PRELIMINARY BASELINE DATA FOR THE BASIN-SPECIFIC FEASIBILITY STUDIES TO ACHIEVE THE LONG-TERM WATER QUALITY GOALS FOR THE EVERGLADES

Prepared by the
South Florida Water Management District

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96

LIST OF TABLES

Table Number **Page**

98

LIST OF FIGURES (continued)

Figure Number **Page**

system have occurred over the last three decades which likely will not be replicated in the future. To provide system-wide consistency in flow period of record, overall water balance, and to enable forecasting of future conditions, it was decided to use simulated flows from the District's regional South Florida Water Management Model. To develop baseline flows, the SFWMM was used to simulate current operational conditions (including full operation of the STAs) and utilized rainfall for the 31-year period between January 1965 and December 1995. Note that the goal was not to recreate the 31-year period of record flows, but rather, to simulate the expected hydrologic response in each of the basins as a result of the 31-year rainfall history.

The observed water quality data and simulated flows were combined for each basin to create a complete 31-year period of synthetic data. The methodology used to combine the flow and water quality data preserved the key features critical to subsequent design work: hydrologic variability over a sufficiently long time frame and preservation of the flow-weighted mean concentration of phosphorus. Subsequent evaluations of alternative treatment solutions will be based on anticipated flows representing future conditions; hence preservation of the long-term flow-weighted mean phosphorus concentration was determined to be more critical than preserving the total phosphorus loads observed during the period of record. The long-term estimate of baseline flows and phosphorus concentrations for each of the thirteen basins are presented below.

Table 1-1. Summary of Estimated Baseline Flows and Phosphorus Concentrations

Basin/STA	Primary Discharge Structures	Mean Annual Discharge (acre-feet)	Phosphorus Concentration (parts per billion)
C51 West - STA-1 East	S-362	110,175	50
S-5A - STA-1 West	G-251, G-310, G-300, G301	184,119	35
S-6 – STA-2	G-335	228,222	50
S-7/S-8 - STA-3/4	S-7, S-8	624,249	50
C-139 - STA-5	G-344s	128,799	50
STA-6	G-606	22,633	25
Acme Basin B	Acme1DS, G-94D	31,677	92
North Springs Improvement District	NSID-1	12,351	39
N. New River Canal Basin	G-123	1,234	18 (see note 4)
C-11 West Basin	S-9	180,134	16
L-28 Basin	S-140	90,970	39
Feeder Canal Basin	S-190	77,179	117

NOTES:

1. Estimates of flow are simulation results (Calendar Year: January to December).
2. Discharges from the STAs are assumed to achieve a long-term average phosphorus concentration of 50 ppb, with the exception of STA-1 West and STA-6. STA-1 West encompasses the Everglades Nutrient Removal Project, which has averaged 22 ppb for the last 5 years, and is assumed to achieve 35 ppb. STA-6 has averaged 20-25 ppb for the two years of operation and is assumed to achieve a long-term average concentration of 25 ppb.
3. For those basins not associated with an STA, the long-term average phosphorus concentration is based on the 1990-1999 historic data (May to April water years).
4. Phosphorus concentration for North New River Canal Basin (G-123) is the arithmetic mean – there was no flow data available to calculate the flow-weighted mean concentration.

SECTION 2. INTRODUCTION

Florida's 1994 Everglades Forever Act (F.S. 373.4592) and the federal Everglades Settlement Agreement (Case No. 88-1886-CIV-HOEVELER) establish both interim and long-term water quality goals designed to restore and protect the Everglades Protection Area. As defined in the Act and the Settlement Agreement, the Everglades Protection Area includes Water Conservation Areas 1, 2A, 2B, 3A, 3B, the Arthur R. Marshall Loxahatchee National Wildlife Refuge, and the Everglades National Park. Figure 2-1 is an overview of the Everglades Protection Area.

Throughout this document, the term "Basin-Specific" is defined as "STA-Specific" for the Everglades Construction Project basins and "Basin-Specific" for the Everglades Stormwater Program basins. The purpose of this document is the development of a baseline flow and water quality data set. This baseline data set will be used in the upcoming basin-specific feasibility studies which will integrate research, planning and other available information into water quality solutions to ensure that all waters discharged into the EPA from thirteen hydrologic basins (seven Everglades Construction Project basins and six Everglades Stormwater Program basins) achieve water quality goals by December 31, 2006.

Activities are currently underway to meet the interim goal of reducing phosphorus levels in discharges from the Everglades Agricultural Area and other sources to the Everglades Protection Area to a long-term annual flow-weighted mean concentration of 50 parts per billion (ppb). These activities include the implementation of Everglades Agricultural Area Best Management Practices (BMPs) and the construction of over 42,000 acres of Stormwater Treatment Areas (STAs) through the Everglades Construction Project (ECP). The ECP captures and treats water from seven hydrologic basins, all of which are included in this baseline data set. Concurrent with implementation of the ECP, the District is implementing the Everglades Stormwater Program (ESP) to address the water quality issues associated with discharges from the remaining eight non-ECP Everglades tributary basins. Of these eight basins, six are included in this baseline data set. Also concurrent with these activities, the District and other groups are conducting water quality research, ecosystem-wide planning (e.g., the C&SF Project Restudy), and regulatory programs to ensure a sound foundation for science-based decision making.

