pump Station Description		Other Notes
Number of Pumps	3	
Discharge Capacity (each pump)	830 cfs	max. static head at 5.3 ft
Design Headwater Elevation	12.0 ft NGVD	
Design Low Water (HW) Elevation	8.7 ft NGVD	
Structure Maximum (HW) Elevation	13.0 ft NGVD	
Design Tailwater Elevation	18.3 ft NGVD	
Nominal Pump Operation Speed	68 rpm	
Nominal "On Elevation"	as needed to maintain headwater at or below 12.0 ft NGVD	
Nominal "Off Elevation"	as needed to maintain headwater at or below 12.0 ft NGVD	
Motor/Engine Size	895 hp	
Motor/Engine Speed	720 rpm	
Number of Culverts	1	
Culvert / Gate Size	13.3-ft high; 14.7-ft wide	
Culvert Length	43 ft	
Culvert Invert	1.75 ft NGVD	

Structure Operations:
S-7 will be operated only when STA discharges exceed 1,170 cfs or if hydrologic conditions warrant discharge of water to WCA-2A. During operation of the station, headwater elevations will be maintained at 12.0 ft NGVD within the station's capacity to do so.

Data Acquisition and Telemetry:
Only local operation of this pump station is possible. Meteorological and hydrologic data are available to the West Palm Beach Control Room, while headwater/tailwater staff gauges are available for local operation.

Water Quality Sampling:
Flow proportional, automatic sampling equipment exists at Pump Station S-7 (See Figure 2.3).

3. Structure S-150

Structure S-150 is located on the L-5 Borrow Canal at the confluence with the L-38W Canal. This structure is located adjacent to Hwy US 27, just west of Pump Station S-7, and adjacent to the northeastern corner of the Water Conservation Area 3A. This structure has historically been used to pass S-2/3 basin waters into WCA-3A, and upon request by the U.S. Army Corp of Engineers to provide regulatory discharge from Lake Okeechobee so long as not to affect the water supply to WCA-2A via Pump Station S-7.

Structure S-150 will be used to facilitate movement of STA-3/4 discharges from the L-5 Borrow Canal to the northeastern section of WCA-3A when stages in the conservation area are low enough to permit gravity inflows. Operation of the structure will be solely at the discretion of the Control Room based on hydrologic requirements. When the gates are closed, S-150 will prevent back flow from the WCA into the L-5 Borrow Canal. When the East WCA-3A Hydropattern Restoration works are completed, the operational

plan for this structure will be reviewed, and if necessary, modified for consistency with said plans. A description of this structure is shown in Table 2.16.

Table 2.16 WCA-3A Structure S-150

Control Structure Description	
Number of Culverts	5
Culvert / Gate Size	84-in dia CMP
Culvert Length	92 ft
Culvert Invert	3.0 ft NGVD
Design Inflow (each culvert)	200 cfs
Design Max. Headwater Elevation	12.07 ft NGVD
Design Max. Tailwater Elevation	11.0 ft NGVD
HW/TW Data via Telemetry	S-150 HW/TW

Structure Operations:
Both manual and remote operations of these structures are possible. Remote operation is from the SFWMD's Operations Control Center located in West Palm Beach. In the event of loss of electrical power at the site, the S-150 structure can be manually operated by hydraulic or electric powered maintenance equipment. S-150 will be normally closed, but can be opened when desired to divert low-flow discharges to WCA-3A or to augment discharge capacity at S-7 and S-8 so as to limit stages in the STA-3/4 Discharge Canal.

Data Acquisition and Telemetry:
The headwater/tailwater data at S-150 are available via telemetry to the remote operators. Headwater/tailwater staff gauges are also available at S-150 while gate position information (for manual operation) is available at this structure.

Water Quality Sampling:
Flow proportional, automatic sampling equipment exists at S-150 for the purpose of monitoring STA-3/4 discharge water quality (See Figure 2.3).

4. Pump Station S-8

By maintaining water levels in the West L-5 Borrow Canal and the STA-3/4 Discharge Canal, Pump Station S-8 provides the required hydraulic gradient to facilitate discharge from STA-3/4 (with assistance from Pump Station S-7). This pumping station is located in the alignment of the Miami Canal at the northern boundary of WCA-3A, about 30 miles southwest of the town of Belle Glade and 15 miles west of Hwy US 27. The pumping station is equipped with four pumps for a total capacity of 4,160 cfs. The station also has an adjacent gated spillway that allows water to enter WCA-3A via gravity when downstream stages are low. The operational purpose of S-8 is to discharge waters from STA-3/4 and STA-5 to the Miami Canal in WCA-3A. Pump and hydraulic descriptions are shown in Table 2.17.

Table 2.17 Pump Station S-8

Pump Station Description		Other Notes
Number of Pumps	4	
Discharge Capacity (each pump)	1,040 cfs	max. static head at 4.5 ft
Design Headwater Elevation	10.0 ft NGVD	
Design Low Water (HW) Elevation	9.5 ft NGVD	
Design Maximum (HW) Elevation	12.0 ft NGVD	
Design Max. Tailwater Elevation	16.5 ft NGVD	
Nominal Pump Operation Speed	68 rpm	
Nominal "On Elevation"	as needed to maintain headwater at or below 10.0 ft NGVD	
Nominal "Off Elevation"	as needed to maintain headwater at or below 10.0 ft NGVD	
Motor/Engine Size	895 hp	
Motor/Engine Speed	720 rpm	
Number of Culverts	1	
Culvert / Gate Size	14.4-ft high; 16.5-ft wide	
Culvert Length	78.5 ft	
Culvert Invert	1.0 ft NGVD	
Design Inflow	500 cfs	

Structure Operations:
S-8 will be utilized to transfer virtually all discharges from STA-3/4 below 1,170 cfs to WCA-3A. In order to create the required hydraulic gradient, it will be necessary to operate the station so that a headwater stage of 10.0 ft NGVD is maintained. During periods of very low discharge or no discharge, the headwater stage can be allowed to rise to 11.0 ft NGVD.

Data Acquisition and Telemetry:
Only local operation of this pump station is possible. Meteorological and hydrologic data are available to the West Palm Beach Control Room, while headwater/tailwater staff gauges are available for local operation.

Water Quality Sampling:
Flow proportional, automatic sampling equipment exists at Pump Station S-8 for the purpose of monitoring inflow water quality (See Figure 2.3).

5. Pump Station G-404

Pump Station G-404 is located in Broward County on the Miami Canal at its confluence with the L-4 Borrow Canal. The station is located adjacent to Structure G-357, just north of Pump Station S-8, and adjacent to the southeastern corner of the Rotenberger Wildlife Management Area (see Figure 2.1). There are two operational objectives for G-404:

1. To supply the northwest corner of WCA-3A with treated discharges from STA-3/4 and STA-5, and
2. To provide supplemental irrigation water supply to the Big Cypress Seminole Indian Reservation and US Sugar Southern Division's Unit 2 farm. (G-404 will be operated in conjunction with G-409 in this scenario.)

Although not explicit project objectives, there is another ancillary benefit of G-404; during storm events, G-404 may supplement the capacity of S-8 to remove STA-3/4 and STA-5 discharges.

In general, G-404 shall operate to supply STA-3/4 and STA-5 discharges to the northwest corner of WCA-3A via the L-4 Borrow Canal.

Pump Station G-404 has three pumps providing a total nominal capacity of 600 cfs. The factory test report, including performance curves, for these pumps are contained in the SFWMD files. Pump and hydraulic descriptions are shown in Table 2.18.

Table 2.18 Pump Station G-404

Pump Station Description		Other Notes
Number of Pumps	3	
Discharge Capacity (each pump)	190 cfs	Startup: at a total developed head of 10.3 ft NGVD, and a static head of 8.0 ft (HW=8.0 ft NGVD; pipe crest elevation = 16.0 ft NGVD)
	207 cfs	Flood condition: at static head of 5.5 ft (HW=11.0 ft NGVD, TW=16.5 ft NGVD)
	209 cfs	Siphon-assisted: at a static head of 4.45 ft (HW = 8.0 ft NGVD, TW = 12.45 ft NGVD)
Design Headwater Elevation	10.0 ft NGVD	
Design Low Water (HW) Elevation	9.5 ft NGVD	Shut Off Elevation
Design Tailwater Elevation (estimate)	12.45 ft NGVD	
Design Maximum Tailwater Elevation	16.5 ft NGVD	
Design head loss across trash rack:	1.0 ft	in all above conditions
Nominal Pump Operation Speed	275 rpm	
Nominal "On Elevation"	Subject to STA 5, STA-3/4 and Miami Canal conditions	
Nominal "Off Elevation"	Subject to STA 5, STA-3/4 and Miami Canal conditions	
Motor/Engine Size	375 hp	
Motor/Engine Speed	1800 rpm	
Centerline Discharge Connection	13.5 ft NGVD	
Pump Station Floor Elevation	20.1 ft NGVD	
Intake Floor Elevation	-7.75 ft NGVD	
Discharge Bay Floor Elevation	2.0 ft NGVD	

Structure Operations:
These pumps will operate primarily when discharges from STA-5 and STA-3/4 are low or when the station's capacity is needed for flood protection. The station will normally be operated to maintain a stage of 10.0 ft NGVD in the Miami Canal, but the headwater stage may be allowed to rise to 11.0 ft NGVD during periods of minimal or no discharge from the STAs.

Data Acquisition and Telemetry:
Only local operation of this pump station is currently possible, although soon G-404 will be outfitted with the means to be operated remotely. Meteorological and hydrologic data are available to the West Palm Beach Control Room, while headwater/tailwater staff gauges are available for local operation.

Water Quality Sampling:
Flow proportional, automatic sampling equipment exists at Pump Station G-404 for the purpose of monitoring water quality (See Figure 2.3).

6. Structure G-357

Structure G-357 is located on the Miami Canal at the confluence with the L-4 Borrow Canal. This structure is located adjacent to Pump Station G-404, just north of Pump Station S-8, adjacent to the southeastern corner of the Rotenberger Wildlife Management Area. The structure consists of two 10-ft high by 10-ft wide concrete box culverts fitted with motorized lift gates. The northern culvert has an invert in the Miami Canal at elevation 3.66 ft NGVD, and an invert in the L-4 Borrow Canal at 2.84 ft NGVD. The southern culvert has an invert in the Miami Canal at elevation 2.85 ft NGVD, and an invert in the L-4 Borrow Canal at 2.76 ft NGVD.

The structure has historically been used to facilitate movement of water from the L-4 Borrow Canal to the Miami Canal or to pass irrigation flows to L-4 from the Miami Canal. With STA-3/4 and STA 5 in operation, the structure is used to control flow between the L-4 Borrow Canal and the Miami Canal. When the gates are closed, G-357 will prevent back flow from the L-4 Borrow Canal to the Miami Canal when G-404 is pumping. Under water supply conditions, if the Miami Canal stage is higher than the L-4 Borrow Canal, G-357 may be opened to allow gravity flow to the L-4 Borrow Canal.

Structure Operations:
Both manual and remote operation of this structure is possible. Remote operation is from the SFWMD's Operations Control Center located in West Palm Beach. In the event of loss of electrical power at the site, the G-357 structure can be manually operated by means of portable maintenance equipment. The G-357 structure will normally be closed, except when Miami Canal water levels are higher than the L-4 water levels, and there is a desire for delivery of water to the L-4 Borrow Canal.

