EVALUATION REPORT

A Thirty Day Field Experiment of Water Deliveries to Northeast Shark River Slough April -- May, 1984

by

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SUMMARY

From April 19 through May 18, 1984 the South Florida Water Management District (District) conducted a 30 day field test to introduce surface water flow into Northeast Shark River Slough (NESRS) via the S-333 spillway. The test included an extensive data collection effort both in the slough and in the residential and agricultural areas adjacent to the L-31N levee. Weather conditions were very dry prior to and during the test, allowing a very large discharge (on the order of 61,000 acre feet) to be put into the slough during the 30 days.

The water passed into the slough where it was held in surface storage, as indicated by the rise in the water level at the slough recording stations. A large percentage was probably lost due to evapotranspiration and a small amount seeped into the Biscayne aquifer and began to slowly move east.

There was no measurable increase in the water table outside of NESRS related to the opening of S-333. Water levels in the northern portion of Everglades National Park and in the south end of Water Conservation Area 3A fell during the test as a result of the S-333 operation.

The L-31N canal system was shown to have a very large area of influence west of the levee, exerting the dominant man-made influence on water conditions in the residential and agricultural areas of the East Everglades north of C-111.

CONCLUSIONS

1. The G-596 well is not an appropriate indicator of whether water should or should not be introduced into NESRS.

2. The rule curve developed for G-596 is inappropriate considering the design objectives and operational flexibility of the South Dade Conveyance System.

3. Under conditions similar to those applied during the test, strategies to reduce flood risk in the residential and agricultural area of the East Everglades should emphasize the L-31N canal system rather than S-333.

RECOMMENDATION

A wet season demonstration should be conducted for a minimum of 90 days duration, during which S-333 would be operated with the objective of restoring a more natural hydroperiod and overland flow in NESRS.

INTRODUCTION

The Supplemental Appropriations Act, 1984 (PL98-181) authorized a 2-year experimental program of modified water deliveries to Everglades National Park. One feature of a proposed new water delivery scheme for the park is the re-introduction of surface water from the Water Conservation Area system into NESRS. The historical flow pattern was interrupted by the construction of levee L-29 in 1963. The completion of the facilities of the South Dade Conveyance system in 1979 established the capability of releasing water from Water Conservation Area 3A into NESRS through structure S-333 and the L-29 canal along the north side of the Tamiami Trail. (See Figure 1)

In response to a proposal made by Everglades National Park, the Jacksonville office of the Corps of Engineers (Corps) developed a strategy (limited by water conditions in the developed portion of the East Everglades west of L-31N) for introducing flow into the slough. A rule curve was developed based on the water table position at observation well G-596, located off S.W. 136th Street, 1.0 miles west of L-31N. On January 10th the Corps gave the District authority to operate S-333 for the purpose of putting water into NESRS provided the water level at well G-596 was below the level designated by the rule curve (see Figure 2).

Representatives of the south Dade agricultural community expressed opposition to this proposal. Repeated discussions between the District and the agricultural representatives failed to produce an agreement on the use of S-333. The District decided to proceed with a 30-day field test and opened the S-333 spillway at noon on March 14, 1984. Attorneys for the agricultural interests obtained a temporary restraining order in Federal District Court and the gate was closed before 1 PM on March 14. The court, following several hours of hearing, refused to lift the restraining order and instructed both sides to try to reach an understanding on the use of S-333.

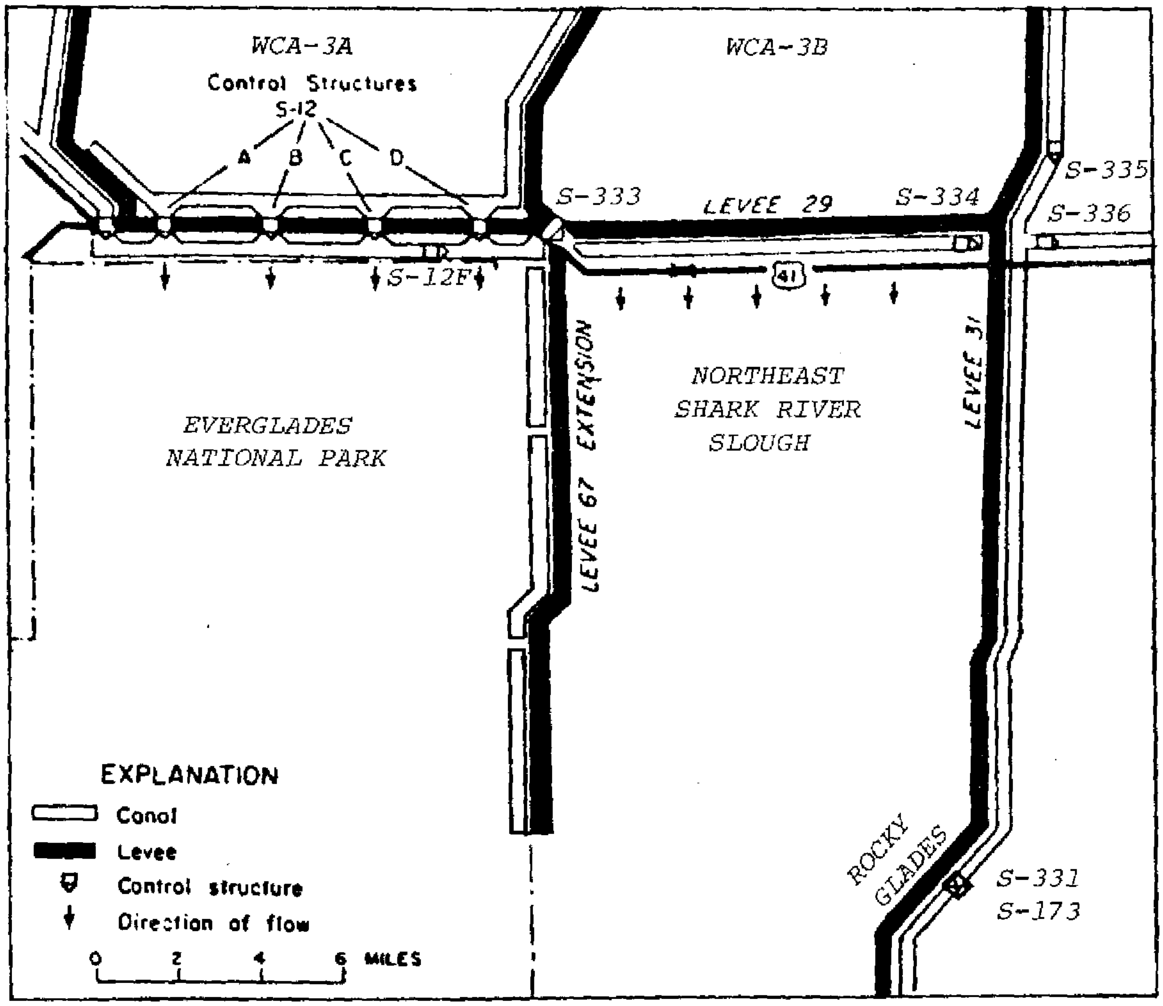

Figure 1. Vicinity Map of S-333 and Northeast Shark River Slough

A formal agreement was signed on April 18 specifying in detail the conditions under which S-333 would be operated during the 30 day test period. On April 19 S-333 was opened and water began to flow from WCA-3A into NESRS.

The purpose of the test was to document the impacts of releasing a large volume of water into NESRS Of particular concern were any measureable effects in the residential area of the Rocky Glades (northwest of S-331) or in the agricultural property along the west side of L-31N. The region east of L-31N was also closely monitored to record any possible rise in the water table associated with the S-333 discharge. Another objective was to assess suitability of the G-596 operating criteria and to determine whether the G-596 well was an appropriate location to use as a decision mechanism for water deliveries into NESRS.

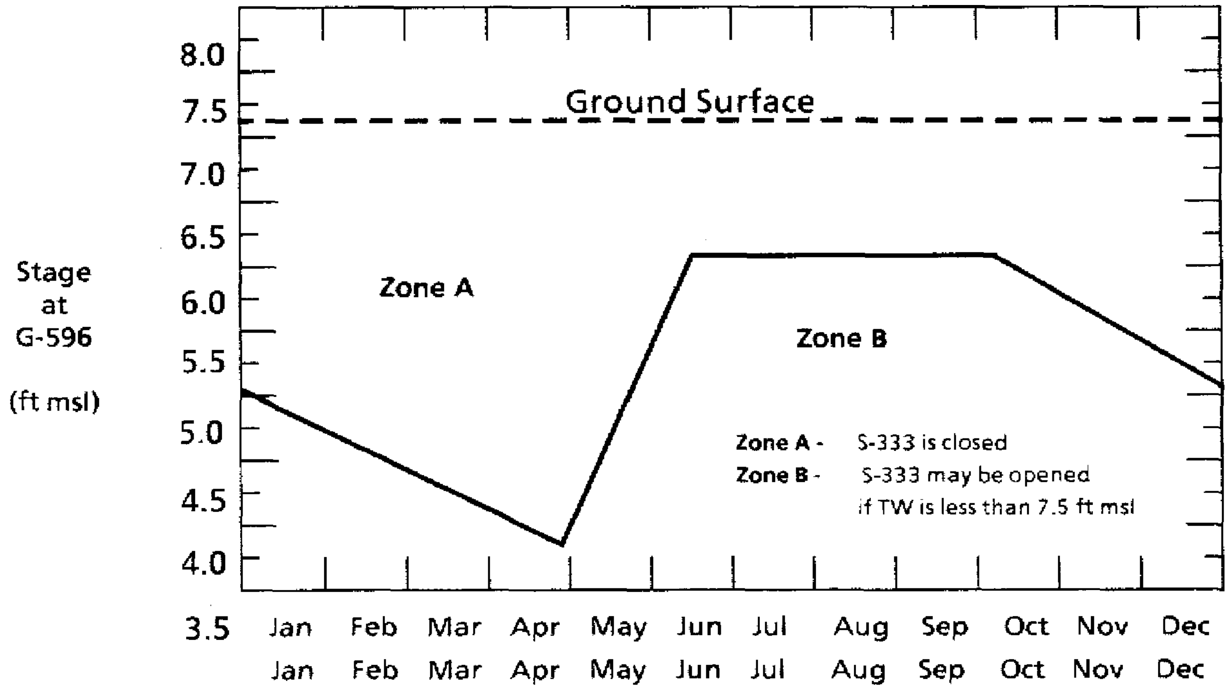

Figure 2. G-596 Schedule as a Restraint to S-333 Discharges

THE AGREEMENT

The agreement signed by attorneys for the District and the Farmers stipulated that S-333 must be operated within the limits of the Corps of Engineers' proposal, specifically:

1. The water level in the L-29 canal along the Tamiami Trail between L-30 and L-67A could not exceed 7.5 feet above sea level, and
2. S-333 must be closed when the water level at well G-596 is above that specified by the Corps rule curve. (Figure 2.)