In accordance with the Everglades Forever Act, current research activities will provide the basis for the determination of the final EPA phosphorus criteria and are to be completed by December 31, 2001. Also in accordance with the Act, the EPA phosphorus criterion shall be 10 ppb in the event the Florida Department of Environmental Protection (DEP) does not adopt by rule such criterion by December 31, 2003. The Act further mandates that the Florida Department of Environmental Protection (DEP) establish the relationship between discharge levels and the water quality in the EPA. The Corps of Engineers Permit for the Everglades Construction Project requires "For the purposes of planning, 10 ppb (phosphorus) shall be used as the design parameter pending adoption of the numeric criterion by the DEP or ERC."

An additional objective of the Everglades Forever Act is the restoration of a suitable hydroperiod in the Everglades Protection Area. Efforts are currently underway to develop a comprehensive program of operational practices to increase the total quantity of flows to the EPA at an ecologically optimum timing and distribution. Hydroperiod restoration is crucial to the revitalization of the Everglades ecosystem and will therefore be a key element in the overall restoration effort. The Act established a preliminary target of 28% increase in flow to the EPA compared to the 1979-88 period; the C&SF Restudy subsequently estimated an increase of approximately 19%.

The long-term goal of the Everglades Program restoration effort is to combine point source, basin-level and regional solutions in a system-side approach to ensure that all waters discharged into the Everglades Protection Area meet the numeric phosphorus criterion and other applicable state water quality standards by December 31, 2006. In order to achieve this goal, the District is implementing a strategy to ensure all water quality standards are met on a basin by basin basis. This strategy consists of conducting basin-specific feasibility studies which will integrate information from research, regulation, and planning studies to determine the optimal combination of BMPs, optimized STAs, advanced treatment technologies, Water Preserve Areas, etc., to meet the final water quality objectives. The relationship between the overall restoration activities is presented in Figure 2-2.

Although unanticipated, there may be substantive changes in the underlying design criteria that occur during the course of the feasibility studies, including inflow volumes, phosphorus loads, regional reservoirs, BMP performance, STA performance and/or design outflow phosphorus criteria. In recognition of these potential changes, this baseline data set may be further refined to ensure that the most accurate and timely information available is incorporated into the basis of design.

Some of the more critical time frames of the Everglades restoration effort are identified below.

Legislative and Permit-related Deadlines:

- By January 1, 2001, the District shall submit to the Army Corps, DEP, and others, a final strategy for achieving compliance with state water quality standards by the December 2006 deadline.
- Pursuant to Special Condition No. 1 of the Army Corps 404 Permit, the District shall make best efforts to implement long-term water quality solutions for STA-2 discharges within four years of the first discharges into WCA 2A (anticipated to be February 2000).
- By December 31, 2003, the District shall submit to the DEP a permit modification to incorporate proposed changes to the ECP and its EFA mandated permits.
- All water delivered to the EPA to achieve compliance with state water quality standards by December 31, 2006.

The District's objective is to conduct basin-specific feasibility studies and conceptual designs for thirteen Everglades Protection Area tributary basins (7 ECP basins and 6 ESP basins). Since the seven ECP basins discharge to six STAs, the feasibility studies for the ECP basins will be STA-specific, and the feasibility studies and conceptual designs will be developed for the six STAs.

Therefore, it is envisioned that a total of twelve feasibility studies/conceptual designs will eventually be developed (6 STAs and 6 ESP basins). These feasibility studies and conceptual designs will integrate information from ongoing STA construction and operation activities, ongoing STA design activities (STA-1E, STA-3/4, and STA-6 Sec. 2), and ongoing research, regulation, and planning studies to determine the optimal combination of BMPs, optimized STAs, and advanced treatment technologies to meet the final water quality and water quantity objectives for the benefit of the Everglades.

The conceptual design documents will be developed through completion of the following six activities.

1. **Characterize basin-specific baseline flows and water quality levels.** District flow and water quality data will be analyzed, compiled and combined with simulated flows to establish a baseline set of flows and water quality levels for each basin. This document is the preliminary work product of this activity. **Target timeframe: October 1999 through February 2000.**

2. **Determine adjustments to the baseline flows and concentrations, and establish the basis of design flows and water quality levels.** It is likely that capital projects, regulatory programs or other activities, in addition to the long-term treatment solutions, will be implemented in the basins prior to December 31, 2006 that could influence the flows and water quality levels. Examples include the C&SF Project Restudy and the Lower East Coast Water Supply Plan. Projects anticipated to be implemented prior to December 31, 2010 will be identified and potential adjustments to the baseline flows and concentrations will be quantified. Projects planned to be completed between December 31, 2006 and December 31, 2010 will be highlighted. The adjusted flows and water quality levels will become the **basis of design** for the subsequent feasibility studies. Subsequent refinement of the basis of design is anticipated as additional information becomes available. **Target timeframe: October 1999 through March 2000.**