Data Acquisition and Telemetry:
For G-357, headwater/tailwater data are available via telemetry to the West Palm Beach Control Room. Headwater/tailwater staff gauges and gate position information (for manual operation) are available at this structure.

Water Quality Sampling:
Water sampling will be taken at G-404; therefore no operating permit water quality sampling is required at this site.

7. Holey Land Wildlife Management Area

The Holey Land Wildlife Management Area consists of a total area of approximately 35,000 acres bounded by the Miami Canal on the west, the L-5 levees and borrow canal on the south, the Supply Canal on the north, and STA-3/4 on the east. The total area of the Holey Land includes approximately 3,680 acres in the "Toe of the Boot", an addition in the southeasterly corner of the original Holey Land. Structures include Pump Stations G-200A located in the northwest corner and G-201 located in the southeast corner as well

as Outlet Structures G-204, G-205, and G-206 located along the North L-5 Levee. A stage-recording station, G-203, is located along the eastern border, 4 miles south the northern boundary.

Historically, the majority of inflows to the Holey Land at G-200A consisted of untreated runoff from the S-3/8 basin, C-139, Chapter 298 basins of the Everglades Agricultural Area, and treated discharges from STA-5 as well as regulatory releases from Lake Okeechobee. Following completion of STA-3/4 and the STA 5 Outlet Canal, inflows to the Holey Land at G-200A will consist of treated discharges from STA-5 and STA-3/4.

The operation of the Holey Land is covered under the requirements of FDEP Permit No. 06-500809209.

a. Pump Station G-200A

Pump Station G-200A introduces treated discharges (from STA-5 and STA-3/4) to the Holey Land Wildlife Management Area. This pump station is located in the northwest corner of the Holey Land, immediately north of the Miami Canal and STA-5 Outlet Canal intersection, about 25 miles southwest of the town of Belle Glade and 15 miles west of Hwy US 27. The pump station is equipped with three pumps for a total capacity of 600 cfs.

Normal operations include wet/dry phases as a special designation, to mimic the natural hydrologic cycle of South Florida in order to foster normal wildlife habitation.

Structure Operations:
The Pump Station is operated as required to maintain tailwater stages of 10.75 and 12.00 ft NGVD in the wet and dry seasons, respectively.

Data Acquisition and Telemetry:
Both local and remote operation of this pump station is possible. Meteorological and hydrologic data are available to the West Palm Beach Control Room, while headwater/tailwater staff gauges are available for local operation.

Water Quality Sampling:
Flow proportional, automatic sampling equipment exists at Pump Station G-200A for the purpose of monitoring inflow water quality (See Figure 2.3).

b. Pump Station G-201

Pump Station G-201 was originally constructed as a seepage return pump station for the Holey Land Wildlife Management Area, used to return seepage to the Holey Land. This pump station is located in the southeast corner of the Holey Land, adjacent to the L-5-2 Bridge, about 30 miles south of the town of Belle Glade and 6 miles west of Hwy US 27. The station is equipped with three pumps providing a total capacity of approximately 165 cfs. Following completion of STA-3/4, there will be no defined function for G-201, with the result that the station is being placed on inactive status.

c. Structures G-204, G-205, and G-206

Structures G-204, G-205 and G-206 are located approximately equidistant from each other on the West L-5 Borrow Canal between the southwest corner of STA-3/4 and Pump Station S-8. These structures are located on the south boundary of the Holey Land Wildlife Management Area.

These structures have historically been used to facilitate movement of water from the Holey Land to WCA-3A through a degraded portion of the South L-5 Levee. Upon construction of the West L-5 Borrow Canal Enlargement, this connection was eliminated and these structures now discharge directly to the L-5 Canal instead. A description of these structures is shown in Table 2.19.

Table 2.19 Holey Land WMA Control Structures G-204, G-205, & G-206

Control Structure Description	G-204	G-205	G-206
Number of Culverts	4	6	5
Culvert Size	72-in dia CMP	72-in dia CMP	72-in dia CMP
Culvert Length	72 ft	72 ft	72 ft
Culvert Inverts (Holey Land / L-5)	5.09/5.18 ft NGVD	4.64/4.14 ft NGVD	3.85/4.73 ft NGVD
Top of Riser	13.25 ft NGVD	13.25 ft NGVD	13.50 ft NGVD
Wet Season Peak Headwater Elevation	12.00 ft NGVD	12.00 ft NGVD	12.00 ft NGVD
Dry Season (HW) Elevation	10.75 ft NGVD	10.75 ft NGVD	10.75 ft NGVD

Structure Operations:
The structures will typically not be operated unless extreme hydrologic conditions in the Holey Land occur and discharge is required. However, discharge will only be possible when stages in the L-5 Borrow Canal are below those in the Holey Land. Based on the hydraulic modeling contained in the Plan Formulation Document, stages in the canal will typically be at or above those in the Holey Land except during periods of low discharge from the STA.

Data Acquisition and Telemetry:
No telemetry for headwater and tailwater data is available to the remote operators.

Water Quality Sampling:
No operating permit water quality sampling is required at this site.

8. Water Conservation Area 2A

With STA-3/4 online, WCA-2A will receive treated water from STA-2 directly and STA-3/4 (via S-7); although STA-3/4 will discharge most of its waters to the west (to WCA-3A) during periods of low flow. Thus, WCA-2A will receive a substantial portion of its water from STA-2 via overflows along the L-6 Borrow Canal.

The primary functions of WCA-2A are the following:

- To provide viable wetland habitat
- To detain and store flood and drainage water during the wet season
- To prevent water accumulating in the Everglades from overflowing into urban and agricultural lands in Eastern Broward County and WCA-2B
- To supply water to Eastern Broward County and WCA-2B
- To receive and store regulatory releases from Lake Okeechobee and WCA 1
- To pass water supply releases from Lake Okeechobee to the North New River Canal Basin

Following completion of STA-3/4, inflows to WCA-2A will consist of treated discharges, with the result that the quality of the inflows is expected to improve.

9. Water Conservation Area 3A

WCA-3A receives discharges from C-139 Basins, STA-5, STA-6, and STA-3/4, as well as any discharges from the Holey Land and Rotenberger Wildlife Management Areas, through S-8, S-150, and G-404. All discharges to WCA-3A from these sources will be treated with the exception of C-139 Basin flows bypassed through G-406 at STA 5. See the STA 5 Operation Plan for more information.

The primary functions of WCA-3A are the following:

- To provide viable wetland habitat
- To detain and store flood and drainage water during the wet season
- To prevent water accumulating in the Everglades from overflowing into urban and agricultural lands in Eastern Dade County
- To supply water to Eastern Dade County and Everglades National Park
- To receive and store regulatory releases from Lake Okeechobee and WCA 2A
- To pass water supply releases from Lake Okeechobee to Eastern Dade County and Everglades National Park

Following completion of STA-3/4 (along with STA 5 Outlet Canal) inflows to WCA-3A will consist of treated discharges, with the result that the quality of the inflows are expected to improve.

III. STA OPERATION

Introduction

This section as well as Appendix B describes the general operational scenarios associated with STA-3/4. Operation of the STA will be performed under the following modes:

1. Start-up operation
2. Normal operation
3. Extreme flow operation
4. Drought operation
5. Operation to take one or more treatment cells out of service, and
6. Future changes to optimize nutrient removal performance

Throughout this operation plan, an operational range of +/- 0.25 ft. is applied to all the target stages, unless otherwise stated. For example, if the plan calls for a target stage of 12.0 ft. NGVD, then the operational range is 11.75 – 12.25 ft NGVD.

Background

During the period of STA-3/4 construction, the contractor was contractually obligated to hold water on-site from direct rainfall and construction dewatering activities at ground level, to the maximum extent possible, in order to accelerate desirable STA vegetation growth. Construction of STA-3/4 was substantially complete on December 1, 2003. On December 24, 2003 both the Eastern and Western flow-ways passed the Total Phosphorus startup criteria. On January 9, 2004 the DEP issued the operating permit for STA-3/4. On January 15, 2004 the Eastern flow-way passed the mercury start-up criteria as specified in the DEP permit and was placed into service. On February 25, 2004 the Eastern flow-way began making treated discharges to WCA 2A via S-7. On March 19, 2004 the DEP issued a permit modification to the January 9, 2004 permit to allow flow thru operations in the Western flow-way to commence prior to that flow-way passing the mercury start-up criteria.

Enhancements Sequence

During the period between December 2003 and December 2006 STA-3/4 will undergo a series of enhancements as described in Part 2 of the Long Term Plan. Operations and sequencing during this interim period are further detailed in Section H of this plan.

A. START-UP PHASE OPERATION

1. Background

Since some of the vegetation will not be fully grown by the time of startup, certain precautions are required for storm and intra-event conditions. Operational stage elevations will necessarily be required to be lower in cells that have incomplete

vegetation coverage. Once all vegetation coverage is complete, as determined by the site manager, normal STA-3/4 operations can commence.

If an extreme event occurs at any time that reduces the vegetation coverage, particularly serious fires, operation stage levels should be re-determined and operated as such until vegetation is deemed fully recovered.

Discretion in the operation of STA-3/4 structures is reserved by the District Operations staff to account for flood protection, excess precipitation and upstream and downstream conditions. The following discussion is offered only as general guidance.

In addition, for start up of STA-3/4 operation, all permits and regulatory requirements shall be satisfied to allow discharges from STA-3/4 to go offsite.

After a period (e.g. 6 months) of start-up operation, the extent of STA-3/4 vegetation-coverage should be revisited by the site manager to determine the percentage of grown-in coverage. This step is highly advisable, particularly if vegetation-coverage is significantly less than 100% at the beginning of start-up operation.

2. **Flow-way Operation**

The vegetation management goal for STA-3/4 is to encourage establishment of emergent vegetation, primarily cattail, in the upstream cells and SAV in the downstream cells once the enhancements are completed. To facilitate vegetation grow-in, it is desirable to keep the water depths around an average of 6-12 inches during the early grow-in phase. Since Static Water Level (SWL) is 1.25 feet above ground level, grow-in depths correspond to the minimum and maximum start-up stages as shown in Table 3.1.

Table 3.1 Start-Up Operational Stages

Flow Way	Cell	Average Ground Elevation ft NGVD	Minimum Startup Stage ft NGVD	Target Startup Stage ft NGVD	Operating Gates
Eastern	1A	9.35	8.60	9.10	G-375 A-F
	1B	9.25	8.50	10.25	G-376 A-F
Central	2A	9.70	8.95	9.45	G-378 A-E
	2B	9.70	8.95	10.70	G-379 A-E
Western	3	9.60	10.20	10.85	G-381 A-F

* The operating range is +/- 0.2 ft around the target above.

Therefore, if stages fall below the minimum or rise above the maximum stated levels listed in Table 3.1 (e.g. 9.85 and 10.35 ft NGVD for Cell 1A) on the headwater (HW) side of the outflow structures in each cell (e.g. G-375 A-F HW for Cell 1A), the outflow gates should be modulated to return the water levels to acceptable level.