The District also agreed to check four groundwater wells west of L-31N on a daily basis, and if the water level in any of those wells rose more than 6 inches above its position the day before the structure was opened (April 18), S-333 would be closed. These wells are identified on Figure 3 as Angel's, Mitchell's, 200th Street, and Rutzke's. Limits were also accepted on water levels in several of the south Dade canals which would have required closing S-333 if they were exceeded for more than 24 hours. The constraints at the 4 trigger wells were the most sensitive, however, and these would have required action before the canal levels or the G-596 schedule was exceeded.

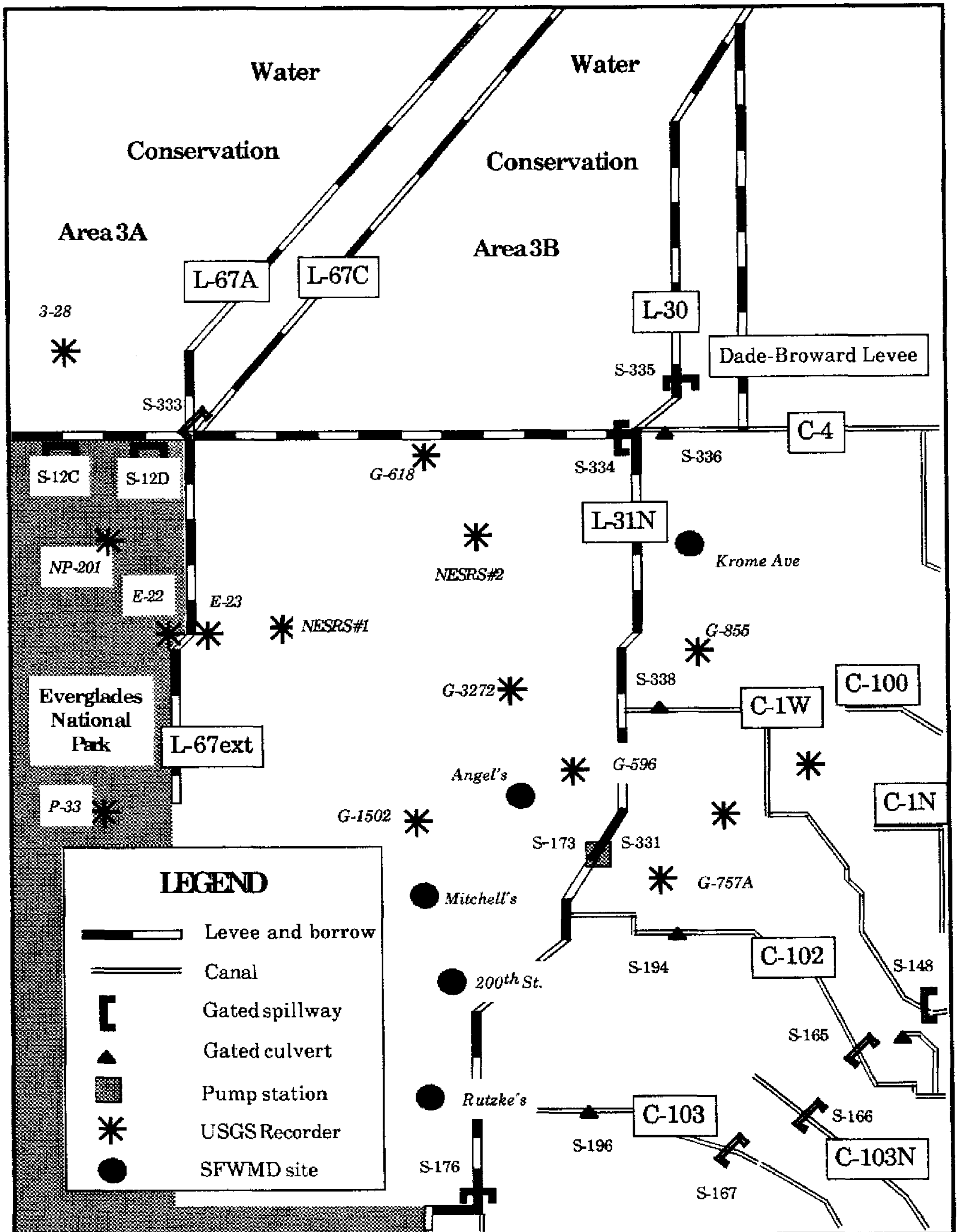

Figure 3. Daily Water Level Monitoring Network.

In addition, an extensive monitoring program was established to provide daily water level information from 20 different recorder locations, several of which could be reached only by airboat. (See Figure 3). Staff gages were installed at two peripheral areas, one in the "Frog Pond" agricultural area and one just east of Krome Avenue, 3 miles south of Tamiami Trail.

The Corps of Engineers made special arrangements to have one of the technicians from their Clewiston office visit the 12 U.S.G.S. (U.S. Geological Survey) recorder sites every day from March 2 through May 18. The water reader from the District's Homestead Field Station visited the four trigger wells and the Frog Pond and Krome Avenue sites every day to check the position of the water table..

RESULTS AND ANALYSIS

In order to keep the interpretation of the test results in proper perspective it is important that several facts be clearly understood. First, the physical processes (except rainfall) that control water movement in the East Everglades are very slow moving phenomena. Evapotranspiration, overland flow through shallow, almost flat marshes, and groundwater flow respond very slowly and no 30-day test could provide definitive answers to all possible ramifications of a long term shift in water delivery policies in the area.

Secondly, the operation of S-333 during the test period is not representative of the District's long term proposal for re-introducing surface flow into NESRS. Very large flow in the driest part of the year certainly does not reflect the historical hydrologic behavior. The dry season was chosen in the hope of obtaining a period of low rainfall that would enable the effects of the S-333 operation to be distinguished from the effects of local rainfall at the monitoring locations. The maximum amount allowable was released to the slough in order to gain as much insight as possible in the 30-day period. The physical laws describing the hydrologic processes are constant and valid conclusions can be made even though their scope may be limited by the data set.

Hydrologic Conditions

The period prior to the test was very dry. There was virtually no rain in south Dade from March 24 until the start of the test on April 19. In order to comply with the G-596 regulation, which reaches its lowest point of 3.8 ft. on May 1, the District had been using S-331 and S-173 to lower the stage in the L-31N canal north of S-331. Under these conditions, with the structures to the north (S-334 and S-335) closed, groundwater from west of L-31N is intercepted by the L-31N canal and directed to the south through S-173/S-331. In periods of little or no rain this causes a steady decline in the water table west of L-31N. Figure 4 shows the hydrologic behavior at several key locations prior to the test.

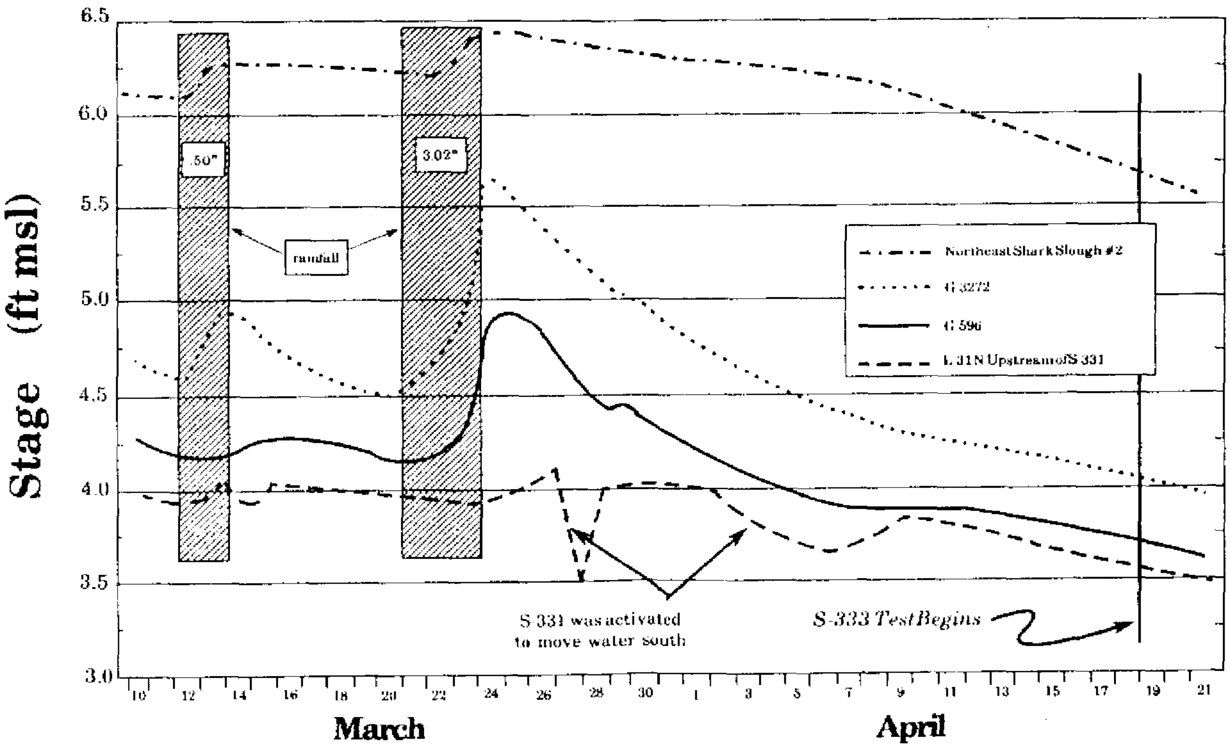

Figure 4. Pre-S-333 Test Conditions. (Note the rapid response to rainfall at all locations and the sharp drop in the L-31N canal upstream of S-331 when the pumps are turned on.)

Water Conservation Area 3A water level was well above average for that time of year with a large volume of water stored in the marsh. The S-12 A, B, and C structures had been open full for the preceding 8 months and water levels in the north end of the park were also well above normal.

The S-333 spillway was opened at 8:30 AM, April 19. The gate was opened in a series of small increments to gradually bring the water level in the L-29 canal to the target level of 7.5 ft. Prior to opening the spillway the stage in L-29 was 6.4 ft. It came up slowly and stabilized near 7.5 ft. on April 24 with a gate opening of 5.5 ft. The U.S.G.S. measured the discharge through the gate on the morning of April 25 and registered 1330 cubic feet per second (cfs).