3. **Summarize basin-specific outflow targets and determine the degree of treatment required to achieve water quality targets.** For planning purposes, and in accordance with the Corps of Engineer's permit for the Everglades Construction Project, the District will use a target phosphorus discharge concentration of 10 ppb. Dissolved oxygen will be a parameter of concern, and consultation with the Florida Department of Environmental Protection will lead to an appropriate target. For other parameters of concern, the current State water quality standard will be utilized as the target. For each STA/basin, the degree of treatment required to achieve compliance with applicable long-term water quality standards will be compiled. This degree of treatment will be determined by comparing the basis of design levels with the target levels. If applicable, District staff may compile upstream compliance targets based on local government regulations. No new hydropattern restoration goals will be developed as a part of this Work Order, however, the hydropattern restoration goals of the Restudy and the Everglades Construction Project shall be adhered to in the completion of this work effort. **Target timeframe: April 2000 through June 2000.**

4. **Identify alternative combinations of solutions (BMPs, STA Optimization, advanced treatment technologies, etc.).** Based on the degree of treatment required in each basin. alternative combinations of potential water quality solutions will be identified. Available

1. Establish baseline flows and water quality levels
   Target completion: February 2000

↓

2. Adjustments to baseline flows and water quality levels and development of Basis of Design flows and water quality levels
   Target completion: March 2000

↓

3. Identify targets and determine degree of treatment for each basin
   Target completion: June 2000

↓

4. Identify potential alternative combinations of treatment solutions
   Target completion: September 2000

↓

5. Evaluate alternatives and recommend optimal combination for each basin
   Target completion: September 2001

↓

6. Complete conceptual designs for each basin
   Target completion: September 2003

Figure 2-3. Schematic of Activities Leading to Conceptual Engineering Designs.

be more critical than preserving the total phosphorus loads observed during the period of record. Adjustments to the flows and phosphorus loads will be estimated in a subsequent work effort.

For each STA, inflow volumes and phosphorus loads were calculated to reflect the phosphorus quality upstream of the STA, in case a long-term solution would be applied upstream of an STA. In addition, outflow volume and phosphorus loads were estimated, to provide a basis for a treatment technology downstream of an STA.

B. Flow

Historic flow records for were obtained from the District's hydrologic database. For the stations on the south boundary of the Everglades Agricultural Area, stormwater runoff volumes and pass-through water from Lake Okeechobee were estimated. Historically, pass-through water was released from the Lake either for downstream water supply purposes or when regulatory releases were made from the Lake. This pass-through volume was estimated by comparing the daily volume released from the structures on the Lake and the volume passing through the southern boundary structures, using the method consistent with the EAA Regulatory program.

The South Florida Water Management Model was utilized to generate a thirty-one year set of discharges from each of the thirteen basins, including the six Stormwater Treatment Areas. The simulation results were analyzed on a basin-by-basin level to identify obvious discrepancies between observed and simulated flow values. Where there were discrepancies, for example, for the North Springs Improvement District Basin, additional analyses were performed to develop the baseline flow data set. These are described more fully in the basin-specific sections of this document. Output from the SFWMM utilizes a calendar year beginning January 1 and ending December 31, therefore all references to years in the simulation sections of this report correspond to the period from January 1 to December 31.

The South Florida Water Management Model (SFWMM) is a regional-scale model used to evaluate the interaction of water supply and demand with hydrologic conditions in Palm Beach, Broward and Dade counties and portions of seven other counties in South Florida. The model simulates physical processes in the natural (coupled surface water and ground water) and man-made (canals, structures, and reservoirs) systems in South Florida. It includes management guidelines and policy-based operational rules established, mostly by the U.S. Army Corps of Engineers, for operating the Central and Southern Florida Project for Flood Control and Other Purposes (C & SF Project). As a planning tool, the model can be used to predict the response of the hydrologic system to proposed changes in hydraulic infrastructure and/or operating rules. The design of the model takes into consideration the distinct hydrologic and geologic features of subtropical South Florida which include: 1) the strong interaction between canals and the highly permeable surficial aquifer, especially in the eastern portion of the region; and 2) the dominance of evapotranspiration, and overland flow and groundwater movement within the Water Conservation Areas (WCAs) and Everglades National Park (ENP).

Initial work on the model started as early as the 1970s. The South Florida Water Management District (SFWMD) under contract (DACW17-81-C-0035) completed the model for the U.S. Army Corps of Engineers. Technical Publication 84-3 (TP84-3) "South Florida Water Management Model

For consistency with other District programs, historic water quality data were compiled and analyzed based on a water year beginning on May 1 and ending on April 30. All references to water years in the water quality sections of this report correspond to the period from May 1 to April 30.