The absolute upper limit for the start-up stages in all cells is determined by levee integrity factors including wind and wave effects. The normal maximum stage for extreme storm conditions, which is discussed in Section III.D., was determined based on the assumption of full cattail coverage. However, during vegetation grow-in, some portion of each cell will not be covered with cattail, and thus a reduced extreme event stage is necessary. During the start-up phase it is recommended to lower the maximum stormwater depth by one to two feet, corresponding to the startup stages in Table 3.2.

Table 3.2 Maximum Start-up Operational Stage under SPS Conditions

Flow Way	Cell	Maximum SPS Stage ft NGVD	Maximum "Start-up" SPS Stage ft NGVD	Operating Gates
Eastern	1A	16.80	15.80	G-375 A-F
	1B	15.80	14.30	G-376 A-F
Central	2A	16.80	15.80	G-378 A-E
	2B	15.90	13.90	G-379 A-E
Western	3	16.80	15.80	G-381 A-F

If during the start-up phase, stages should rise high enough to threaten life, property or damage to vegetation; allowance for discharge will depend on permitting requirements.

B. NORMAL OPERATION

1. Background

Normal Operation is defined as the operation of STA-3/4 for flows up to and including the Design Peak Flow Condition of 6,440 cfs with fully grown vegetation in each cell. During normal operation, headwater stages at the outflow control structures in each cell are to be maintained between the low (9" below SWL) and high (design) stages shown in Table 3.3.

Table 3.3 Minimum and Maximum Design Stages for STA-3/4

Flow-way	Cell	Average Ground Elevation ft NGVD	Target Depth ft	Target Stage ft NGVD	Minimum HW Stage ft NGVD	Design HW Stage ft NGVD	Design TW Stage ft NGVD	Operating Gates
Eastern	1A	9.35	1.25	10.60	9.85	13.80	13.30	G-375 A-F
	1B	9.25	1.25	10.50	9.85	12.80	12.30	G-376 A-F
Central	2A	9.70	1.25	10.95	10.15	13.80	13.50	G-378 A-E
	2B	9.70	1.25	10.95	10.15	12.90	12.60	G-379 A-E
Western	3	9.60	1.25	10.85	10.25	13.80	13.10	G-381 A-F

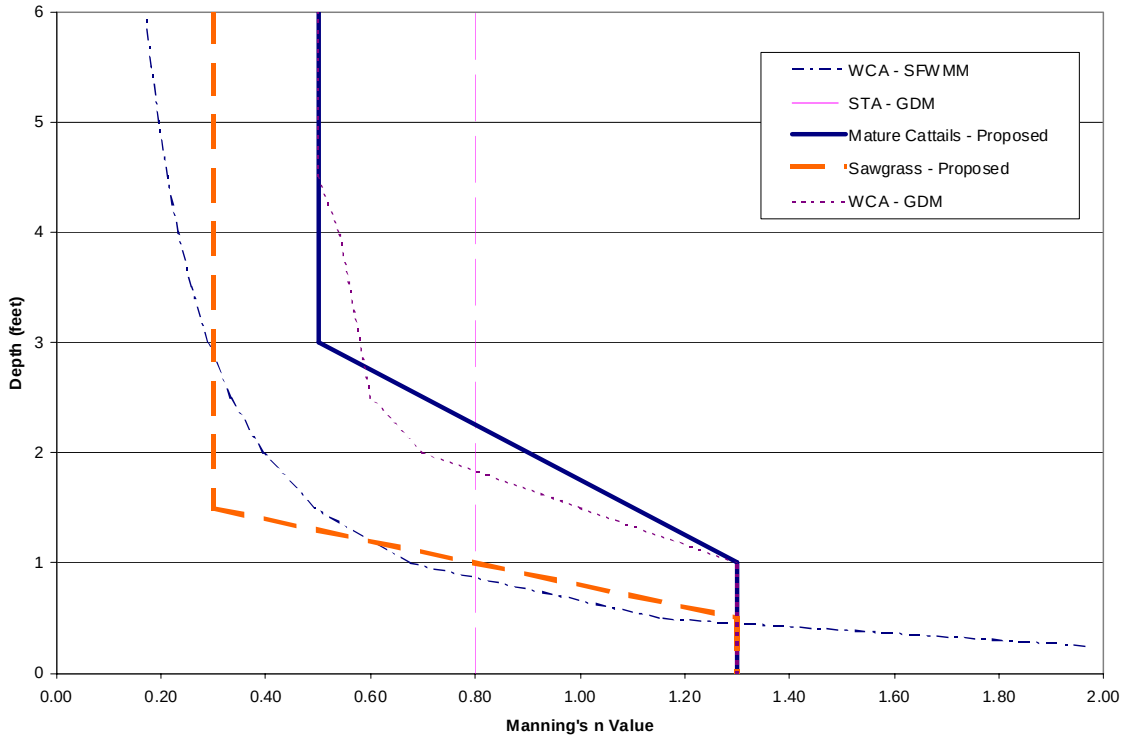
Normal Operating Depths. It is the operational intent that the depths within each of the STA-3/4 treatment cells be maintained between the minimum operational depth (0.5 ft above average ground elevation) and the maximum operational depth, with a target depth of approximately 1.25 ft between storm events. This should yield a long-term average depth of approximately 1.5 ft. For STA-3/4 the maximum operating depth is 4.5 ft above

average ground elevation, corresponding to tailwater elevations of 14.4, 14.4, and 14.0 ft NGVD for G-374, G-377, and G-380, respectively. The maximum operational depth is applied to the average cell depth, and intended as a limit on the maximum permissible water surface elevation under steady state conditions with inflow at the maximum flow (6,440 cfs). This depth may be exceeded under extreme conditions as a result of a heavy rainfall event occurring on the treatment area. To avoid damage to vegetation, the maximum depth should not be exceeded for a period of more than 10 days.

STA-3/4 Operation Modeling. The *Plan Formulation Document* presented the modeling results of the steady-state Design Peak Flow (5,840 cfs[2]) and Average Annual Inflow (885 cfs) conditions through STA-3/4 using 2-dimensional hydrodynamic FESWMS modeling for all of STA-3/4 (except for the 1-dimensional modeling, HEC-2, used for canal hydraulics).

The 30% design configuration for STA-3/4 was modeled based on the assumption that the entire treatment area is a monoculture of cattails. This vegetation was modeled using a depth-dependent Manning's *n* values for natural and constructed wetlands as shown in Figure 3.1.

Figure 3.1 Manning's *n* Values for Natural and Constructed Wetlands



Selection of appropriate values for Manning's *n* typically depends on the vegetation type, vegetation density, surface irregularities, soil types, and other hydraulic characteristics within each region of a model. The values used for STA-3/4 are shown in Table 3.4.

[2] The 30% design used 5,840 cfs as the design value. During detailed design, the G-370 pump capacity was increased to 2,770 cfs from 2,170 cfs. In the next model update, stage level numbers will be updated where necessary.

Table 3.4 STA-3/4 Mature Cattails

Depth (ft)	Manning's *n*
> 6.0	0.5
3.0	0.5
3.0 to 1.0	Varies linearly
1.0	1.3
0	1.3

The above listed STA-3/4 *n* values were taken from field studies at the Everglades Nutrient Removal (ENR) site, which is representative of a mixture of vegetation (mature cattails) and open water.

Results for both the average annual and design peak flows were obtained in FESWMS and are detailed in the following sections. Inflow to STA-3/4 is through the Supply/Inflow Canal via structures G-374, G-377, and G-380, and outflows are discharged to the Discharge/L-5 Canal via G-376, G-379 and G-381. Structural operations of these structures are discussed in Section II *Structure and Canal Descriptions*.

The 2D-modeling effort will be updated to document the effects of the actual vegetation coverage present in STA-3/4, as well as, to incorporate design changes made since the 30% was completed including the revised maximum flow rate of 6,440 cfs. This 2D-modeling which is part of the Long-Term Plan project titled Update and Maintenance of Hydraulic Models [Bc82(5)] is scheduled to occur in 2005 (Sept – Nov.). The vegetation coverage will be determined through field observations and validated by aerial infra-red photography. In addition, this modeling effort will further define the usage of auxiliary control structures G-382 A & B, and G-383 as well as refine the overall STA operational strategy. The operational plans for STA-3/4 will be reviewed, and if necessary, modified for consistency with found conditions. Until the desired vegetation coverage is achieved, or has stabilized, periodic updates of the 2D-modeling effort will be required to optimize STA-3/4 operations.

2. Normal Flow Operation

Normal Flow Operation consists of STA-3/4 operations resulting in cell stages within the range of those found in Table 3.3. Normal Operation includes flows up to the design discharges (6,440 cfs). STA-3/4 operation for rainfall events resulting in STA-3/4 stages above design stage should follow Section III.D., *Extreme Flow Operations*.

Long-term Operating Depths. It is the operational intent of this document that operational depths/stages during storm events up to the design discharge be managed within the range shown in Table 3.5. Operations during events higher than the design discharge are discussed in Section III.C. Once the storm event has passed depths/stages should be reduced so as to achieve the long-term target depths in Table 3.6.

Table 3.5 Summary of STA-3/4 Design Stages

Flow-way	Cell	Design Cell TW Stage ft NGVD	Measured at Structure HW	Operational Structure
Eastern	1A	13.8	G-375	Primary: G-375 Secondary: G-376
	1B	12.8	G-376	Primary: G-376 Secondary: S-7/8 & G-404
Central	2A	13.8	G-378	Primary: G-378 Secondary: G-379
	2B	12.9	G-379	Primary: G-379 Secondary: S-7/8 & G-404
Western	3	13.8	G-381	Primary: G-381 Secondary: S-7/8 & G-404

Structures G-374, G-375, G-376, G-377, G-378, G-379, G-380, and G-381 will normally be fully open. Structures G-382 and G-383 will normally be closed.