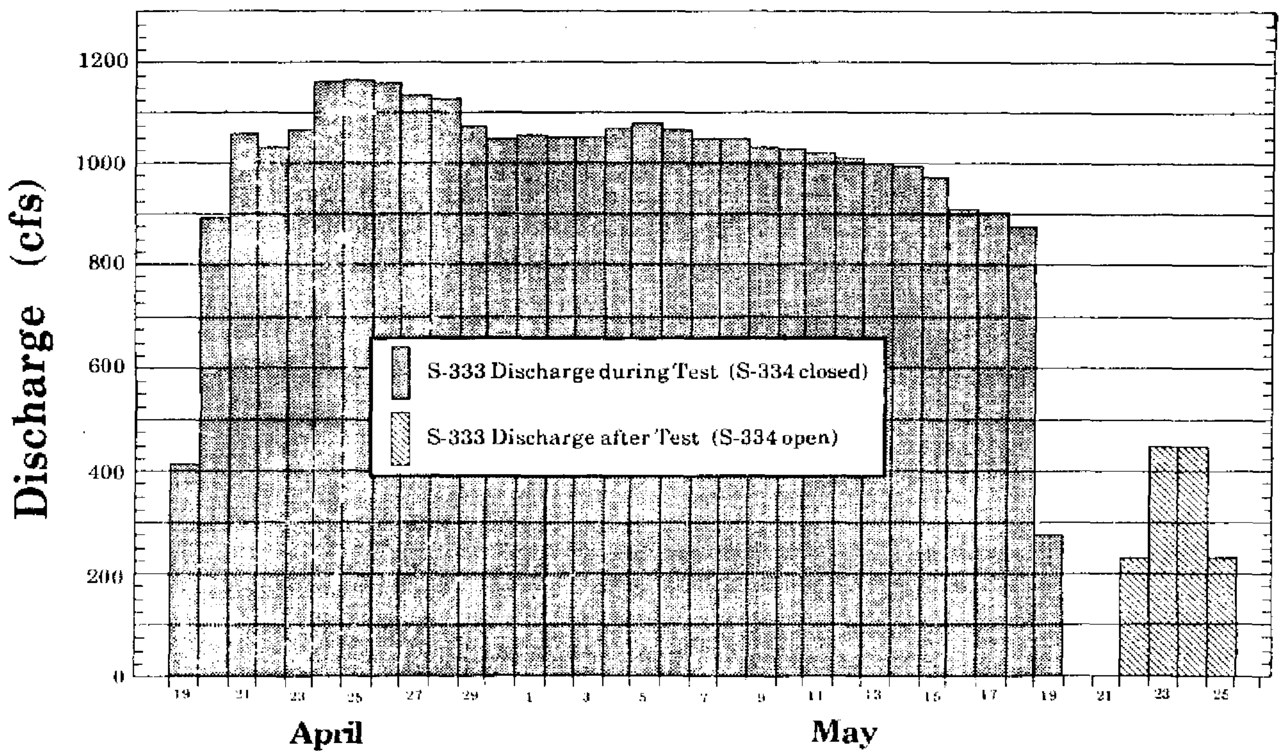

Figure 5. S-333 Discharges During Experiment. (Flow from May 22-25 was for water supply in south Dade and very little went into Northeast Shark River Slough.)

Figure 5 shows the daily discharge rate through S-333 for the 30-day test as computed by the U.S.G.S., based on their original rating curve. The flow measurement on April 25 was 10% to 15% higher than that predicted by the U.S.G.S. rating curve for the structure. A total volume of 61,000 acre feet was passed into NESRS during the 30-day test according to U.S.G.S calculations. The dry rainfall conditions that preceded the test continued for 3 weeks after the gate was opened (see Figure 6). Although there was over an inch of rain on May 16, the water levels never approached the point that would have required the gate to be closed to comply with the agreement.

Northeast Shark River Slough

The only stations downstream of S-333 to show any response to the flow through the spillway were those in the L-29 canal and in the slough itself. Figure 7 presents the response of several slough gages during the test. Gage G-618 is directly south of

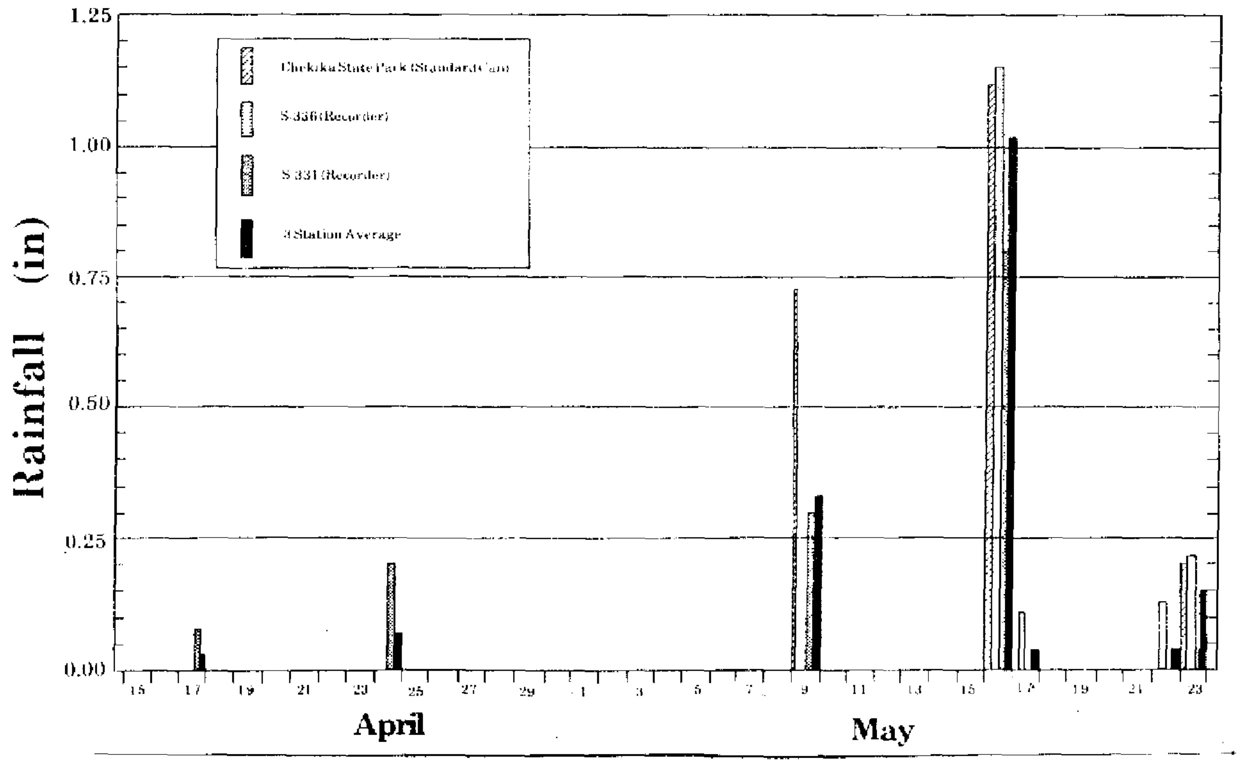

Figure 6. Rainfall During S-333 Discharge Experiment

the Tamiami Trail and responds quickly to changes in the level in the L-29 canal. It reached a level of 6.8 ft. 6 days into the test and remained stable throughout the remainder of the 30 day period. There was a constant head loss of 0.7 ft. maintained across the Tamiami Trail once the level in L-29 stabilized at 7.5 ft. In other words, the water level on the south side of the highway was 0.7 ft. lower than the level of the canal, or approximately 6.8 ft. The NESRS #2 gage began to respond after 5 days and the NESRS #1 gage rose after 13 days. The G-3272 gage did not rise in response to the S-333 release, but, instead, tracked very close to the L-31N canal stage and rose only in response to rainfall. This gage is located in a transition area between the slough and the Rocky Glades residential area (refer to Figure 3 for all gage locations). If flow through S-333 were to cause a rise in the water levels in the residential area west of L-31N, well G-3272 would be the first well in the area to show an increase.

Mathematical analysis (see Appendix A) was used to compare the relative velocities of overland flow in the slough and subsurface flow in the Biscayne aquifer. Using the conditions on May 15, 25 days into the test, the estimated surface flow rate between the NESRS #2 gage and the NESRS #1 gage was 720 ft. per day. On the same day the flow velocity in the aquifer between the NESRS #2 gage and gage

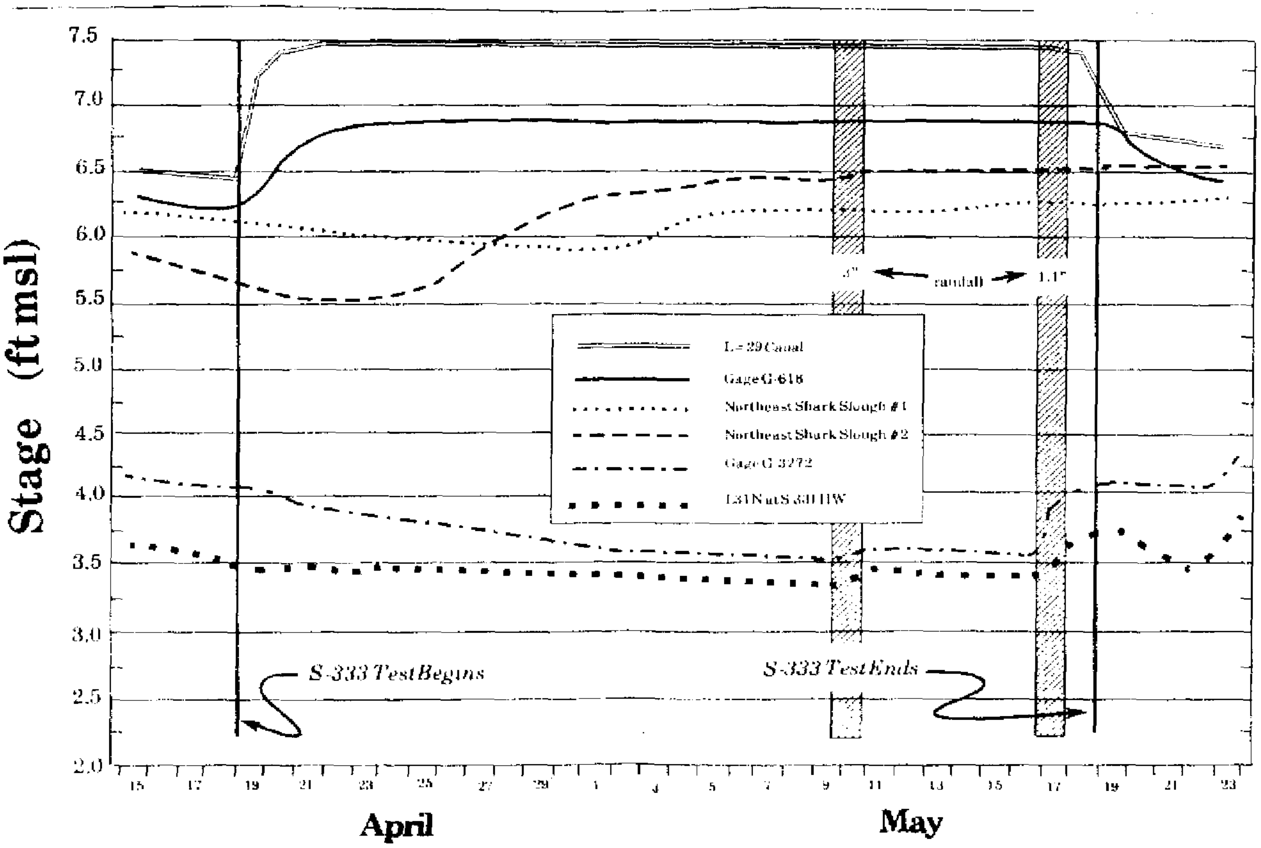

Figure 7. Water Surface Elevations at Selected Stations in the East Everglades. (The Northeast Shark River Slough surface water gages all showed marked increases, while the groundwater monitoring points showed no change due to S-333.)