Two additional calculations were employed for the EAA basins. For the EAA pump stations S-5A, S-6, S-7 and S-8, historic flows were separated into runoff and Lake Okeechobee releases to differentiate the volumes and phosphorus concentrations of each. In addition, in recognition that 100% of the landowners within the EAA had Best Management practices in place for the water years May 1995 – April 1999, the baseline phosphorus concentration for those basins used the most recent 4-yr flow-weighted average.

The following methodology, consistent with the methodology used in the preparation of the *Everglades Consolidated Report* and in the Everglades Agricultural Area regulatory program, was used for TP load calculation:

1) Data retrieval

Daily flow and TP concentration data were retrieved from the District's databases by executing SQL commands (scripts) of a database program ORACLE at a UNIX workstation. Daily mean flow (unit in cfs) data were retrieved from the "dm_daily_data" table. Total phosphorus concentration (unit in mg/L ppm) data were retrieved from the "wqdora.sample" table.

2) Outlier checking

A statistics based outlier detection algorithm was incorporated for EAA Basin TP load calculation program codes to eliminate outliers for the base period data (10/1/1978 – 9/30/1991). The algorithm tests the significance of residual of each data, from largest one to next, and so on, from the regression of TP concentrations on flow for the ten-year base period. Only one value was eliminated by this detection method.

3) Calculate the daily load and sum for monthly load for each structure

The following protocol for calculating total phosphorus loads is based on the EAA model. The computational algorithms are retained for computing loads and concentrations to have the computations yield the output in the same consistent manner. However, the program needs to be expanded to accommodate different sites and flows (ESP sites).

The algorithm of the calculation program is:

a) Eliminate grab sample TP data if flow data show that there was no flow or the flow was reversed on the sampling day at the sampled site.
b) Fill in the daily grab TP concentrations by interpolating the values of adjacent two grab sample data.
c) If there are auto-sampler data, fill in the daily auto-sampler TP concentrations for the fourteen days including and prior to the auto-sampler values.
d) Compare daily loads for the days both grab and auto-sampler loads exist. Calculate the ratio by dividing the sum of grab load with the sum of auto-sampler load.

3) Data with obvious mis-coding errors such as FIELD COND. values below 50 were eliminated from the data set.
4) Data with obvious mis-coding errors such as DO values above 100 were eliminated from the data set.

E. Combining Flow with Phosphorus Data

The observed water quality data and simulated flows were combined for each basin to create a complete 31-year period of synthetic data. Numerous methods of combining simulated flow with observed phosphorus data were evaluated. The key factors in evaluating the various methods were, in order of priority:

1) Does the method preserve the long-term (31-year) hydrologic variability (minimum, average and maximum) associated with the 31-year rainfall/runoff characteristics for each basin?
2) Does the method preserve the observed long-term flow-weighted mean phosphorus concentrations?
3) Does the method cover the entire 31-year period of record?
4) Is the method consistent across all the basins?
5) Does the method preserve the observed variability in phosphorus concentrations?
6) How much effort would be involved to carry out the method?
7) Is there a precedent for using the method?

Subsequent evaluation of alternative treatment solutions will be based on anticipated flows representing future conditions; hence preservation of the long-term flow-weighted mean phosphorus concentration was determined to be more critical than preservation of the total phosphorus loads observed during the period of record. Adjustments to the flows and phosphorus loads will be estimated in a subsequent work effort.

A summary of the various methods evaluated is presented in Appendix 3-2. Regression relationships were developed for each basin and results are also presented in Appendix 3-2 (figures and summary tables). Based on the poor regressions between flow and phosphorus (in most cases r^2 was less than 20%), those methods requiring regressions were deemed inappropriate. It was decided to apply the long-term (1990-1999) flow-weighted mean concentration to the 31-year period of simulated flows. Modifications to the resulting data set are anticipated as more information becomes available, however, for the purpose of evaluating alternatives, this method was determined to be appropriate.

Table 4-2. Summary of Baseline Flow and Phosphorus Data - STA-1 East Discharges

Calendar Year	Simulated Outflow acre-feet	TP Load metric tons	Calendar Year	Simulated Outflow acre-feet	TP Load metric tons
1965	86,211	5.317	1980	84,904	5.237
1966	176,512	10.887	1981	77,268	4.766
1967	85,424	5.269	1982	141,373	8.720
1968	136,195	8.401	1983	173,175	10.681
1969	148,222	9.142	1984	123,120	7.594
1970	139,222	8.587	1985	94,634	5.837
1971	59,469	3.668	1986	106,576	6.574
1972	92,728	5.719	1987	99,220	6.120
1973	78,316	4.831	1988	89,802	5.539
1974	89,105	5.496	1989	45,620	2.814
1975	98,901	6.100	1990	66,817	4.121
1976	83,569	5.155	1991	140,586	8.671
1977	102,778	6.339	1992	123,132	7.595
1978	116,764	7.202	1993	103,044	6.356
1979	91,739	5.658	1994	201,990	12.459
			1995	159,018	9.808