Table 3.6 Summary of Long-term Target Depths / Stages for STA-3/4

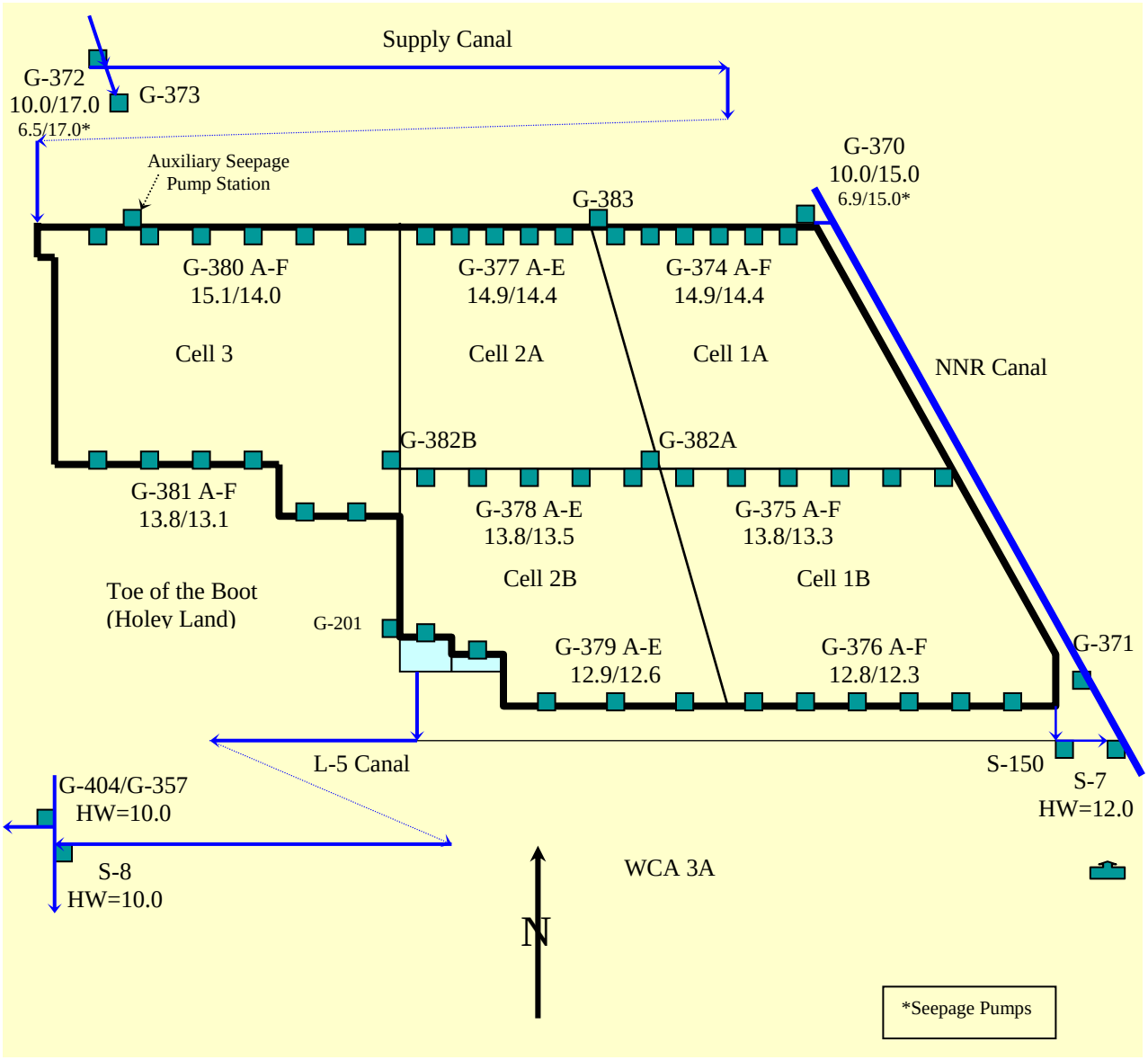
Flow-way	Cell	Cell Target Depth ft	Target Cell TW Stage ft NGVD	Measured at Structure HW	Operational Structure
Eastern	1A	1.25	10.60	G-375	Primary: G-375 Secondary: G-376
	1B	1.25	10.50	G-376	Primary: G-376 Secondary: S-8 & G-404
Central	2A	1.25	10.95	G-378	Primary: G-378 Secondary: G-379
	2B	1.25	10.95	G-379	Primary: G-379 Secondary: S-8 & G-404
Western	3	1.25	10.85	G-381	Primary: G-381 Secondary: S-8 & G-404

Structures G-374, G-375, G-376, G-377, G-378, G-379, G-380, and G-381 will normally be open. Structures G-382 and G-383 will normally be closed.

Design Flow Conditions are defined as inflow of 6,440 cfs from G-370 and G-372, for which the Eastern flow-way treats 2,770 cfs and the Central and Western flow-ways treat 3,670 cfs. Table 3.5 and Figure 3.2 summarize the design cell tailwater stages for STA-3/4.

For design inflows during the 2D-simulation, headwater elevations at structures G-376, G-379, and G-381 were assumed to remain constant at 12.8, 12.9 and 13.8 ft NGVD, respectively. Headwater elevations at structures G-375 and G-378 assumed a 0.5 ft head increase over structures G-376 and G-379, respectively, plus structure headloss allowance specified. The result was that, with full vegetation coverage, the recommended design configuration for the maximum design inflow condition is rated good to excellent.

Figure 3.2 STA-3/4 Design Water Surface at 5840 cfs
(stages listed as Headwater/Tailwater in ft NGVD)



Low Flow Conditions are defined as operation of STA-3/4 when stages fall below SWL, but remain six inches or more above the average ground elevation in each cell. The target elevations for this condition are shown in Table 3.7. If the stage in any cell falls below the minimum water level shown in Table 3.7, then that cell should be considered as being under drought conditions; operation requirements for this condition are discussed in Section III.D.

Table 3.7 Water Stages During Normal Low Flow Conditions

Flow-way	Cell	Minimum Water Level ft NGVD	Static Water Level (SWL) ft NGVD	Operational Structure
Eastern	1A	9.85	10.60	G-376
	1B	9.75	10.50	G-376
Central	2A	10.20	10.95	G-379
	2B	10.20	10.95	G-379
Western	3	10.10	10.85	G-381

When the water level in any cell falls below SWL, the outflow control gates (G-376, G-379 or G-381) should be fully closed to retain the remaining water within the cell. In addition, Structure G-382B should be opened to redirect Cell 3 discharges to Cells 2A and 2B.

If the G-370 and G-372 main pumps are already shut off, inflow control structures G-374, G-377, and G-381 will remain open if the water level is above SWL. If, during the dry season, one or both of the G-370 / G-372 main pumps are operating, inflow control structures G-374, G-377, and G-380 should be open. Outflow control structures will remain closed until G-376, G-379, and G-381 HW reach 10.67, 11.12, and 11.02 ft NGVD (2" above SWL).

3. Other Structures related to STA-3/4 Normal Operations

Operational criteria for other STA structures such as seepage pumps, diversion structures, and outflow pumps for normal operations are described in this section. Conditions for extreme storms are described in Section III.C.2.

Seepage Pumps: G-370, G-372 and Auxiliary Seepage Pumps

Water levels in the seepage collection canal adjacent to the Supply and Inflow Canals will be maintained at levels required to prevent seepage from STA-3/4 from adversely impacting adjacent lands. The design minimum water levels in the canal are 6.9 ft. NGVD at G-372 and 6.5 ft NGVD at G-370, resulting in a maximum water surface elevation (WSE) of 8.0 ft NGVD in the canal near the northeast corner of the Holey Land. This elevation is approximately 1.5 to 2.0 feet below prevailing grade. Flows in the canal are evenly split between the G-370 and G-372 seepage pumps, with up to two 75 cfs pumps normally running at each station. The seepage pumps at G-370 and G-372 shall be operated at all times to maintain 8.0 ft. NGVD at any point in the canal.

Under normal conditions, all seepage will be returned to the Inflow/Supply Canal; however, recovered seepage at G-372 can be placed directly into the Holey Land Wildlife

Management Area if desired or under extreme conditions (drought and/or fires), usually under the discretion of the District.

Facilities for installation of auxiliary seepage pumps (100 cfs each) have been constructed as part of STA-3/4, but use of additional seepage pumps is not expected during normal operation. However, if the stage in the seepage canal rises above 8.0 ft NGVD and the seepage pumps at the main stations do not lower the stage to the desired level within a reasonable time frame (one week); temporary pumps can be installed to provide additional capacity.

Diversion Structure G-371

Diversion Structure G-371 will be closed under normal operations, except when drought conditions exist and water supply releases from Lake Okeechobee are transferred to downstream urban areas. The two control gates at G-371 should be operated as required to maintain a headloss of less than 0.5 ft across the structure.

Diversion Structure G-373

Diversion Structure G-373 will be closed under normal operations, except when drought conditions exist and water supply releases from Lake Okeechobee are transferred to downstream urban areas.

Pump Station S-7 and Structure S-150

During normal operations, Pump Station S-7 will typically not be operated until the headwater elevation at the station reaches 12.00 ft NGVD and discharges from STA-3/4 exceed 1170 cfs, at which point the station will be operated within its capacity to maintain this stage. S-7 may be operated at other times if hydrologic conditions warrant transfer of discharges to WCA-2A, or when water supply or regulatory releases are issued. Structure S-150 will be normally closed, but can be operated, if desired, when the stage in L-5 is higher than that in WCA-3A.

Pump Stations S-8/G-404 and Structure G-357

There are two operational objectives for G-404 and S-8 as identified in and adapted from the STA 5 Operation Plan: (1) to supply the northwest corner of WCA-3A with treated discharges from STA 5 and STA-3/4, and (2) to provide supplemental irrigation water supply to the Big Cypress Seminole Indian Reservation and the U.S. Sugar Southern Division's Unit 2 farm.

Pump Stations S-8 and G-404 will be operated under normal conditions to maintain a headwater elevation at the stations of 10.00 ft NGVD in order to create the required hydraulic gradient for STA-3/4 discharges. Pump Station G-404 should be operated to the maximum extent possible to send treated discharges to the northwest corner of WCA-3A. If the water surface elevation (WSE) is higher in the Miami Canal (@ G-404) than the L-4 Canal WSE, then Structure G-357 can be operated in lieu of G-404.

At the request of the Big Cypress Seminole Indian Reservation or the US Sugar Southern Division's Unit 2 farm, G-404 will be operated to supply water to the west along the L-4 Borrow Canal. If the request is from the Big Cypress Seminole Indian Reservation, G-404 will be operated in concert with the G-409 pump station to supply water to the Reservation.

4. Lake Okeechobee Regulatory Releases during STA-3/4 Normal Operations

STA-3/4 was designed to treat approximately 250,000 acre feet annually of Lake Okeechobee Regulatory Releases and BMP make-up water. It is the operational intent of this document that Lake Okeechobee Regulatory Releases shall be alternated between the three flow-ways of STA-3/4 on a ten day cycle. For example, during the first ten day period the Eastern flow-way shall receive all of the flows emanating from the regulatory release. Then during the next ten day period all flows shall be directed to the Central flow-way and Eastern flow-way shall be drawn down so as to achieve the long term water depths in Table 3.5. This process shall continue so as to give each flow-way a period of rest in between releases.

*Note: Regulatory Releases from Lake Okeechobee should only be initiated when the Lake's Regulation Schedule (WSE) calls from them and only when the Everglades (the downstream receiving water body) can accept the water with minimal or no impact.

Summary of STA-3/4 Structure Operations Required During Normal Conditions:

- During the wet season, keep STA-3/4 inflow structures G-374, G-377 and G-380 open if both of the G-370/372 TW are 14.5 ft NGVD. During the dry season, close G-374, G-377 and G-380 except when water supply is available (i.e. G-370/G-372 pumping storm water).

- During the wet season, when stages in the North New River Canal reach levels prescribed for this canal, resume G-370 pumping operations at a headwater elevation of 10.0 ft NGVD. Open G-374 structures when G-370 TW is 14.5 ft NGVD. Likewise, when stages reach prescribed levels in the Miami Canal, resume G-372 pumping operations at a headwater elevation of 10.0 ft NGVD. Open the G-377 and G-380 structures when G-372 TW is 14.5 ft NGVD.

- Keep STA-3/4 interior structures G-375 and G-378 open unless stages during low flow conditions warrant their closure.

- Auxiliary control structures G-382 and G-383 will normally be closed. During startup operations of G-370 and G-372 at the beginning of wet season, re-open G-383 to facilitate raising the Inflow Canal stage to 14.5 ft NGVD. Upon reaching this stage, close G-383. When STA-3/4 falls below SWL, open G-382 B. G-382 A and B can be opened, if desired, to transfer water among cells.