G-3272 was computed at 1.5 ft. per day. Discharge computations were made through cross sections in the slough and in the aquifer to compare actual flow rates in the two areas (see Figure A1). A rate of 884 cfs was computed for the surface flow in NESRS, while total flow towards the Rocky Glades in the aquifer was estimated as 164 cfs. These are instantaneous rates valid for May 15, 1984 and are not necessarily representative of long term behavior in the area. However, they do indicate the dominance of the slough system and support the conclusion that a 30-day period is not adequate to document groundwater response.

Surface flow in the slough was virtually zero before the test while the groundwater flow rate was probably on the order of 50-100 cfs even with S-333 closed.

The Rocky Glades

For the purposes of this report the Rocky Glades refers to the residential and agricultural areas west of L-31N. Most of the homes are to the north and west of Pump Station S-331 within a radius of 3 miles. While there is some agriculture in the residential area most of the large operations are south of S-331 and within 2 miles of the L-31N levee. Mitchell's mango grove (directly south of Chekika State Park) is the farthest west of any farmed area, 3 to 4 miles west of the L-31N levee.

All four trigger wells and an additional four U.S.G.S. groundwater observation wells are located in the Rocky Glades. There was no measurable rise in any of these wells that could be attributed to the discharge through S-333. However, the influence of the L-31N canal on the groundwater west of the L-31N levee was visible at every one of the wells, which range from 1 to 4.5 miles distant from the canal. The water table continued to fall, even after it was below the root zone, until it approached the level of the L-31N canal and stabilized near that level. Figures 8 and 9 show the

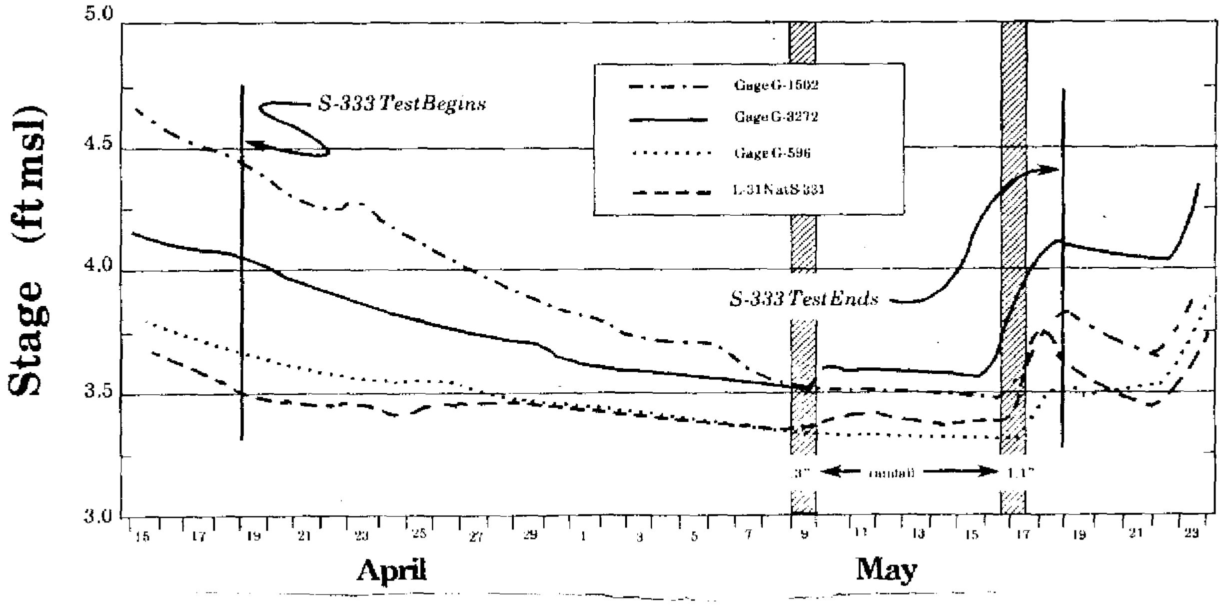

Figure 8. Groundwater Stages in the Rocky Glades west of L-31N. (All gages follow the L-31N stage closely and show no increase traceable to S-333 activity.)

water table activity recorded in the Rocky Glades during the 30 day test.

Higher levels in NESRS have the potential to increase flow to the east in the Biscayne aquifer. This flow would be intercepted by the L-31N canal and result in either higher levels in the canal or greater discharges through S-173 and S-331 to maintain a steady level in the canal. This behavior was not observed during the field test. Figure 10 shows this graphically. The canal stage fell throughout the test period and the discharge to the south remained fairly constant at 200 to 250 cfs.

This data supports the conclusion that using well G-596 to decide whether S-333 can be opened does not make sense hydrologically. The 30 day test failed to demonstrate any connection between S-333 discharge and water levels in the Rocky

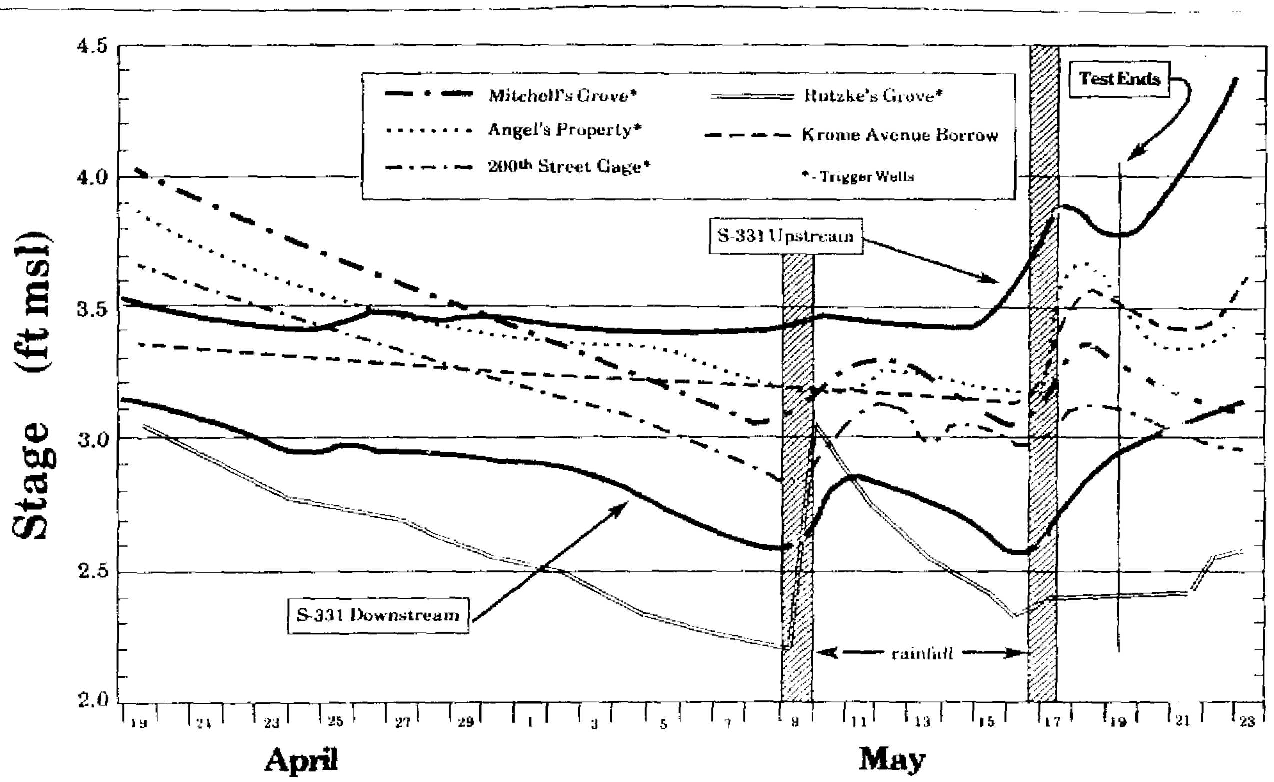

Figure 9. Hydrologic Response of New Monitoring Points Established for the Test. (Rutzke's Grove is 7 miles south of S-331 and the water table is controlled by the L-31N canal north of S-176. The water table in the Frog Pond is controlled by the L-31W and C-111 canals.)

Glades area west of L-31N. It is likely that over a longer period of time the water table in the Rocky Glades may show some response to higher levels in the slough. However, the test conditions which raised the level in the slough and lowered it in L-31N, favored an exaggerated movement of groundwater to the east. In spite of this there was no observable rise in water level in the Rocky Glades as a result of the S-333 discharge. Under wet season conditions there would be less difference between levels in the slough and the Rocky Glades, and any water movement to the east would be even slower. A wet season field test will require a longer duration (at least 90 days) to provide useful data to evaluate the impacts of water deliveries to NESRS.

One feature that was clearly demonstrated by the test is the hydraulic connection between the L-31N canal and the Biscayne aquifer. The canal is between 75 and 100 feet wide and 20 feet deep. It cuts through one of the most permeable sections of the formation. Every trigger well and all the monitoring sites in the Rocky Glades

S-12C fell from 8.91 on April 18 to 8.03 on May 23, a difference of 0.88 ft. The flow into the park from the S-12 structures fell from 659 cfs to 85 cfs during the same period. The flow through the S-12 structures dropped by over 20% in the 5 days it took to bring the L-29 canal up to the level of 7.5 ft msl.

The water that flowed into NESRS during the test did not reach any park gages within the 30 days. However the reduction in flow through the S-12 structures affected the north end of the park almost immediately (see Figure 12).

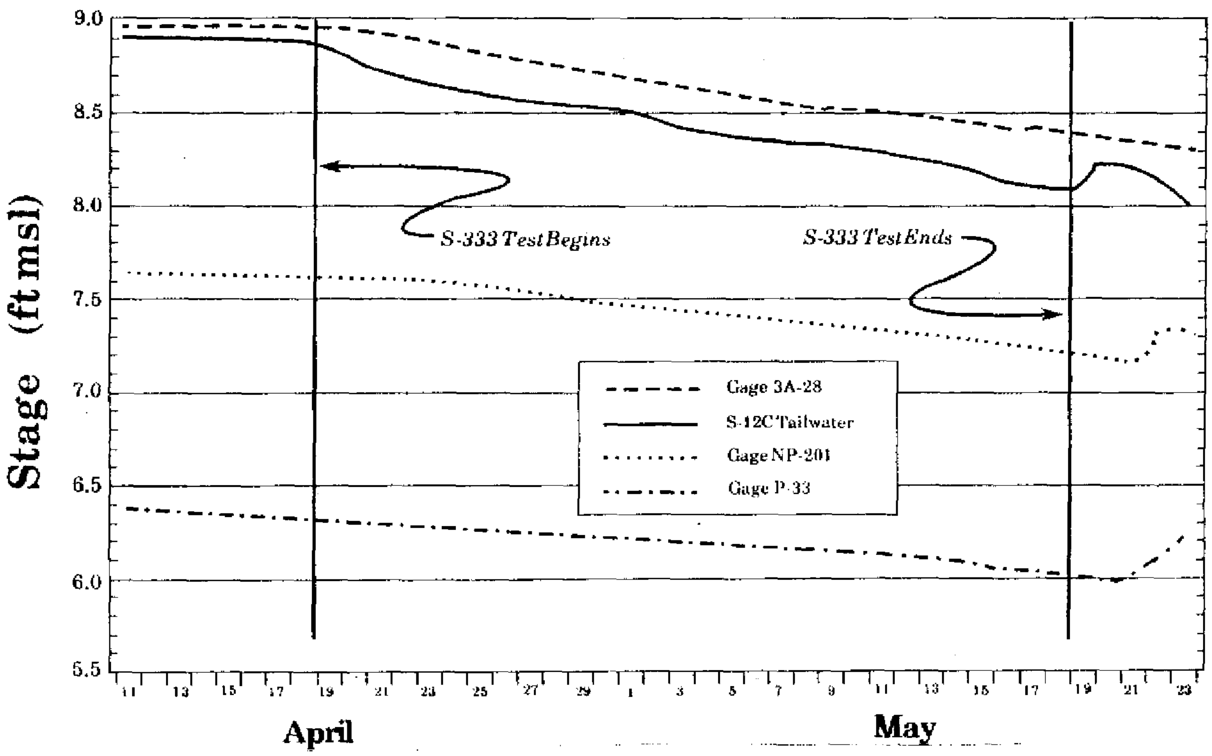

Figure 12. The S-12 structures control flow from WCA-3A into Everglades National Park. (Gage NP-201 is 3 miles south of the Park boundary, and shows a distinct increase in recession rate caused by the S-333 test. P-33, about 10 miles south of the S-12 structures, shows no obvious changes caused by the test.)