Mean	110,175	6.796
Minimum	45,620	2.814
Maximum	201,990	12.459

Flow-weighted mean TP conc. (ppb) = 50

Figure 4-2. Summary of Baseline Flows and Phosphorus Loads - STA-1E Discharges

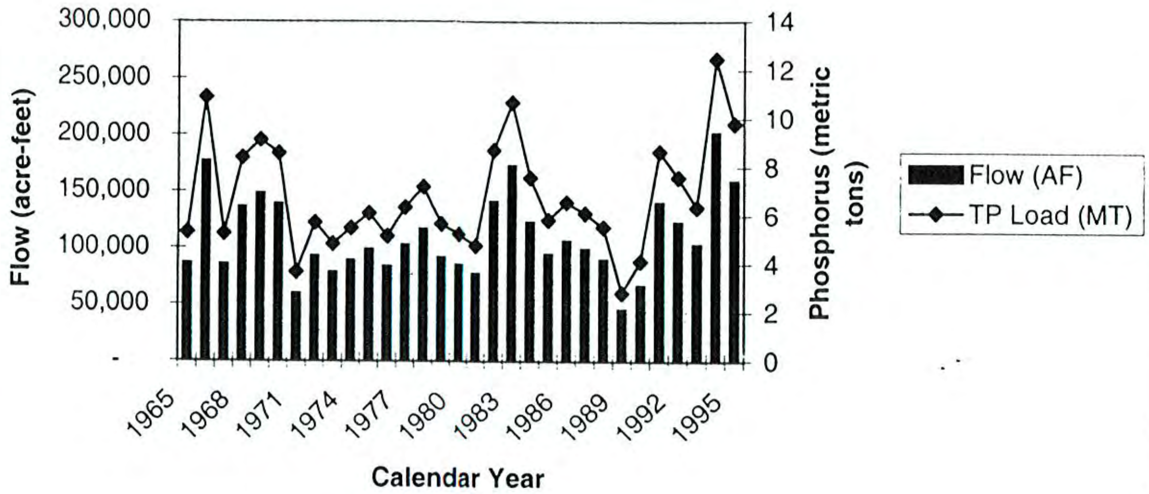


Table 5-1. Summary of Historic Flow and Phosphorus Data – S-5A Basin (May to April Water Years)

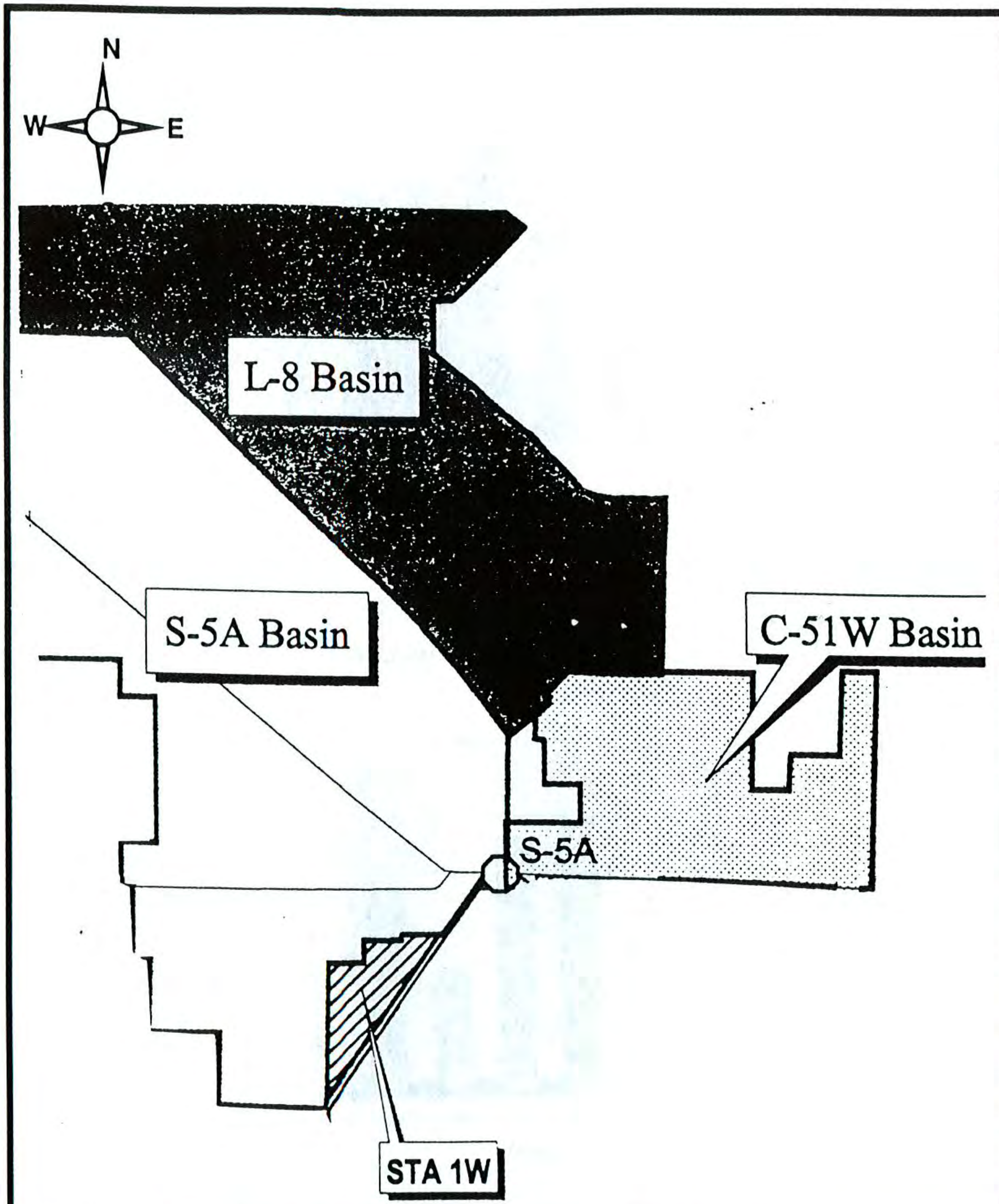
Runoff (Period of record: May 1989 – April 1999)	
Minimum annual (acre-feet)	138,201
Average annual (acre-feet)	367,604
Water Year 1996-99 average (acre-feet)	390,357
Maximum annual (acre-feet)	627,829
Runoff phosphorus (Period of record: May 1989 – April 1999)	
Minimum annual (ppb)	131
Flow-weighted average annual (ppb)	179
Water Year 1996-99 average	153
Maximum annual (ppb)	275
Lake releases (Period of record: May 1989 – April 1999)	
Minimum annual (acre-feet)	0
Average annual (acre-feet)	74,662
Maximum annual (acre-feet)	179,718
Lake releases phosphorus (Period of record: May 1989 – April 1999)	
Minimum annual (ppb)	86
Flow-weighted average annual (ppb)	141
Maximum annual (ppb)	230