- Normally, STA-3/4 outflow structures G-376, G-379, and G-381 will be open. When any one of the G-376, G-379 and G-381 HW fall below the SWL of 10.50, 10.95, or 10.85 ft NGVD, respectively, close the respective outflow control structures.

- After a period of low flow, when both main pumping stations G-370 and G-372 resume operations, and G-376, G-379, and G-381 HW stage rise above 10.67, 11.12, and 11.02

ft NGVD (2" above SWL), respectively, re-open G-376, G-379, and G-381 and close control structure G-382B.

- All STA-3/4 structures will be operated to maintain the target stages shown in Table 3.6 for long-term target depths, and below the maximum design stages shown in Table 3.5 except during extreme storm events as described in Section III.C.
- Keep Diversion Structure G-371 closed except to transfer (in conjunction with S-7) water supply to downstream urban areas.
- Keep Diversion Structure G-373 closed except to transfer (in conjunction with S-8) water supply to downstream urban areas.
- Seepage control pumps at G-370 and G-372 will be operated to maintain water surface elevations below a maximum of 8.0 ft NGVD (1.5 to 2.0 feet below prevailing grade) midway in the seepage collection canal at all times. If the WSE is not maintainable, and if available, operate the auxiliary seepage pumps as well.
- Maintain Pump Stations S-7 and S-8 HW at stages of 12.0 and 10.0 ft NGVD, respectively. If STA-3/4 stages fall below SWL, S-7 and S-8 will not be operated.
- Maintain G-404/G-357 HW stages at 10.0 ft NGVD. The District will conduct special operations if additional water is requested from the Big Cypress Seminole Indian Reservation or the US Sugar Southern Division's Unit 2 farm.
- Lake Okeechobee Regulatory Releases shall be cycled through each flow-way on a rotating basis.

C. EXTREME FLOW OPERATION

1. Background

STA-3/4 has been designed to accommodate estimated inflows resulting from extreme precipitation events, up to and including the Standard Project Storm (SPS), as described below. Inflows and rainfall events resulting in STA-3/4 stages below design levels (Table 3.5) should fall under "Normal Operating Conditions" for the STA. **Rainfall associated with events larger than the SPS are extremely improbable and can be considered catastrophic. Such an event was not considered in the design of STA-3/4 or in the preparation of this plan.**

Discretion in the operation of STA-3/4 structures is reserved by the District Operations staff to account for flood protection, excess precipitation and upstream and downstream conditions. The following discussion is offered only as general guidance.

Stages within STA-3/4 will rise and fall with the passing of the extreme storm event, and will be influenced by the rainfall amount, the STA stage at the initiation of rainfall, operations during the event, and the volume of pumping before and during the event.

The Standard Project Storm (SPS) as defined by the District's Management and Storage of Surface Waters (MSSW), Permit Information Manual, Volume IV ranges between 36.0 and 56.0 inches for a 3-day duration storm depending on site specific conditions and risk management considerations. STA-3/4 is considered low risk because of its long distance from major urban population centers. Therefore, a maximum 3-day precipitation depth of 36 inches was employed in the design of STA-3/4 as described in the Plan Formulation Document (PFD). The analyses contained in the PFD assumed that the STA was full prior to the event and that full pumping inflow from G-370 and G-372 would be maintained throughout the storm**. Bypass of EAA discharges is not required under these extreme conditions.** Direct rainfall on the STA will increase stages substantially and discharges from the STA will overwhelm the capacity of S-7, S-8, and G-404. Under these conditions, the outflow gates of STA-3/4 should be operated as required to maintain S-7 / S-8 headwater elevations at 14.0 ft NGVD or less.

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Effects of SPS and Hurricane Forces on STA-3/4 Operations. The exterior levees were designed to protect against overtopping during extreme storm events due to wind setup and wave runup. In general, the top of the levee was established to meet the most restrictive requirements of the following criteria:

- To contain the increase above SPS stages resulting from wave runup (computed for the significant wave) and wind setup resulting from occurrence of a Probable Maximum Hurricane (PMH) wind
- To contain the increase above SPS stages resulting from wave runup (computed for the average of the highest five- percent of waves) and wind setup resulting from the occurrence of the highest 2% wind for fully vegetated conditions.
- To provide three (3.0) feet of freeboard above design stages for full treatment area operation (4.5 feet).

The interior vegetation of an STA indirectly affects operations guidelines as a result of hydraulic energy losses associated with resistance to flow. In hydraulic modeling, this resistance to flow is often expressed as the Manning's "n" roughness factor. This resistance to flow influences the hydraulic conveyance capacity of the treatment area with an associated influence on operating levels and levee design. In addition, the height and type of vegetation influences the wave runup and wind setup, both of which influence the maximum allowable operating depths in the treatment cells.

During the original design, STA-3/4 was designed under the assumption that cattails or other emergent vegetation would dominate all treatment cells. This roughness function is discussed in Section III.B. As part of the STA Enhancements projects of the Long-Term Plan, the downstream treatment cells are to be operated as SAV dominated cells. The maximum stages estimated for STA-3/4 for Standard Project Storm is shown in Table 3.8.

Table 3.8 Cell-Average Stage during Standard Project Storm

Flow-way	Cell	Cell-Average SPS Stage ft NGVD
Eastern	1A	17.10
	1B	16.05
Central	2A	17.10
	2B	16.20
Western	3	16.80

The combined wave runup and wind setup for the PMH (119 mph wind speed) was 2.31 ft and 2.11 ft for the highest 2% hurricane (71 mph wind speed) on top of these stages.

As is the standard District practice, STA-3/4 will be drawn down in anticipation of a pending large storm such as a hurricane, but not before the drainage areas served by STA-3/4 are drawn down.

During the start-up period of STA-3/4, where vegetation may not be fully grown-in, an approximate adjustment to operational recommendations is considered. Refer to Section III.A for SPS conditions during Start-up Phase Operation.

2. <u>Other Structures related to STA-3/4 SPS Operation</u>

G-370, G-372 and Auxiliary Seepage Pumps

Under extreme storm conditions, the seepage pumps at stations G-370 and G-372 and the auxiliary station (if installed) should be utilized to maintain stages in the canal as close as possible to those associated with normal operation (i.e. maximum stage of 8.0 ft NGVD). However, given the fact that surrounding agricultural areas will likely be flooded as well, it may not be possible to maintain the desired stages in the canal. In this situation, the pumps should be run continuously until stages return to normal.

Diversion Structure G-371

In the extreme unlikely event that total failure of G-370 occurs, Diversion Structure G-371 can be used to allow flow to bypass STA-3/4. A flow rate of 2,170[3] cfs can be expected with a headwater of 10.92 ft NGVD and a tailwater at 10.04 ft NGVD.

Diversion Structure G-373

In the extreme unlikely event that total failure of G-372 occurs, Diversion Structure G-373 can be used to allow flow to bypass STA-3/4. A flow rate of 3,670 cfs can be expected with a headwater of 11.90 ft NGVD and a tailwater at 11.50ft NGVD.

[3] The flow rate is 2,770 cfs, the new G-370 inflow rate. The stage level will be updated in the next 2D analysis.

Pump Station S-7 and Structure S-150

For extreme operations, Pump Station S-7 (2490 cfs) and Structure S-150 (1000 cfs) should be utilized within their capacity to remove STA-3/4 discharges.

Pump Stations S-8/G-404 and Structure G-357

For extreme operations, Pump Stations S-8 / G-404 and Structure G-357 are not designed to handle both the STA-3/4 and the STA 5 SPS. Refer to the STA 5 Operations Plan for provisions to divert water away from the Miami Canal. During extreme conditions, Pump Station S-8/G-404 will be operating at or near full capacity (4160 cfs and 570 cfs, respectively). If a concurrent extreme storm event occurs within the STA 5 watershed, operation of G-404 should be terminated to minimize effects on bypass Structure G-406 at STA 5. There are plans to upgrade the G-404 / G-357 structures to a higher capacity, and when completed, the STA-3/4 Operations Plan will be reviewed and modified by SFWMD staff.

Summary of STA Structure Operations Required During SPS Event:

- Maintain full pumping through Pump Stations G-370 and G-372.
- Fully open all interior control structures (G-374 thru G-381).
- Keep Diversion Structure G-371 closed.
- Keep Diversion Structure G-373 closed.
- Keep control structures G-382 A-B and G-383 closed.
- Operate G-370, G-372, and Auxiliary Seepage Pumps (if available) within their capacity to maintain 8.0 ft NGVD at any point in the seepage canal.
- Operate Pump Stations S-7, S-8, and G-404, and Structure S-150 within their capacity to maintain headwater stages of 14.0 ft NGVD or lower.
- Operational discretion for structure operations is reserved by the District Operations staff, to account for flood protection, excess precipitation and upstream and downstream conditions. Treatment Cell depths are predicted to exceed the "Design Flow Operations" maximum depth of 4.50 ft above average treatment cell ground elevations.

D. DROUGHT OPERATION

1. Background

The District shall maintain stages at or above 0.5 feet above the average ground elevation in the treatment cells to the maximum extent practicable to minimize potential negative effects

of drought on subsequent project performance. Drought operations shall commence once cell water operations fall nine inches below the static water level (SWL) as shown in Table 3.9.

Table 3.9 Average Ground and Drought Water Surface Elevations

Flow-way	Cell	Average Ground Elevation ft NGVD	Drought Water Levels ft NGVD
Eastern	1A	9.35	9.85
	1B	9.25	9.75
Central	2A	9.70	10.20
	2B	9.70	10.20
Western	3	9.60	10.20

The ability to maintain this minimum water elevation is determined primarily by the availability of water from the upstream watershed and on rainfall. In the extreme case that there is no water available from the upstream watershed and/or from rain, the treatment cells may dry out. After an extended dryout, there is a potential that the water quality improvement performance of subsequent discharges of water from treatment cells may be adversely affected. The severity and duration of the dry conditions that may lead to reduced project performance is currently unknown, as is the magnitude and duration of the potential reduction of project performance. Analysis of the monthly compliance monitoring data collected at the project outflow monitoring station will be useful in making these determinations.

2. Operation During Drought Conditions

Treatment cell drought conditions shall be in effect when the water level at the outfall structures (G-376, G-379 or G-381) in any cell falls below the drought water levels in Table 3.9. During these conditions, there is no pumping at G-370 and G-372 (except for seepage pumps), and all outflow structures have been closed. Supplemental water, when available, will be directed towards the North New River Canal. When the North New River Canal stage reaches 10.00 ft NGVD at the G-371 diversion structure, G-376, G-379, G-381 and G-371 should be opened to let the supplemental water backflow into STA-3/4. When the stage in North New River Canal falls below 10.0 ft NGVD, structures G-376, G-379, G-381 and G-371 should be closed.

The main pumps at G-370 and G-372 may also be used during drought operation. Inflow control structures G-374, G-377, and G-380 should be open to allow as much inflow to STA. Outflow control structures G-376, G-379 and G-381 will remain closed so long as drought conditions are anticipated.

If any cell has less than 0.5 feet of water and water is available from another cell, then the interior gates should be modulated to allow for some transfer between cells.