Approximately one week after the start of the test the water level at gage NP-201, 3 miles south of Tamiami Trail, began a steeper recession rate that can only be explained by the reduction in flow coming from the north. These data support the conclusion that S-333 can be very effective in reducing the total flow through the S-12 structures when there is storage available in NESRS.

Appendix A

Computation of Relative Velocities

Conditions on May 15, 1984 were used to estimate flow velocities using standard mathematical procedures and the best data available on the physical properties affecting flow.

<u>1). Overland Flow Velocity in Northeast Shark River Slough</u>

NESRS #1	6.29 ft msl	distance = 27,200 ft
NESRS #2	6.52 ft msl	

Energy gradient can be computed by

$$S = \frac{\partial h}{\partial x}$$

Substitution yields

$$S = \frac{(6.52 - 6.29)\,ft}{27{,}200\,ft} = 8.46\,X\,10^{-6}$$

Manning's Equation can be applied to compute approximate velocities in the slough

$$V = \frac{1.49}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

where

V = velocity (ft per second)
R = hydraulic radius (feet)
S = energy gradient
n = Manning's "n", and for a saw grass slough, can be defined as [US Army Corps of Engineers, 1955]

$$n = .45R^{-.77}$$

Substitution for Manning' s "n" will yield

$$V = 3.31R^{1.44}S^{\frac{1}{2}}$$

With a bottom slough elevation of 5.5 ft msl, velocity on May 15 can be approximated as

$$V = 3.31(.9)^{1.44}(8.46\,X\,10^{-6})^{\frac{1}{2}} = .00832\ \frac{ft}{sec} = 719\ ft/day$$

<u>2). Groundwater Velocity</u>

NESRS #2	6.52 ft msl	distance = 21,300 ft
G-3272	3.57 ft msl	

Permeability is defined as

$$k = \frac{T}{H}$$

where
T = Transmissivity (ft^2 per second)
H = aquifer depth (ft)

The following aquifer characteristics are used:
T = 4.5 MGD / ft [Appel, 1973]
H = 50 ft [Schroeder, 1974]

This gives a permeability of

$$k = \frac{4.5\,X10^6\,gals}{50\,ft{\cdot}day{\cdot}ft} \cdot \frac{1\,ft^3}{7.481\,gals} \cdot \frac{1\,day}{24{\cdot}3600\,secs} = .1395\,\frac{ft}{sec}$$

Darcys Law can be applied to approximate the velocity through a porous medium

$$V_x = -k\,\frac{dh}{dx}$$

Substitution gives

$$V = .139\,\frac{ft}{sec} \cdot \frac{(6.52 - 3.57)\,ft}{21{,}300\,ft} = 1.69\,X\,10^{-5}\,\frac{ft}{sec} = 1.46\,\frac{ft}{day}$$

3). Volume Flow Rates

To determine actual volume flow rates in the slough and the aquifer, water level contours were drawn over a topo map of NESRS (USGS, 1979). Conditions on May 15th were used and lines were drawn representing the 3.5 ft., 6.0 ft., 6.3 ft. and 6.5 ft. levels. Flow sections were chosen and Manning's Equation and Darcy's Law were applied using the best available data. The approximate position of the sections is shown in Figure A1. The overland flow sections were aligned between the 6.5 ft. and 6.3 ft. contours since gage readings confirming these two levels were available. The groundwater flow was calculated between the 3.5 ft. and the 6.0 ft. contours. The 6.0 ft. contour was taken to roughly follow the 6.0 ft. topo line except near the northwest corner where it was drawn closer to L-31N. Gage readings were available to place the 3.5 ft. contour. Tables A1 and A2 summarize the individual terms used to compute flow in each section.

Total surface flow was found to be 884 cfs while groundwater flow was calculated at 164 cfs.

TABLE A1 Overland Flow

Section #	R (ft)	S (10^{-5})	L (ft)	Q (cfs)
OV1	.78	3.24	8700	63
OV2	1.15	3.53	8300	228
OV3	1.4	3.24	7700	330
OV4	1.15	3.24	7200	190
OV5	.65	4.88	9040	73

L = Approximate Width of the Section

TABLE A2 Groundwater Flow

Section #	T (MGD)	H (ft)	L (ft)	S ($x10^{-4}$)	Q (cfs)
GW1	4	38	18,503	2.58	26
GW2	6	43	22,100	1.87	38
GW3	8	50	9,040	2.17	24
GW4	8.2	53	12,330	4.86	76

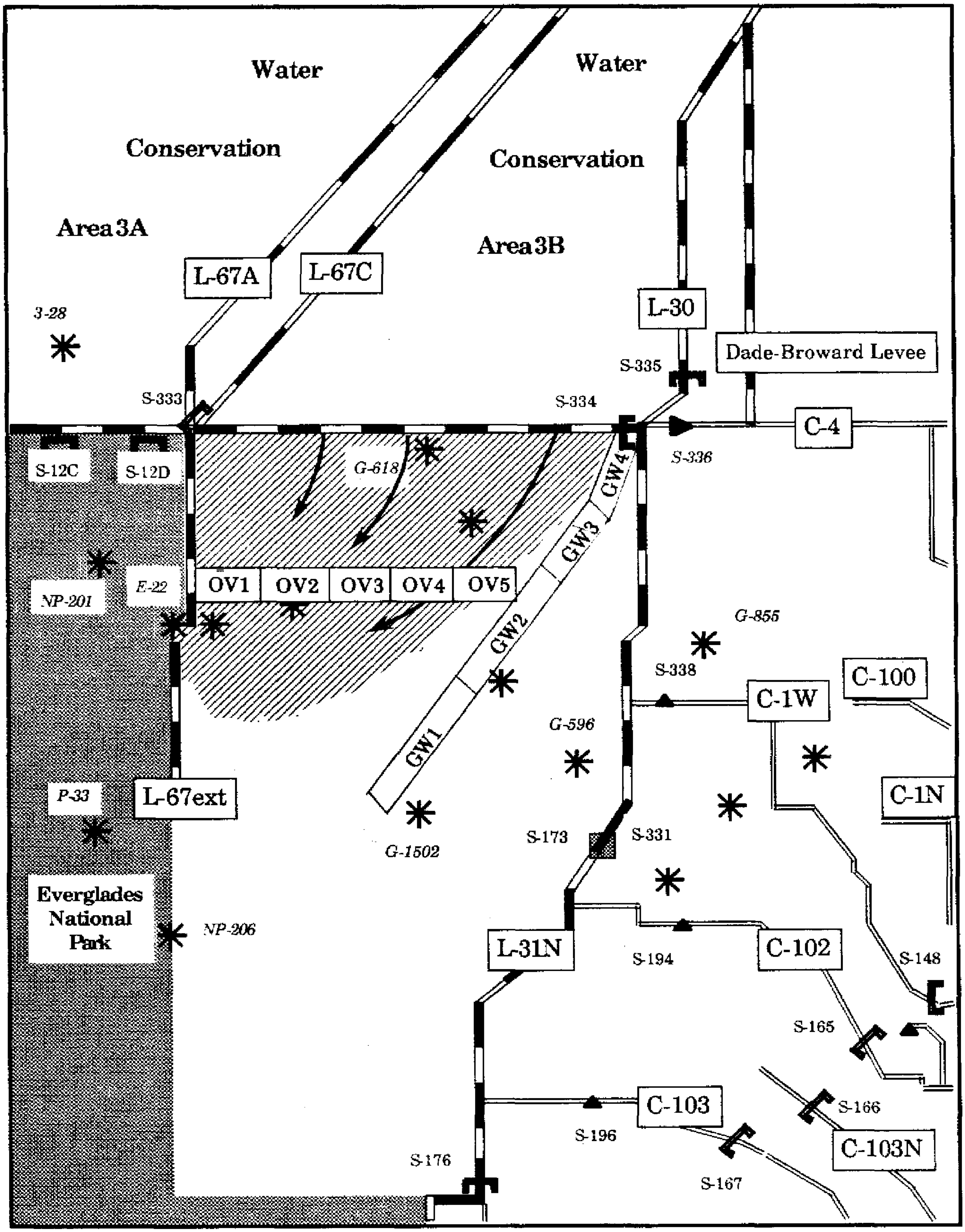

Figure A1. Approximate Extent of Surface Water Spreading as a Result of Test and Location of Cross Sections Used in Flow Volume Calculations.