A summary of simulated inflows for STA-1 West for the 31-year period (1965-1995) is presented in Table 5-2. The annual inflow data set is found in Appendix 5-2.

Table 5-2. Summary of Simulated Inflows for Calendar Years 1965-1995 - STA-1 West

	Flow (acre-feet)	Phosphorus (metric tons)
Minimum annual	76,287	14.162
Average annual	183,679	34.356
Maximum annual	299,836	56.509

A summary of the combined baseline data set for STA-1W for the 31-year period (1965-1995) is presented in Table 5-3 and Figure 5-5. For purposes of this baseline data set, it was assumed that the outflow from STA-1 West will be 35 ppb, in recognition that 55% of the area was the Everglades Nutrient Removal Project that consistently achieved a discharge of 22 ppb (22 ppb*55% + 50ppb*45% = 35 ppb).



Tributary Basin Map - STA-1 West
Figure 5-1

Figure 5-4. Summary of Historic Phosphorus Concentrations - S-5A Basin

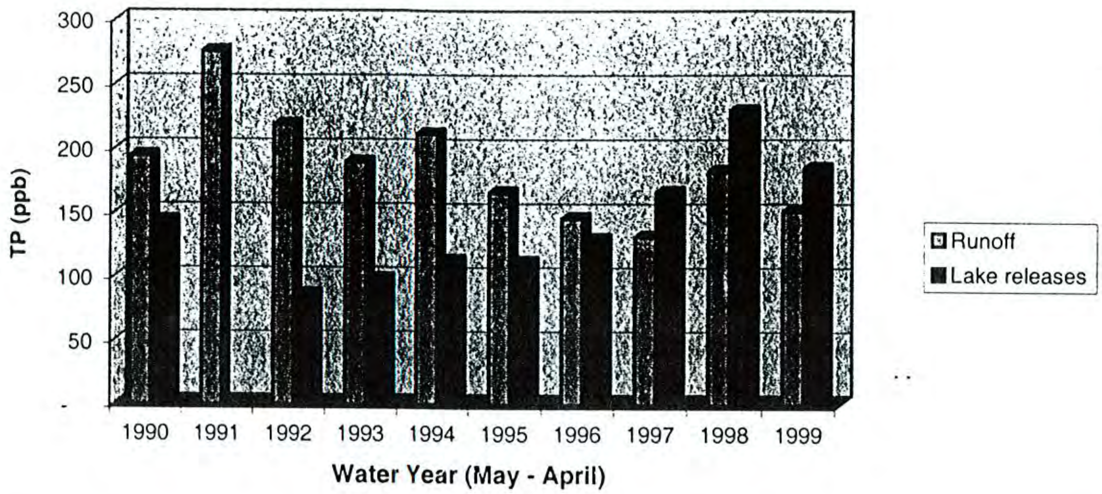
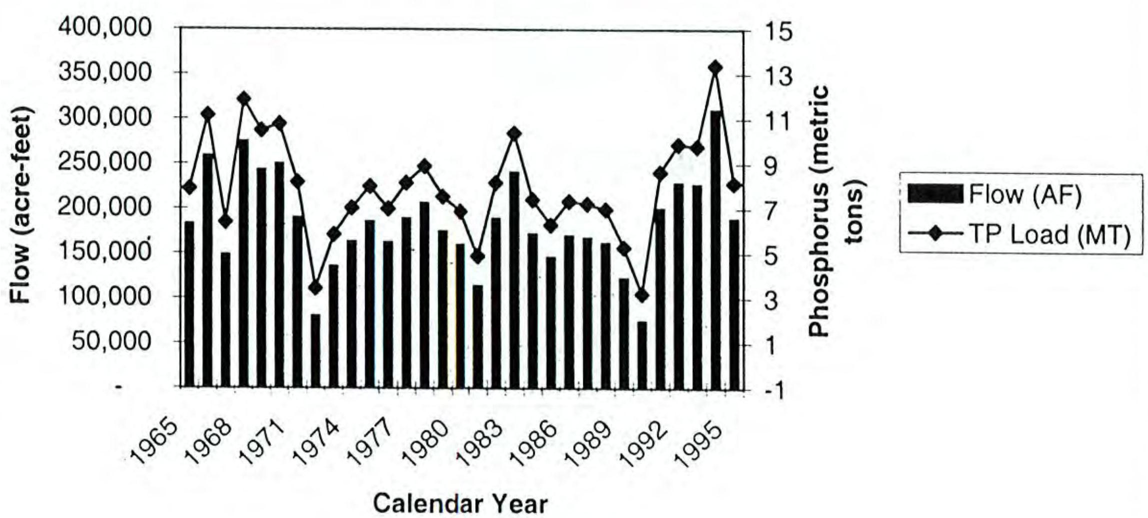