If the discharges do not meet the criteria, including issued permits, used for operating STA-3/4 and this criteria violation can be related to dryout, then proper reporting procedures

should be utilized to document the event, identify causes and specify remediation measures, including modifications to the operation plan as appropriate and as approved by reporting authorities.

3. Other Structures related to STA-3/4 Drought Operation

G-370, G-372 and Auxiliary Seepage Pumps

During drought conditions, the seepage collection canal will be maintained at the 8.0 ft NGVD as described in previous sections of this Plan by the pumps located in G-370 and G-372.

The use of auxiliary seepage pumps is not contemplated during drought operations.

Diversion Structure G-371

Under drought conditions, Diversion Structure G-371 will be closed, unless supplemental waters or urban water supply release are required.

Diversion Structure G-373

Under drought conditions, Diversion Structure G-373 will be closed, unless supplemental waters or urban water supply release are required.

Pump Station S-7 and Structure S-150

During drought conditions, Pump Station S-7 and Structure S-150 will not be operating. However, if water supply releases are issued, the S-7 spillway will be opened.

Pump Stations S-8/G-404 and Structure G-357

Under drought conditions, Pump Station S-8 and Structure G-357 will not be operated. However, if water supply releases are issued, the S-8 spillway will be opened.

Pump Station G-404 will be operated at the request of the Big Cypress Seminole Indian Reservation or the US Sugar Southern Division's Unit 2 farm. If operated, G-404 will send, to the fullest extent practicable, supply water to the west along the L-4 Borrow Canal. If the request is from the Big Cypress Seminole Indian Reservation, G-404 will be operated in conjunction with G-409 to supply water to the Reservation.

Summary of Operations Required During Drought Events:

- Treatment cell Drought Conditions shall be in effect when headwater levels at outflow structures G-376, G-379, or G-381 HW fall below 9.75, 10.20, or 10.20 ft NGVD, respectively. G-376, G-379 and G-381 will already be closed, and control structure G-382B will be open.

- Pump Stations G-370 and G-372 will not operate.

- Continue operating seepage pumps at G-370 and G-372 to maintain water surface elevations below a maximum of 8.0 ft NGVD (1.5 to 2.0 feet below prevailing grade).

- Pump Stations S-7 and S-8 will already be shut down, but if water supply releases are issued, open their spillways. Structures S-150 and G-357 will already be closed. If requested by the Big Cypress Seminole Indian Reservation or the US Sugar Southern Division's Unit 2 farm, and water is available, G-404 will be operated.

- Keep interior control structures G-375 and G-378 open, and G-382A and G-383 closed. If the water level in any cell is below 0.5 feet, open and modulate applicable interior gates, if water is available and transfer is desired.

- Keep Diversion Structure G-371 fully closed, except when water supply releases are issued.

- Keep Diversion Structure G-373 fully closed, except when water supply releases are issued.

- If supplemental water is available and the G-371 HW stage in the North New River Canal is above 10.00 ft NGVD, then open G-371, G-376, G-379, and G-381 structures to allow backflow into the STA. In addition, operate Pump Station G-404 when supplemental water through the L-4 Canal is available for farming operations. When supplemental water is not available, close G-371, G-376, G-379 and G-381.

- In the drainage (i.e. wet) season, when the North New River Canal reaches 10.0 ft NGVD, G-370 pumping operations will resume, and the G-374 structures will be re-opened. Likewise, when the Miami Canal reaches 10.0 ft NGVD, G-372 pumping operations will resume, and the G-377 and G-380 structures will be re-opened.

E. TREATMENT CELLS OUT OF SERVICE

Treatment cells and/or flow-ways may be isolated, or "taken off-line", when deemed necessary or desirable for maintenance, vegetation management, or enhancements. The general procedure is to close the inflow and outflow structures associated with the cells of interest, open Control Structure G-383, and possibly open Control Structures G-382A and G-382B. Generally, the optimal time to take a treatment cell(s) off-line is during times of low flow, when the stage in the Inflow Canal is less than 11.0 ft NGVD.

To remove the Eastern flow-way (Treatment Cells 1A and 1B) from service, Inflow Structures G-374 A-F and associated Outflow Structures G-376 A-F will be closed, and G-383 will be opened. (To remove only Cell 1B from service, Intermediate Structures G-375 A-F and associated Outflow Structures G-376 A-F will be closed and G-382 A and G-383 will be opened.)

To remove the Central flow-way (Treatment Cells 2A and 2B) from service, Inflow Structures G-377 A-F and associated Outflow Structures G-379 A-F will be closed, and G-383 will be opened. (To remove only Cell 2B from service, Intermediate Structures G-378 A-F and associated Outflow Structures G-379 A-F will be closed, and G-382 A/B and G-383 will be opened.)

To remove the Western flow-way (Treatment Cell 3) from service, Inflow Structures G-380 A-F and associated Outflow Structures G-381 A-F will be closed, and G-382B and G-383 will be opened.

F. PERFORMANCE OPTIMIZATION

The design purpose of STA-3/4 is to reduce the long-term flow weighted mean Total Phosphorus concentrations to 50 parts per billion (ppb) prior to discharge. It is recognized that further reductions in Total Phosphorus concentrations are beneficial to the Environmental Protection Area (EPA). In addition, the Everglades Forever Act (*F.S. Section 373.4592 4.d.3*) directs the District to "include research seeking to optimize the design and operation of the STAs' in its research and monitoring program". To fulfill these obligations, the District has a program to elucidate operational strategies and design features that will lead to further reductions in Total Phosphorus. As additional knowledge becomes available, this operational plan will be modified to reflect those changes.

G. OPERATIONS DURING ENHANCEMENTS AS DESCRIBED IN THE LONG TERM PLAN.

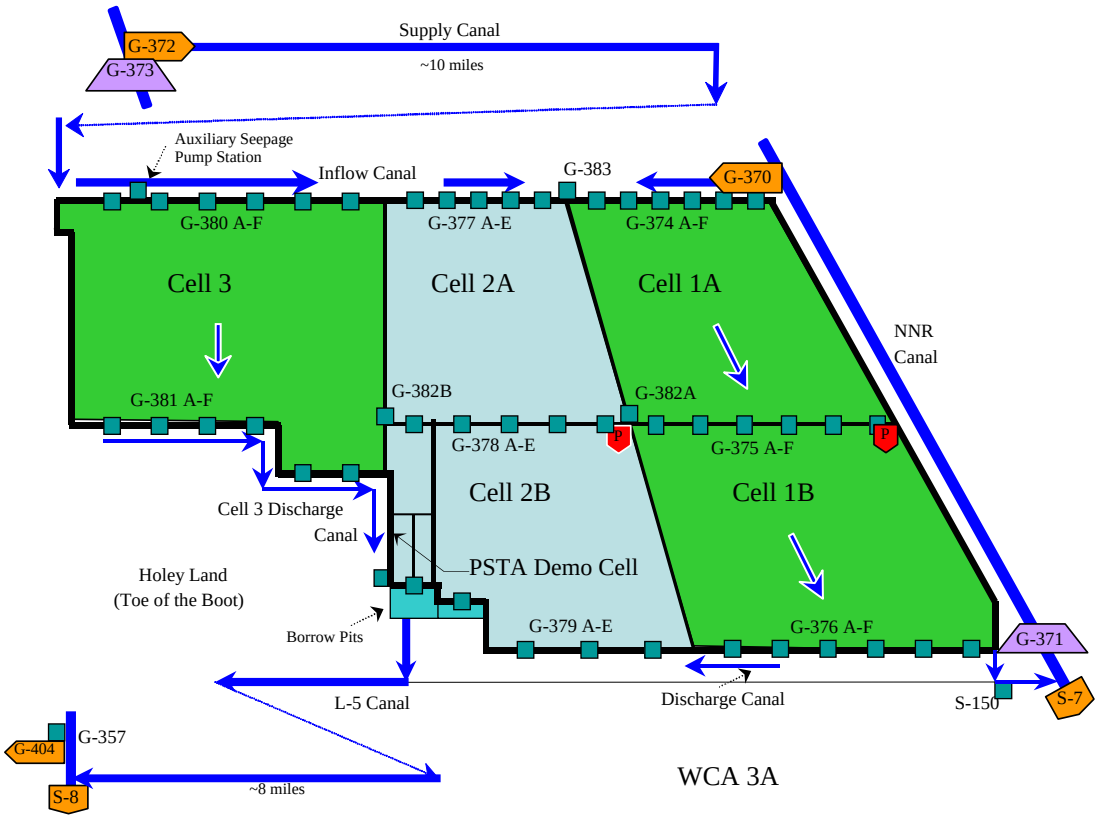
During the period from December 2003 through December 2006, STA-3/4 will undergo a series of enhancements as described in Part 2 of the Long Term Plan. Operations during this interim period shall be as described below:

1. Phase 1: December 2003 to October 2005 (estimated dates) (Figure 3.3)

Cells 1A / 1B and Cell 3 shall remain in normal flow-through operation. It is the operational intent that the depths within these treatment cells be maintained between the minimum operational depth (0.5 ft above average ground elevation) and the maximum operational depth, with a long-term average depth of approximately 1.25 ft. During this time, the vegetation community will be emergent plants, and the maximum operating depth is 4.5 ft above average ground elevation, corresponding to tailwater elevations of 14.4 and 14.0 ft NGVD for G-374 and G-380, respectively. The maximum operational depth is applied to the average cell depth, and intended as a limit on the maximum permissible water surface elevation under steady state conditions with inflow at the maximum flow. This depth may be exceeded under extreme conditions as a result of a heavy rainfall event occurring on the treatment area. To avoid damage to vegetation, the maximum depth should not be exceeded for a period of more than 10 days. Additional information regarding normal operations and extreme conditions can be found in Section III.B, III.C, and III.D of this plan. **Note that flow-through commencement is subject to demonstration of net improvement. Cells 1A/1B passed startup on January 15, 2004 and authorization for flow-through operations in Cell 3 was granted by the DEP on March 19, 2004.*

STA-3/4 Cells 2A and 2B (Central flow-way)are currently offline and shall remain off-line as outlined below and in Section III.E of this plan, so as to facilitate the PSTA demo project; vegetation management within Cell 2B; and the reflooding and SAV grow-in of Cell 2B. To remove Central flow-way from service, inflow structures G-377 A-F and associated outflow structures G-379 A-F are closed, and G-383 will be opened when necessary depending on the need to transfer water from the inflow pumps to Cells 1 and 3. Structures G-382 will normally be closed. Subject to vegetation grow-in and demonstration of net improvement it is anticipated that the Central flow-way will be brought back online by October of 2005.