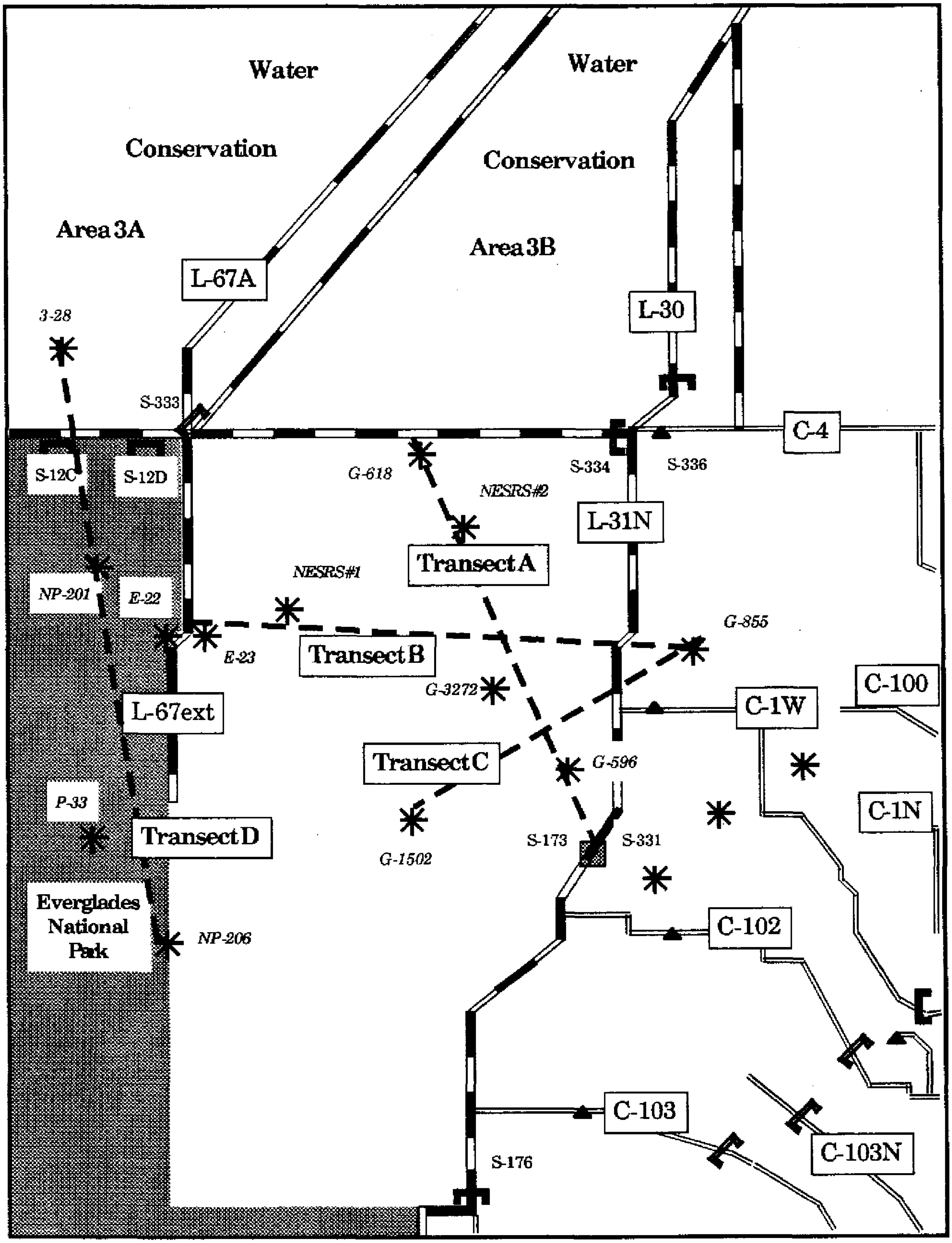

Figure A2. Location of Transects Depicted in Figures A3 Through A6.

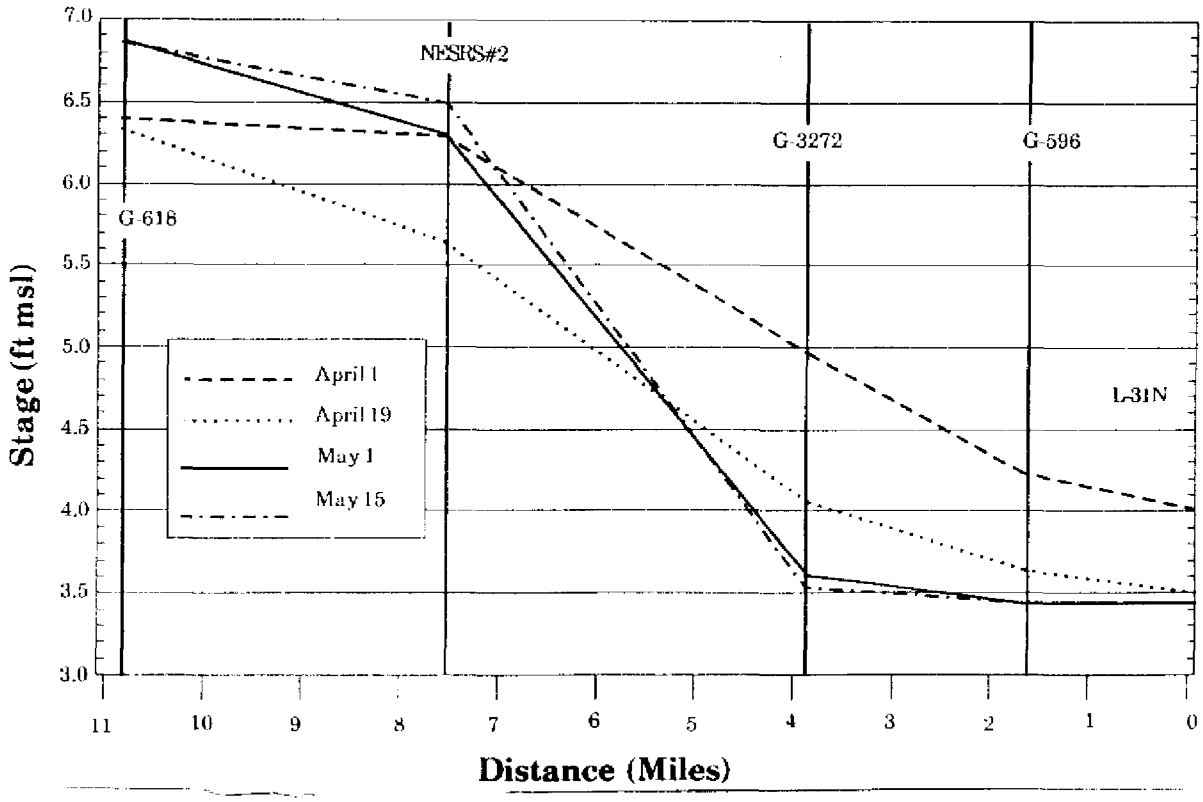

Figure A3. Transect A, from the center of the slough through the Rocky Glades.

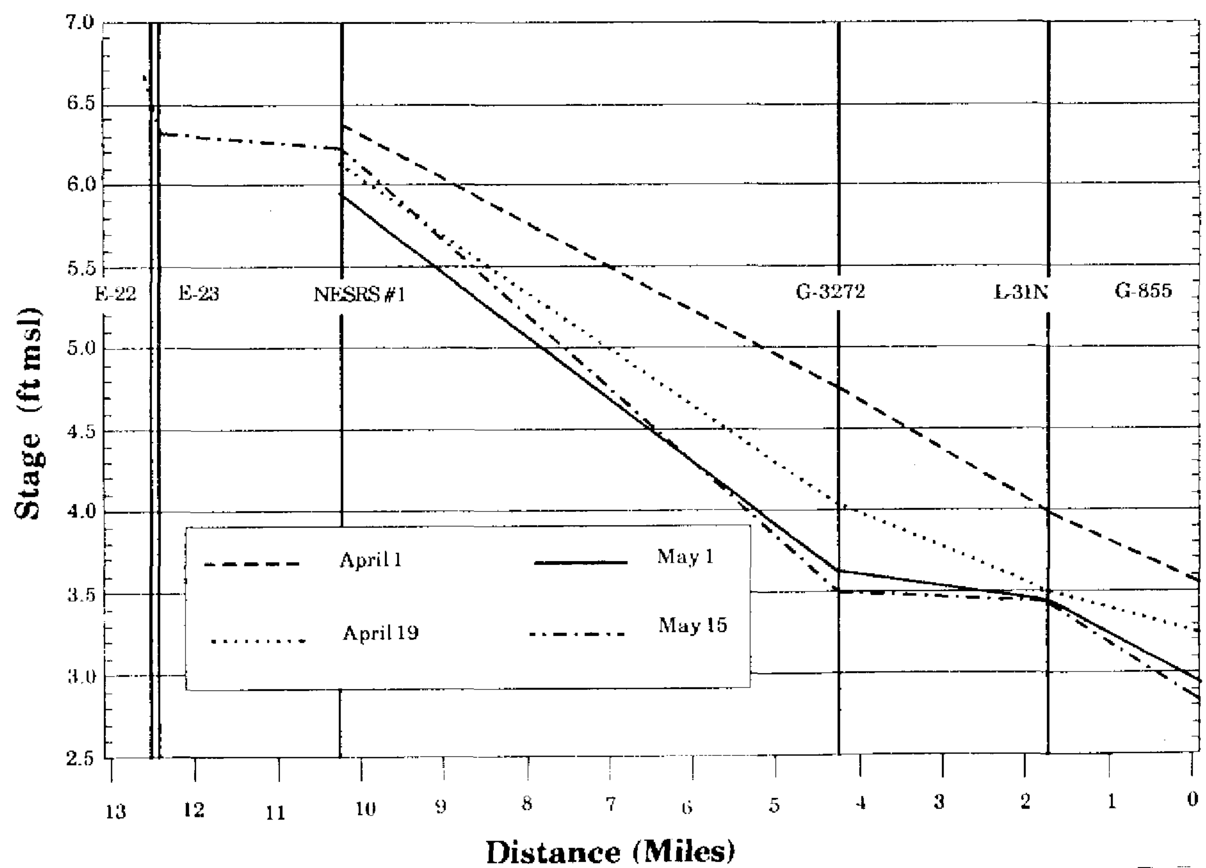

Figure A4. Transect B, through Northeast Shark River Slough from L-67ext to well G-855 (east of L-31N)

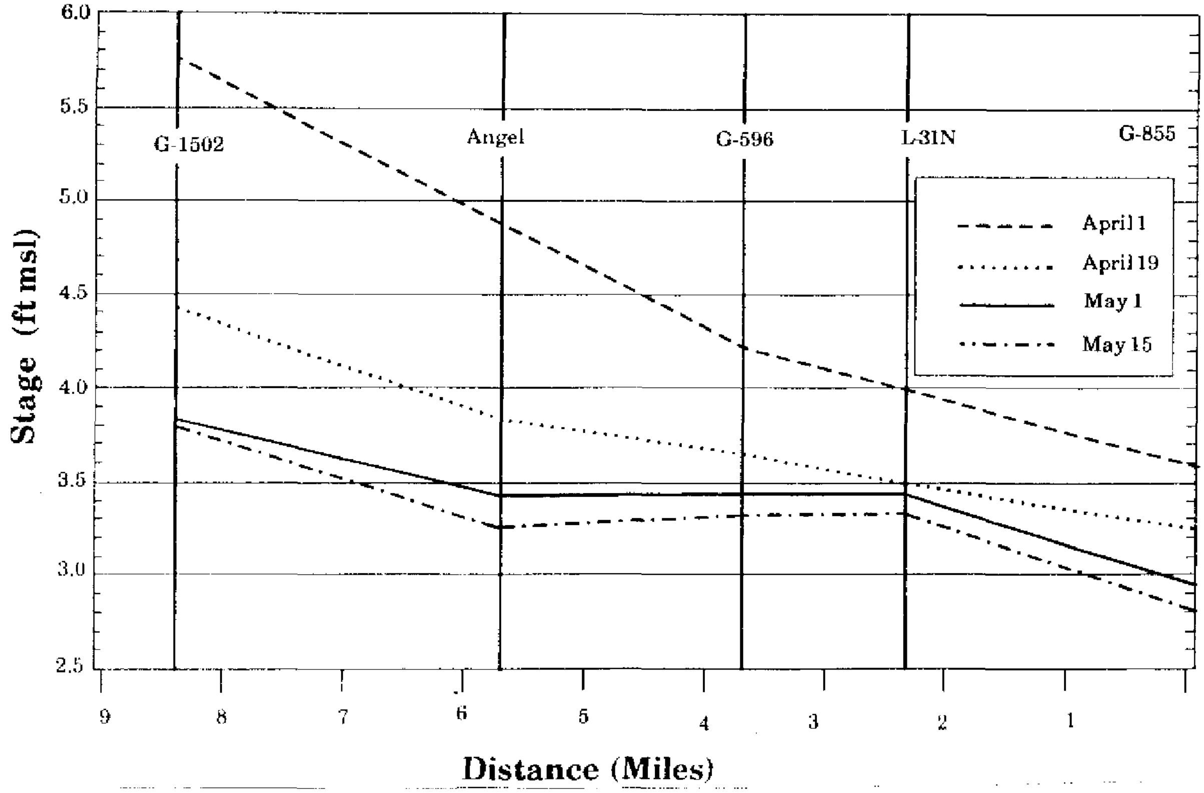

Figure A5. Transect C, through the Rocky Glades residential area.