Figure 5-5. Summary of Baseline Flows and Phosphorus Loads - STA-1W Discharges



A summary of simulated inflows for STA-2 for the 31-year period (1965-1995) is presented in Table 6-2. Due to the inclusion of BMP replacement water, the simulated inflow exceeds the long-term STA-2 average inflow volume estimated during the design. Actual operations will only send BMP replacement water to STA-2 if sufficient capacity is available. The annual inflow data set is found in Appendix 6-2.

Table 6-2. Summary of Simulated Inflows for Calendar Years 1965-1995 – STA-2

	Flow (acre-feet)	Phosphorus (metric tons)
Minimum annual	107,809	15.768
Average annual	233,404	34.303
Maximum annual	379,505	55.836

A summary of the combined baseline data set for STA-2 for the 31-year period (1965-1995) is presented in Table 6-3 and Figure 6-3. For purposes of this baseline data set, it was assumed that the outflow from STA-2 will be 50 ppb.

Table 6-3. Summary of Baseline Flow and Phosphorus Data - STA-2 Discharges

Calendar Year	Simulated Outflow acre-feet	TP Load metric tons	Calendar Year	Simulated Outflow acre-feet	TP Load metric tons
1965	234,569	14.468	1980	176,262	10.872
1966	326,888	20.162	1981	140,147	8.644
1967	195,624	12.066	1982	272,995	16.838
1968	329,278	20.310	1983	266,146	16.416
1969	326,512	20.139	1984	167,295	10.319
1970	274,009	16.901	1985	203,076	12.526
1971	250,670	15.461	1986	231,969	14.308
1972	193,287	11.922	1987	166,598	10.276
1973	171,362	10.570	1988	147,577	9.103
1974	203,747	12.567	1989	129,124	7.964
1975	265,008	16.346	1990	99,867	6.160
1976	200,034	12.338	1991	224,517	13.848
1977	224,531	13.849	1992	255,127	15.736
1978	249,463	15.387	1993	238,173	14.691
1979	267,847	16.521	1994	386,598	23.845
			1995	256,591	15.827
Mean	228,222	14.077			
Minimum	99,867	6.160			
Maximum	386,598	23.845			