Figure 3.3: Phase 1 - December 2003 to October 2005 (estimated dates)



2. Phase 2: December 2004 to October 2006 (estimated dates) (Figure 3.4)

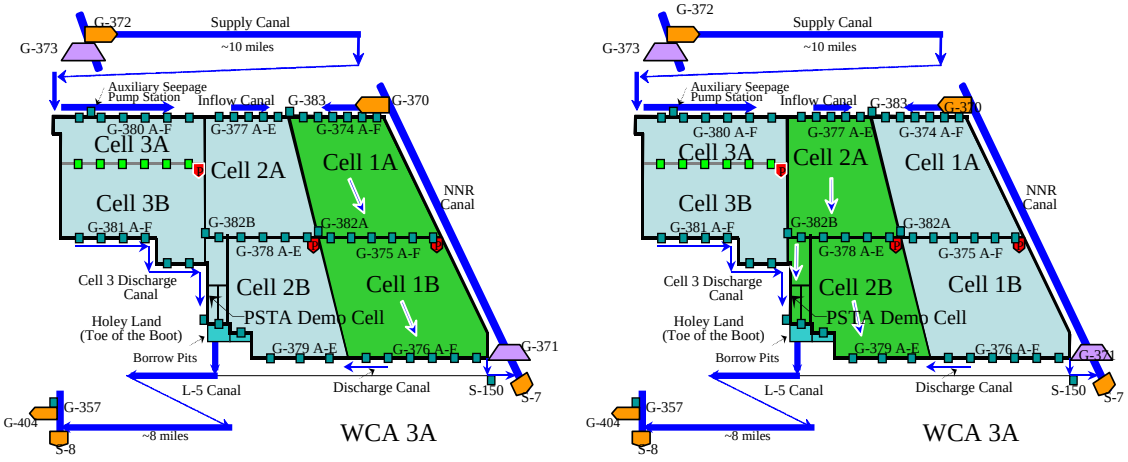
The Long Term Plan called for SAV in Cell 1B and the new Cell 3B by December 2006. However, based on observed performance (12-15 ppb) with existing vegetation, District staff may defer the conversion of emergent vegetation until after December 2006. The following operations would apply if/when the conversion takes place.

Cells 2A / 2B shall initiate flow through operations once net improvement has been achieved (estimated to occur between March 2005 / Oct 2005). It is the operational intent that the depths within these treatment cells be maintained between the minimum operational depth (0.5 ft above average ground elevation) and the maximum operational depth, with a long-term average depth of approximately 1.25 ft. During this time, the vegetation community will be emergent plants in Cell 2A and SAV in Cell 2B, and the maximum operating depth is 4.5 ft above average ground elevation, corresponding to tailwater elevations of 14.4 ft NGVD for G-377. The maximum operational depth is applied to the average cell depth, and intended as a limit on the maximum permissible water surface elevation under steady state conditions with inflow at the maximum flow. This depth may be exceeded under extreme conditions as a result of a heavy rainfall event occurring on the treatment area. To avoid damage to vegetation, the maximum depth should not be exceeded for a period of more than 10 days. Additional information regarding normal operations and extreme conditions can be found in Section III.B, III.C, and III.D of this plan.

Cells 1A / 1B shall remain in normal flow-thru operation as described above until Cells 2A and 2B achieve net improvement pursuant to the operating permit. Once the need for vegetation conversion in Cell 1B has been demonstrated, then Cells 1A / 1B shall be taken offline so as to facilitate the conversion of Cell 1B from an emergent community to a SAV community. In order to take the Eastern flow-way offline the inflow structures G-374 A-F and associated outflow structures G-376 A-F will be closed and G-383 will be opened.

The Western flow-way (Cell 3) shall be taken off-line (Dec 2004 to May 2005) as outlined below and in Section III F of this plan so as to facilitate construction of 3.3 miles of interior levee and water control structures; construction of controls; power and telemetry; vegetation management in the newly constructed Cell 3B; and reflooding and SAV grow-in of Cell 3B. To remove the Western flow-way from service, inflow structures G-380 A-F and associated outflow structures G-381 A-F will be closed, and G-383 will be opened when necessary. Subject to vegetation grow-in and demonstration of net improvement it is anticipated that the Central flow-way will be brought back online by October of 2006.

Figure 3.4: Phase 2 - December 2004 to October 2006 (estimated dates)

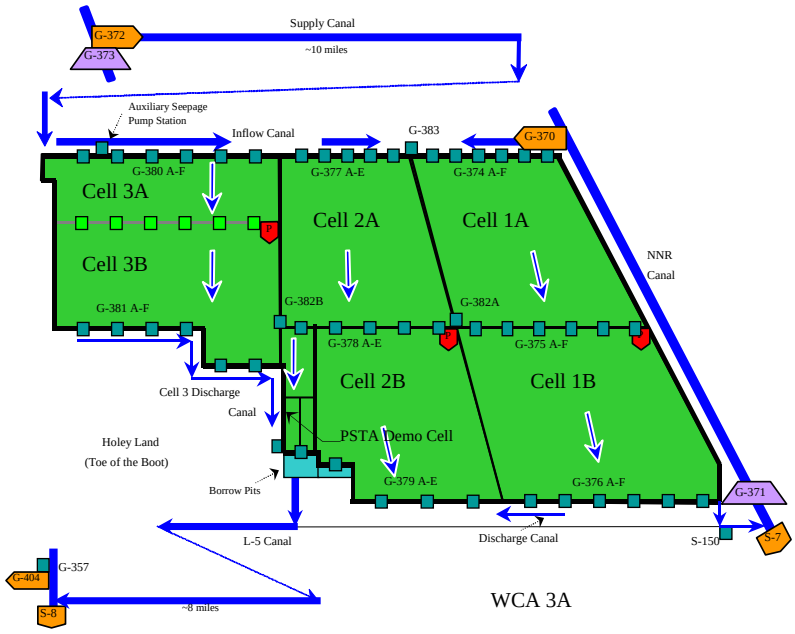


December 2004 to March 2005 **March 2005 to October 2006**

Phase 3: December 2006 Transition to Normal Operations (Figure 3.5)

It is anticipated that the STA enhancements will be completed by December 2006. Once completed STA-3/4 operations will transition over to normal flow through mode within all treatment cells as described in Section III of this plan. **Note that flow-through commencement is subject to demonstration of net improvement*

Figure 3.5: STA-3/4 Enhancements Complete by December 2006



IV. HYDROPATTERN RESTORATION

Discharges from STA-3/4 will be conveyed to Water Conservation Area 2A and 3A (WCA-3A) via outflow pump stations S-7, S-8, G-404, Structures G-357, S-150, and the gap in the southern L-4 levee. There are no immediate hydropattern changes expected as a result of the operation of STA-3/4. The remainder of the hydropattern restoration features contemplated in the Everglades Forever Act will distribute water along a broad boundary of the water conservation areas. Benefits include restoring more natural hydroperiods throughout the northern Everglades. While that redistribution will not reduce the total phosphorus load delivered to the Everglades, it will reduce the areal loading rate, another added benefit of the proposed work. The current discharge configuration concentrates the total phosphorus load at the location of the outlet structures. The proposed configurations will spatially distribute this load as a function of the modified outlet works. Part 7 of the Long-Term Plan outlines a strategy for completion of the hydropattern restoration works originally envisioned in the Everglades Forever Act. When this occurs, the operational plans for the STA-3/4 will be, and if necessary, modified for consistency with said plans accordingly.

V. COORDINATION WITH OTHER PLANS

As modifications to the Central and Southern Florida Project are analyzed through the Lower East Coast Regional Water Supply Plan (LECRWSP), Lake Okeechobee Regulation Schedule (WSE), Holey Land Operational Schedule, and Comprehensive Everglades Restoration Plan (CERP), and other major SFWMD projects, the hydraulic and treatment capacities of the current STA designs will be evaluated. If it is deemed necessary, these studies will recommend additional treatment facilities. The operational plan for the STA-3/4 will be reviewed, and if necessary, modified for consistency with said studies accordingly.

VI. PERMITS FOR OPERATION OF STA-3/4

The required permits for the construction, maintenance, and operation of STA-3/4 were issued January 15, 2004.

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G-371 Diversion Structure, April 2001
STA3/4 Works, April 2001
Supply Canal, November 2000
US Highway 27 Bridges, April 2001
West L-5 Borrow Canal Enlargement, April 2001

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Burns and McDonnell 2003. Everglades Protection Area Tributary Basins Long Term Plan for Achieving Water Quality Goals

APPENDIX A

The design of STA-3/4 was developed in anticipation of the following inflow volumes, inflow total phosphorus (TP) concentrations, and inflow TP loads, in order to produce the desired outflow TP concentration within a reasonable confidence level. The Average TP concentrations in the various components of inflow to STA-3/4 were updated during final design from previous estimates to reflect the most current information available. Those updated values are taken from the Baseline Data for the Basin-Specific Feasibility Studies to Achieve the Long-Term Water Quality Goals for the Everglades (Goforth and Piccone, 2001).

For all inflows combined, and assuming a 25% load reduction due to BMPs, the average annual inflow to STA-3/4 over the period 1965-1995 is estimated to be 645,222 acre-feet (May 2001 report has 660,889 acre-feet) per year at a flow-weighted mean TP concentration of 114 ppb. (The corresponding annual minima and maxima of inflow volume to STA-3/4 and flow-weighted mean TP concentrations are 254,062 (236,892 in May 2001 report) and 1,217,259 acre-feet (1,250,096 in May 2001 report), and 89 and 137 ppb, respectively.)

For the North New River Canal basin, and assuming a 25% load reduction due to BMPs, the average annual inflow to STA-3/4 over the period 1965-1995 at Pumping Station G-370 is estimated to be 254,928 acre-feet per year at a flow-weighted mean TP concentration of 121 ppb. (The corresponding annual minima and maxima of North New River Canal inflow volume to STA-3/4 and flow-weighted mean TP concentrations are 110,335 and 476,707 acre-feet, and 100 and 145 ppb, respectively.)

For the Miami Canal basin, and assuming a 25% load reduction due to BMPs, the average annual inflow to STA-3/4 over the period 1965-1995 at Pumping Station G-372 is estimated to be 390,294 acre-feet per year at a flow-weighted mean TP concentration of 110 ppb. (The corresponding annual minima and maxima of Miami Canal inflow volume to STA-3/4 and flow-weighted mean TP concentrations are 143,727 and 740,552 acre-feet, and 81 and 132 ppb, respectively.)

Lake Okeechobee releases were considered in the analysis as made to the Miami Canal to the maximum practicable extent. This point of release at Miami Canal (thru S-354) is selected due to the slightly lower (roughly 5 ppb) anticipated total phosphorus concentration at that location as compared to the North New River Canal (thru S-351); thus, when all things are equal, S-354 should be used in lieu of S-351. The TP concentrations considered in this analysis are the 1990-99 flow-weighted mean phosphorus concentration of 66.6 ppb (applied to Miami Canal Lake releases) and 71.2 ppb (applied to the North New River Canal Lake releases).

Table A.1: Annual Average Flow, Load, and Concentration

	Annual Average Flow (ac-ft)	Annual Average Load (kg)	Annual Average TP Concentration (ppb)
North New River Canal	254,928	38,064	121
Miami Canal	390,294	52,979	110
Total	645,222	90,767	114

* Regulatory Releases and BMP make-up water from Lake Okeechobee were assumed in the data presented above.