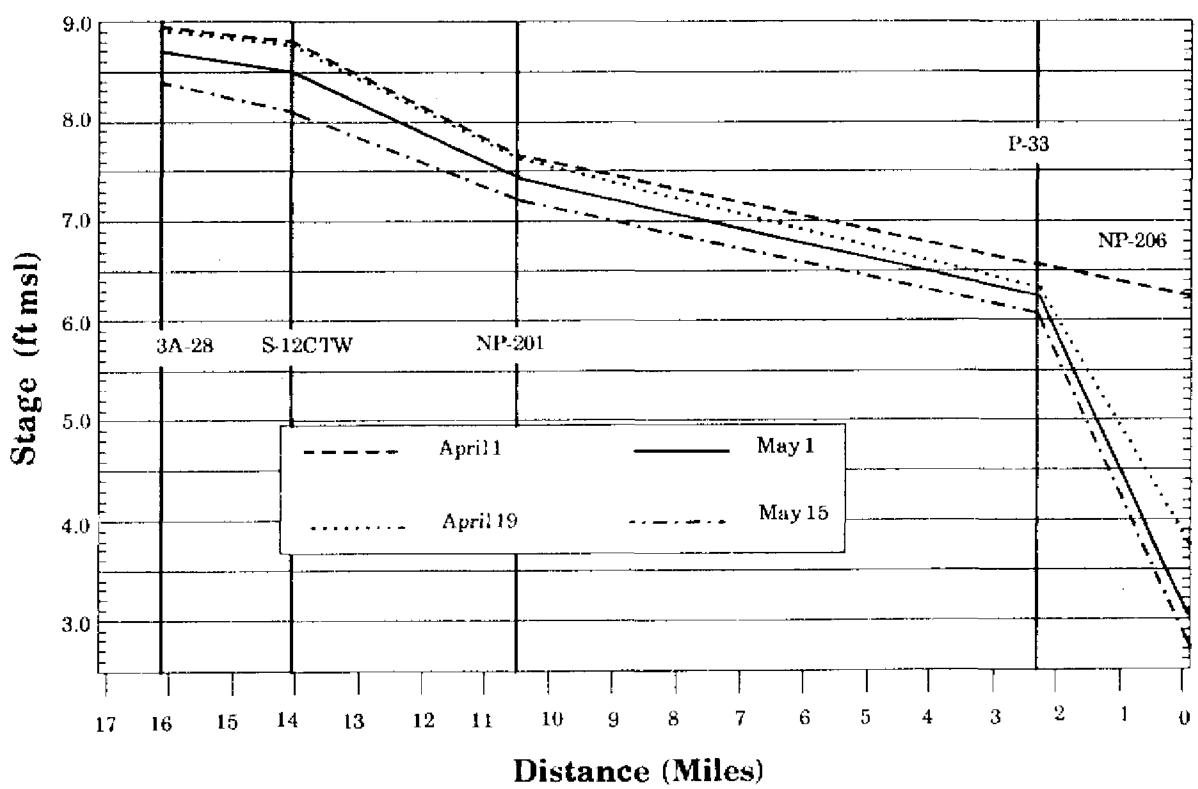

Figure A6. Transect D, from the south end of WCA-3A through the center of Shark River Slough in Everglades National Park.

TABLE A3

Date	Frog Pond	Rutzke	200th St	Mitchll	Angels	Krome Ave
April 19	2.62	3.01	3.61	3.99	3.85	3.33
20	2.61	2.97	3.53	3.92	3.80	3.33
21	2.57	2.93	3.49	3.84	3.75	3.28
22						
23	2.48	2.80	3.47	3.74	3.65	3.31
24	2.50	2.78	3.43	3.69	3.61	3.26
25	2.42	2.74	3.39	3.63	3.59	3.26
26	2.36	2.72	3.34	3.63	3.56	3.28
27	2.21	2.72	3.30	3.59	3.54	3.28
28	2.15	2.68	3.26	3.53	3.50	3.28
29	2.07	2.59	3.24	3.49	3.48	3.28
April 30	2.00	2.55	3.20	3.42	3.45	3.28
May 1	1.98	2.55	3.18	3.38	3.42	3.24
2	1.92	2.53	3.16	3.34	3.40	3.26
3	1.86	2.47	3.11	3.30	3.36	3.26
4	1.78	2.36	3.07	3.22	3.33	3.24
5	1.73	2.34	3.01	3.22	3.33	3.23
6	1.69	2.30	2.99	3.15	3.27	3.22
7	1.67	2.26	2.95	3.09	3.24	3.20
8	1.62	2.21	2.93	3.05	3.21	3.19
9	1.58	2.18	2.86	3.05	3.18	3.15
10	2.27	3.05	2.93	3.22	3.18	3.17
11	2.14	2.80	3.09	3.34	3.23	3.18
12	2.04	2.68	3.11	3.30	3.23	3.18
13	2.0	2.55	2.93	3.26	3.23	3.18
14	1.90	2.49	3.05	3.15	3.21	3.17
15	1.80	2.41	3.05	3.09	3.19	3.15
16	1.73	2.2	2.97	3.03	3.17	3.17
17	1.68	2.39	2.97	3.32	3.60	3.62
18	1.73	2.43	2.97	3.34	3.61	3.52
19						
20						
21	1.71	2.39	2.97	3.15	3,48	3.37
22	2.28	2.53	2.95	3.11	3.46	3.54
23	2.45	2.57	2.97	3.09	3.50	3.68
24	2.58	2.76	2.97	3.30	3.65	3.83
25	2.67	2.83	3.20	3.51	3.78	3.92
26	3.05	3.96	5.01	5.36	5.14	4.34
27	5.15	3.96	6.97	6.51	6.68	5.36
28	5.21	4.21	6.89	6.59	6.76	5.48
29	5.09	4.21	6.86	6.65	6.84	
30	4.54	4.72	6.86	6.67	6.88	5.60
May 31	4.47	4.68	6.91	6.78	6.73	5.88

Daily Readings at Spcial Observation Wells
Established By S.F.W.M.D.

TABLE A4

Date	NE #1	NE #2	G-3272	G-1502	G-596	G-757A	S-333		S-334*		G-618	G-196A	G-1363	G-855	E-22	E-23	S-173
							HW	TW	HW	TW							HW
March 1	6.36	6.34	5.61	5.73	5.30	4.14	9.01	6.54			6.43	3.47	3.76	4.41			4.73
2	6.35	6.33	5.48	5.66	5.13	4.12	9.00	6.53	6.60	4.85	6.42	3.46	3.73	4.30			4.60
3	6.34	6.32	5.38	5.60	4.98	4.10	8.99	6.53	6.60	4.75	6.41	3.44	3.71	4.21			4.54
4	6.33	6.31	5.28	5.54	4.87	4.05	8.98	6.53	6.65	4.75	6.40	3.40	3.67	4.13			4.13
5	6.32	6.29	5.19	5.48	4.78	4.00	8.96	6.52			6.39	3.34	3.63	4.07			4.42
6	6.31	6.28	5.13	5.40	4.70	3.95	8.94	6.51	6.67	4.75	6.38	3.32	3.58	4.01			4.08
7	6.30	6.26	5.01	5.33	4.56	3.93	8.94	6.48	6.65	4.35	6.37	3.29	3.55	3.92			4.07
8	6.28	6.24	4.91	5.27	4.45	3.90	8.94	6.48	6.68	4.45	6.36	3.27	3.52	3.84			4.18
9	6.27	6.23	4.81	5.19	4.38	3.92	8.92	6.48	6.60	4.30	6.34	3.28	3.51	3.74			4.00
10	6.26	6.21	4.74	5.13	4.31	3.92	8.90	6.47	6.55	4.30	6.33	3.28	3.52	3.68			3.97
11	6.25	6.19	4.66	5.08	4.25	3.91	8.89	6.46	6.52	4.28		3.30	3.52	3.66			3.94
12	6.24	6.17	4.60	5.04	4.20	3.91	8.87	6.46	6.54	4.30		3.30	3.57	3.63			3.90
13	6.38	6.31	4.93	5.42	4.21	3.93	8.96	6.60	6.74	4.41		3.34	3.57	3.69			4.03
14	6.38	6.32	4.93	5.43	4.24	3.97	8.98	6.60	6.69	4.30		3.43	3.63	3.70			3.88
15	6.36	6.31	4.83	5.40	4.26	3.97	8.96	6.58	6.66	4.85		3.47	3.66	3.70			4.04
16	6.35	6.29	4.75	5.30	4.26	3.96	8.95	6.55	6.70	4.32		3.47	3.67	3.66			4.05
17	6.34	6.28	4.66	5.24	4.25	3.90	8.94	6.53	6.70	4.30		3.42	3.66	3.63			4.02
18	6.33	6.26	4.61	5.16	4.21	3.86	8.93	6.52	6.70	4.25		3.38	3.63	3.59			3.99
19	6.32	6.24	4.55	5.09	4.18	3.84	8.91	6.52	6.65	4.28		3.34	3.60	3.57			3.96
20	6.30	6.22	4.49	5.03	4.15	3.82	8.88	6.51	6.50	4.30		3.30	3.53	3.54			3.97
21	6.34	6.22	4.74	5.47	4.18	3.86	8.91	6.54	6.20	4.30		3.37	3.55	3.51			4.01
22	6.33	6.20	4.74	5.44	4.21	3.88	8.90	6.54	6.50	4.30		3.39	3.59	3.51			3.95
23	6.40	6.29	5.67	6.06	4.46	3.95	8.99	6.63	6.70	4.20		3.60	3.84	4.07			3.91
24	6.52	6.45	5.67	6.07	4.89	4.08	9.10	6.69	6.80	4.85		3.77	4.05	4.15			3.98
25	6.51	6.44	5.62	6.07	4.93	4.08	9.09	6.65	6.75	4.72		3.76	4.05	4.13			4.05
26	6.50	6.43	5.49	6.03	4.90	4.01	9.08	6.63				3.63	3.96	4.01			4.11
27	6.48	6.41	5.35	5.96	4.75	4.00	9.06	6.62	6.72	3.90	6.50	3.60	3.84	3.80			3.50
28	6.46	6.39	5.20	5.90	4.51	4.00	8.97	6.60	6.80	4.24	6.50	3.56	3.81	3.69			4.00
29	6.44	6.37	5.04	5.84	4.42	3.98	8.99	6.52	6.74	4.44	6.48	3.52	3.76	3.67			4.04
30	6.41	6.35	4.94	5.71	4.34	3.98	9.02	6.56	6.75	4.18	6.46	3.49	3.73	3.65			4.00
March 31	6.39	6.33	4.83	5.62	4.28	3.96	9.03	6.55	6.70	4.18	6.45	3.45	3.69	3.62			4.00

MARCH . Average Daily Water Table Position at Key Monitoring Wells (referenced to mean sea level).

*daily water readings

TABLE A5

Date	NE #1	NE #2	G-3272	G-1502	G-596	G-757A	S-333		S-334*		G-618	G-196A	G-1363	E-22*	E-23*	G-855	S-173*
							HW	TW	HW	TW							HW
April 1	6.38	6.31	4.77	5.56	4.24	3.93	9.03	6.55	6.70	4.28	6.43	3.41	3.65			3.59	3.99
2	6.36	6.29	4.70	5.48	4.21	3.90	9.02	6.57	6.75	4.20	6.42	3.36	3.62			3.57	3.99
3	6.35	6.27	4.65	5.38	4.16	3.85	9.00	6.53	6.70	4.10	6.40	3.31	3.57			3.53	3.78
4	6.34	6.26	4.59	5.32	4.10	3.81	9.01	6.52	6.72	4.10	6.40	3.26	3.52			3.48	3.70
5	6.34	6.25	4.55	5.30	4.03	3.80	9.07	6.50	6.73	4.08	6.40	3.29	3.50			3.45	3.72
6	6.32	6.22	4.47	5.24	3.98	3.79	9.06	6.50	6.70	3.90	6.38	3.28	3.49			3.42	3.64
7	6.30	6.20	4.42	5.14	3.93	3.77	9.04	6.49	6.75	3.80	6.37	3.25	3.48			3.38	3.70
8	6.29	6.16	4.36	5.07	3.89	3.73	9.03	6.49	6.70	3.85	6.35	3.20	3.46			3.35	3.76
9	6.27	6.13	4.32	5.01	3.87	3.69	9.00	6.48	6.72	3.84	6.33	3.16	3.42			3.33	3.83
10	6.27	6.10	4.27	4.94	3.89	3.62	9.01	6.45	6.70	4.00	6.32	3.08	3.36			3.32	3.80
11	6.25	6.05	4.26	4.88	3.88	3.57	9.02	6.44	6.60	3.90	6.31	3.02	3.29			3.30	3.80
12	6.24	6.02	4.24	4.83	3.87	3.50	9.02	6.44	6.58	3.88	6.30	2.96	3.23			3.29	3.80
13	6.24	5.98	4.22	4.78	3.86	3.45	9.02	6.43	6.65	4.00	6.29	2.90	3.17			3.28	3.71
14	6.24	5.93	4.21	4.73	3.83	3.39	9.01	6.41	6.40	3.95	6.27	2.91	3.11			3.26	3.68
15	6.22	5.88	4.18	4.67	3.80	3.39	9.01	6.39	6.45	3.90	6.26	2.90	3.10			3.26	3.65
16	6.20	5.82	4.15	4.61	3.79	3.37	9.02	6.36	6.50	3.82	6.25	2.88	3.09			3.27	3.62
17	6.18	5.76	4.09	4.52		3.34	9.02	6.35	6.55	3.76	6.22	2.85	3.04			3.27	3.59
18	6.17	5.72	4.07	4.49	3.70	3.32	9.02	6.35	6.48	3.72	6.20	2.81	2.99			3.25	3.58
19	6.16	5.66	4.06	4.43	3.67	3.26	8.96	6.68	6.70	3.68	6.56	2.75	2.92	7.15	6.36	3.23	3.50
20	6.14	5.59	4.01	4.35	3.63	3.21	8.84	7.16	7.23	3.66	6.77	2.70	2.87			3.22	3.45
21	6.12	5.54	3.95	4.29	3.62	3.16	8.76	7.32	7.42	3.72	6.80	2.66	2.83			3.19	3.45
22	6.10	5.52	3.89	4.23	3.58	3.13	8.73	7.33	7.43	3.75	6.81	2.60	2.79			3.16	3.45
23	6.08	5.53	3.87	4.18	3.57	3.10	8.69	7.35	7.48	3.77	6.84	2.56	2.74	7.11	6.30	3.14	3.45
24	6.07	5.57	3.84	4.14	3.56	3.00	8.64	7.43	7.56	3.68	6.86	2.51	2.69	7.10	6.29	3.11	3.40
25	6.05	5.64	3.82	4.13	3.53	2.99	8.61	7.46	7.57	3.73	6.87	2.48	2.67	7.08	6.27	3.10	3.44
26	6.04	5.76	3.78	4.07	3.52	2.96	8.60	7.47	7.55	3.73		2.43	2.60	7.08	6.28	3.09	3.43
27	6.02	5.92	3.75	4.04	3.51	2.91	8.57	7.47	7.53	3.74		2.31	2.55	7.07	6.27	3.06	3.45
28	6.00	6.12	3.73	3.97	3.49	2.86	8.55	7.46	7.54	3.80		2.24	2.52	7.07	6.26	3.05	3.45
29	5.98	6.23	3.71	3.90	3.48	2.84	8.54	7.41	7.53	3.74		2.18	2.49	7.04	6.24	3.04	3.45
April 30	5.97	6.28	3.69	3.85	3.47	2.81	8.54	7.38	7.48	3.78		2.13	2.44	7.05	6.23	3.02	3.45

APRIL . Average Daily Water Table Position At Key Monitoring Wells (referenced to mean sea level).

* Daily Water Readings

TABLE A6

Date	NE #1	NE #2	G-3272	G-1502	G-596	G-757A	S-333		S-334*		G-618	G-196A	G-1363	G-855	E-22*	E-23*	S-173*
							HW	TW	HW	TW							HW
May 1	5.96	6.32	3.62	3.80	3.46	2.75	8.51	7.41	7.51	3.77		2.07	2.36	3.00	7.03	6.22	3.44
2	5.96	6.33	3.61	3.76	3.45	2.72	8.48	7.42	7.51	3.79	6.85	2.03	2.32	2.98	7.01	6.21	3.43
3	6.00	6.34	3.57	3.70	3.42	2.69	8.44	7.43	7.53	3.82	6.85	1.98	2.29	2.97	6.99	6.22	3.40
4	6.12	6.37	3.57	3.66	3.50	2.64	8.41	7.46	7.54	3.85	6.87	1.93	2.23	2.95	6.97	6.23	3.40
5	6.18	6.40	3.57	3.62	3.40	2.60	8.40	7.45	7.54	3.83	6.89	1.87	2.18	2.94	6.96	6.23	3.39
6	6.21	6.42	3.57	3.57	3.39	2.58	8.38	7.44	7.54	3.81	6.87	1.83	2.14	2.92	6.94	6.25	3.39
7	6.23	6.44	3.56	3.54	3.38	2.54	8.35	7.44	7.53	3.76	6.86	1.80	2.10	2.91	6.92	6.22	3.38
8	6.24	6.45	3.54	3.47	3.36	2.48	8.32	7.44	7.52	3.77	6.86	1.74	2.06	2.89	6.89	6.21	3.36
9	6.25	6.47	3.54	3.47	3.34	2.46	8.31	7.45	7.57	3.73	6.87	1.70	2.01	2.86	6.87	6.21	3.35
10	6.26	6.49	3.57	3.53	3.34	2.44	8.33	7.46	7.53	3.75	6.87	1.81	2.02	2.86	6.87	6.25	3.40
11	6.27	6.49	3.59	3.55	3.35	2.46	8.31	7.46	7.53	3.72	6.87	1.85	2.05	2.86	6.86	6.25	3.41
12	6.27	6.50	3.58	3.55	3.35	2.45	8.28	7.45	7.52	3.76	6.87	1.87	2.08	2.85	6.80	6.25	3.39
13	6.28	6.50	3.58	3.54	3.34	2.45	8.25	7.45	7.52	3.78	6.87	1.87	2.09	2.84	6.76	6.26	3.38
14	6.28	6.51	3.58	3.49	3.34	2.45	8.22	7.44	7.54	3.78	6.87	1.85	2.08	2.83	6.74	6.28	3.37
15	6.29	6.52	3.57	3.45	3.33	2.42	8.18	7.43	7.56	3.79	6.87	1.80	2.04	2.81	6.71	6.28	3.38
16	6.29	6.53	3.86	3.76	3.32	2.39	8.10	7.43	7.55	3.79	6.89	1.75	2.02	2.84	6.68	6.28	3.36
17	6.31	6.55	4.06	3.83	3.51	2.36	8.09	7.44	7.48	4.15	6.89	1.88	1.99	3.00	6.69	6.30	3.74
18	6.31	6.55	4.09	3.83	3.60	2.38	8.05	7.44	7.47	3.98	6.87	1.95	2.04	3.02	6.67	6.31	3.60
19	6.31	6.54	4.08	3.78	3.62	2.40	8.15	7.08			6.86	1.96	2.08	3.02			
20	6.32	6.53	4.06	3.71	3.70	2.42	8.24	6.73			6.60	1.96	2.11	3.00			
21	6.32	6.50	4.02	3.65	3.60	2.43	8.22	6.65			6.51	1.95	2.12	2.98			
22	6.32	6.46	4.08	3.57	3.74	2.44	8.11	6.64			6.45	1.94	2.11	3.01			
23	6.35	6.47	4.29	3.66	3.94	2.48	8.00	6.65			6.45	1.97	2.14	3.09			
24	6.42	6.50	4.45	3.91	4.12	2.54	8.03	6.68			6.45	1.99	2.18	3.19			
25	6.48	6.50	5.53	4.83	4.48	2.59	8.06	6.69			6.50	2.09	2.34	3.48			
26	6.55	6.78	5.55	4.83	4.76	2.67	8.25	6.70			6.50	2.29	2.34	3.48			
27	6.73	6.94	6.35	4.83	5.74	3.24	8.44	6.96			6.86	3.97	3.58	4.85			
28	6.87	6.98	6.59	4.83	6.18	3.79	8.64	7.09			6.88	4.30	4.15	5.24			
29	6.92	7.01	6.72	4.89	6.31	4.55	8.73	7.07			6.87	4.86	4.84	5.57			
30	6.91	7.01	6.72	4.89	6.32	4.84	8.77	7.08			6.88	4.76	4.88	5.75			
31	6.92	6.98	6.74	4.89	6.54	5.10	8.78	7.07			6.87	4.59	5.01	6.24			

MAY Average Daily Water Table Position at Key Monitoring Wells (referenced to mean sea level).

* Daily Water Readings