APPENDIX B

Operational Design Envelope

The *Everglades Protection Area Tributary Basins Long Term Plan for Achieving Water Quality Goals* recommends structural, vegetative and operational enhancements for each STA, and provides a predicted range of long-term average outflow phosphorus concentrations once the enhancements are completed. Refinement of the operational strategies for the STAs is required to optimize the phosphorus removal performance of the STAs and to ensure that the STAs are not subject to overload from inflow volume or nutrients. In addition, assessment of annual or long-term performance is aided by a comparison of actual loading to the loading that was anticipated during the design of the treatment areas, and the subsequent design of the STA enhancements. The paper "The Operational Design Envelope for the STAs" develops the operational range for inflow volume and phosphorus loads that were anticipated for each STA, and recommends a method for utilizing the resulting information to assist in tactical operational decisions. The following method provides a tactical (e.g., monthly) operational guidance to ensure that the STAs are operated within their design envelope to the maximum extent practicable.

The operational design envelopes presented in the following tables and figures can be used to track the status of each STA relative to long-term cumulative inflow volumes and loads. This information will form a basis to assist with monthly operational decisions and keep the STAs solidly within their design envelopes.

1. Actual monthly and 12-month cumulative flows and phosphorus loads are monitored for each STA. Presently, flow data are available approximately 4-6 weeks after field measurement. Efforts are underway to streamline data processing and reduce this lag time. Estimates of phosphorus loads depend on this flow data, so phosphorus loads are also approximately 4-6 weeks behind collection dates.
2. Comparison of actual flows and loads to the monthly and annual ranges presented in the following tables can be made monthly. If deviations are observed, an immediate evaluation of the causes of the deviations should be conducted. Options for bringing the flows and loads back in the range depicted in the operational design envelopes should be identified, evaluated and implemented.
3. For discretionary operations, such as Lake Okeechobee releases and inter-basin transfer of water (when available), both the monthly and annual cumulative values can be utilized to provide guidance.

   Lake Okeechobee release example:
   Flow-way 1 of STA-3/4 recently began flow-through operation. This flow-way contains approximately 6,500 acres, or about 40% of the STAs' total effective treatment area. A target for Lake releases during the month of March can be obtained from the cumulative monthly design envelope. The 31-year average of simulated flow into STA-3/4 during March is 46,759 acre feet. Assuming uniform distribution through the flow-ways, approximately 40%, or 18,420 acre feet was set as the target for flow-way 1. This equates to about 300 cfs. Since the STA is still in stabilization, the average value was selected, as opposed to the maximum value, which would have been 82,831 acre feet during the month. Had the STA been in operation for the previous 12 months, we could compare the cumulative actual flow/load with the simulated range and use the lower of the 12-month cumulative or monthly cumulative balance. For example, had the previous 11-month cumulative flow been 620,000 acre feet (assuming the entire STA was operational), the balance available to reach the average annual inflow volume would be (655,853 – 620,000 =) 35,853 acre feet. Since this is less than the March average of 46,759 acre feet, the target for discretionary releases would be 35,853 acre feet.

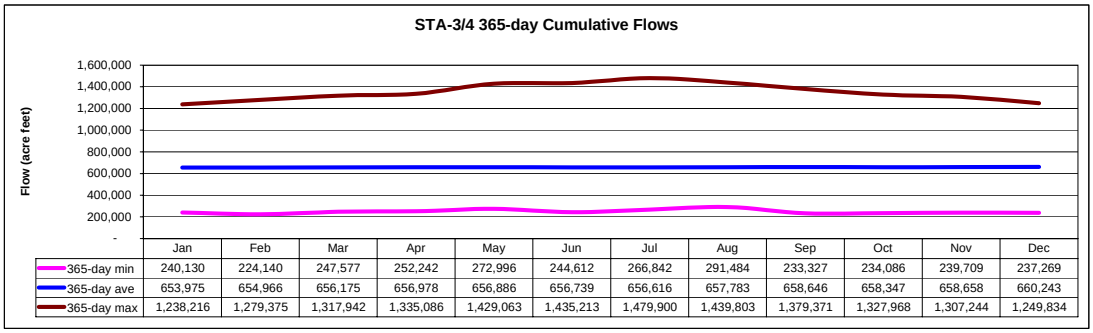
Table B.1: Design Monthly Flow and Loading to STA-3/4

Month	30-day min		30-day ave		30-day max	
	Flow	Load	Flow	Load	Flow	Load
Jan	-	-	48,101	4,822	159,984	14,964
Feb	2,368	179	43,440	4,199	172,534	15,167
Mar	-	-	46,762	4,687	215,246	24,950
Apr	-	-	35,725	3,293	173,684	15,459
May	-	-	29,989	3,346	126,639	13,423
Jun	79	13	68,280	8,307	172,256	21,900
Jul	4,989	529	68,017	8,150	137,381	17,364
Aug	28,142	3,091	77,214	9,111	137,410	16,056
Sep	3,732	540	75,285	8,924	161,566	20,494
Oct	8,751	741	68,892	7,316	152,041	17,364
Nov	7,880	667	44,406	4,547	106,058	13,700
Dec	4,148	348	45,703	4,303	99,176	12,837
Minimum	-	-	29,989	3,293	106,058	13,423
Average	5,007	509	54,318	5,917	155,891	17,349
Maximum	28,142	3,091	77,214	9,111	215,246	24,950

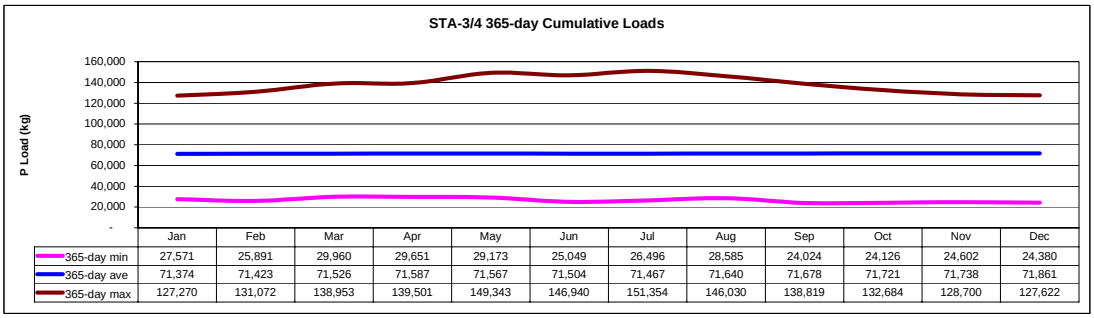
Table B.2: Design Annual Flow and Loading to STA-3/4

Month	365-day min		365-day ave		365-day max	
	Flow	Load	Flow	Load	Flow	Load
Jan	240,130	27,571	653,975	71,374	1,238,216	127,270
Feb	224,140	25,891	654,966	71,423	1,279,375	131,072
Mar	247,577	29,960	656,175	71,526	1,317,942	138,953
Apr	252,242	29,651	656,978	71,587	1,335,086	139,501
May	272,996	29,173	656,886	71,567	1,429,063	149,343
Jun	244,612	25,049	656,739	71,504	1,435,213	146,940
Jul	266,842	26,496	656,616	71,467	1,479,900	151,354
Aug	291,484	28,585	657,783	71,640	1,439,803	146,030
Sep	233,327	24,024	658,646	71,678	1,379,371	138,819
Oct	234,086	24,126	658,347	71,721	1,327,968	132,684
Nov	239,709	24,602	658,658	71,738	1,307,244	128,700
Dec	237,269	24,380	660,243	71,861	1,249,834	127,622
Minimum	224,140	24,024	653,975	71,374	1,238,216	127,270
Average	248,701	26,626	657,168	71,591	1,351,585	138,191
Maximum	291,484	29,960	660,243	71,861	1,479,900	151,354

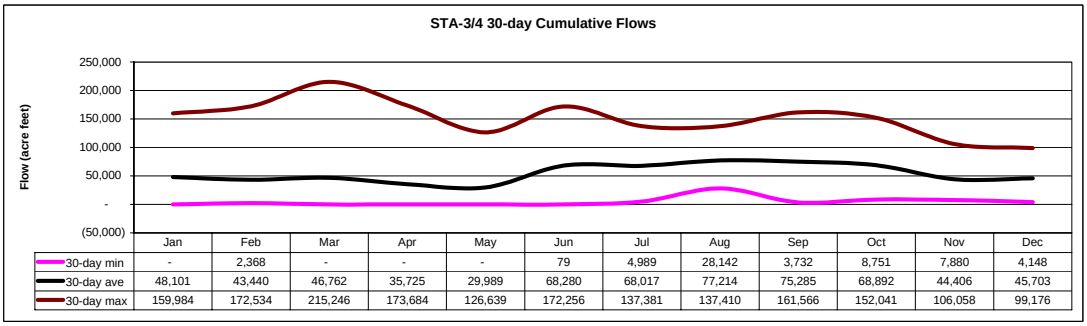
Figure B.1 Monthly and Annual Design Envelope for STA-3/4



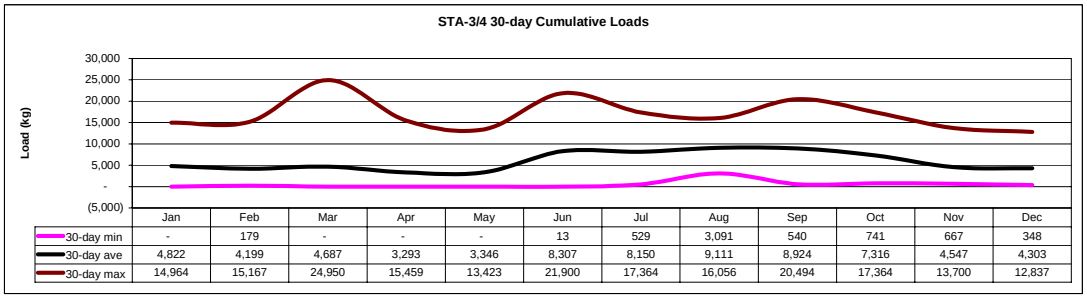
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
365-day min	240,130	224,140	247,577	252,242	272,996	244,612	266,842	291,484	233,327	234,086	239,709	237,269
365-day ave	653,975	654,966	656,175	656,978	656,886	656,739	656,616	657,783	658,646	658,347	658,658	660,243
365-day max	1,238,216	1,279,375	1,317,942	1,335,086	1,429,063	1,435,213	1,479,900	1,439,803	1,379,371	1,327,968	1,307,244	1,249,834



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
365-day min	27,571	25,891	29,960	29,651	29,173	25,049	26,496	28,585	24,024	24,126	24,602	24,380
365-day ave	71,374	71,423	71,526	71,587	71,567	71,504	71,467	71,640	71,678	71,721	71,738	71,861
365-day max	127,270	131,072	138,953	139,501	149,343	146,940	151,354	146,030	138,819	132,684	128,700	127,622



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
30-day min	-	2,368	-	-	-	79	4,989	28,142	3,732	8,751	7,880	4,148
30-day ave	48,101	43,440	46,762	35,725	29,989	68,280	68,017	77,214	75,285	68,892	44,406	45,703
30-day max	159,984	172,534	215,246	173,684	126,639	172,256	137,381	137,410	161,566	152,041	106,058	99,176



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
30-day min	-	179	-	-	-	13	529	3,091	540	741	667	348
30-day ave	4,822	4,199	4,687	3,293	3,346	8,307	8,150	9,111	8,924	7,316	4,547	4,303
30-day max	14,964	15,167	24,950	15,459	13,423	21,900	17,364	16,056	20,494	17,364	13,700	12,837