Flow-weighted mean TP conc. (ppb) = 50

125

Figure 6-2. Summary of Historic Flows - S-6 Basin

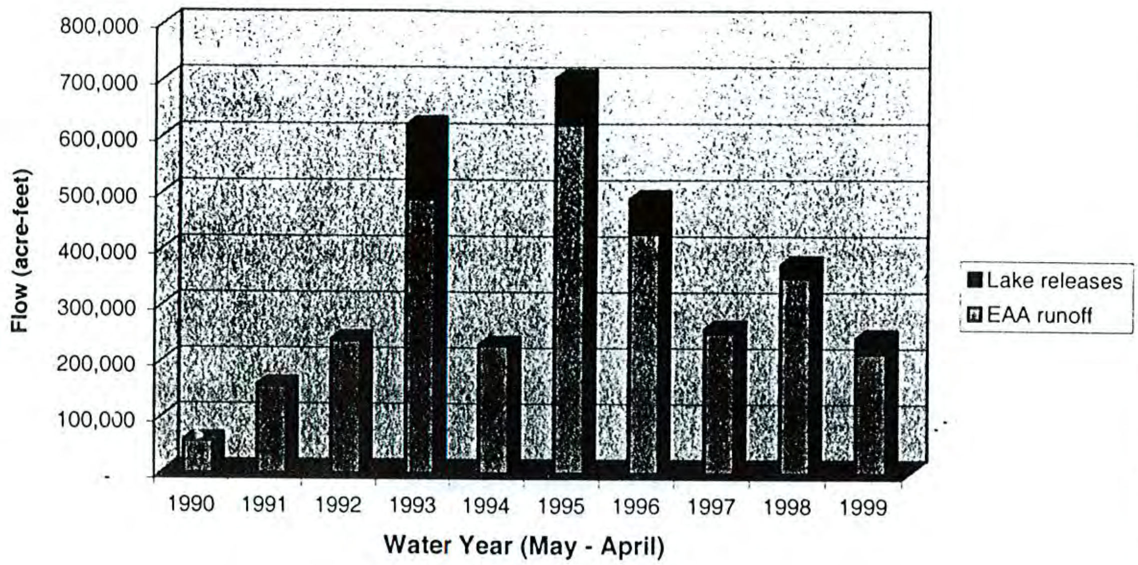
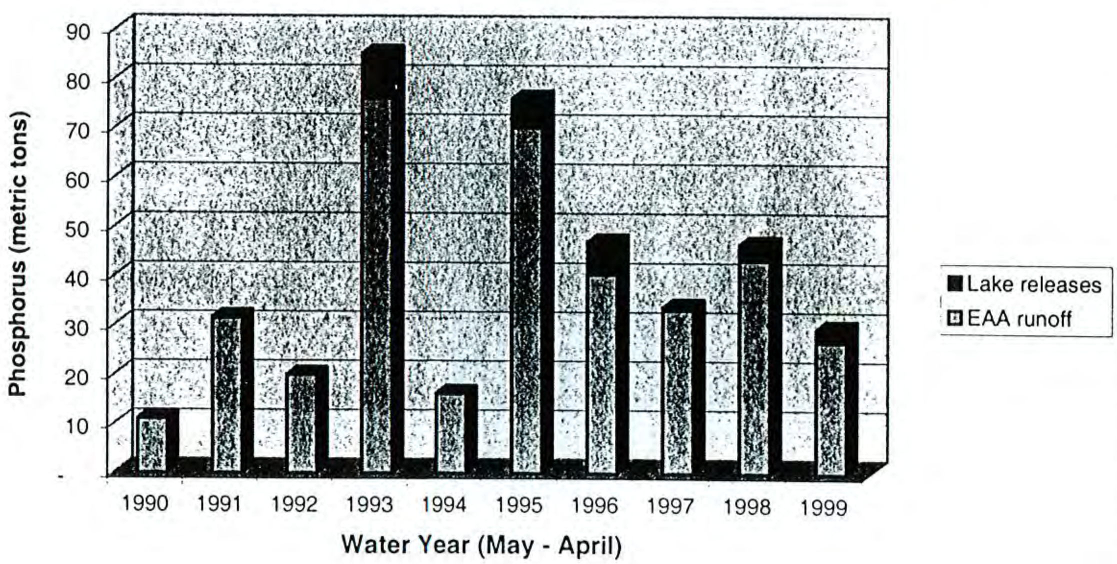


Figure 6-3. Summary of Historic Phosphorus Loads - S-6 Basin



SECTION 7. STA-3/4 (INCLUDING S-7 AND S-8 BASINS)

The S-7 drainage basin is 131.3 square miles in area and is located in south-central Palm Beach County. The project canals and water control structures in the S-7 Basin have four primary functions: (1) to remove excess water from the S-7 Basin to storage in Water Conservation Areas (WCAs) 2A and 3A; (2) to prevent over-drainage of the S-7 Basin; (3) to supply water from Lake Okeechobee to the S-7 Basin as needed for irrigation; and (4) to provide conveyance for regulatory releases from Lake Okeechobee to be passed to storage in WCAs 2A and 3A and for water supply releases to be passed to eastern Broward County. There are three project canals in the S-7 Basin: the North New River Canal, the L-6 borrow canal, and the L-5 borrow canal. There are four project structures affecting flow in the S-7 Basin: S-2, S-7, S-150, and S-351.

The S-8 drainage basin is 201.4 square miles in area and is located in southwestern Palm Beach County and in southeastern Hendry County. The project canals and water control structures in the S-8 Basin have five primary functions: (1) to remove excess water from the S-8 Basin to storage in Water Conservation Area 3A (WCA 3A); (2) to prevent over-drainage of the S-8 Basin; (3) to supply water from Lake Okeechobee to the S-8 Basin as needed for irrigation; (4) to provide conveyance for regulatory releases from Lake Okeechobee to storage in WCA 3A; and (5) to receive discharges of excess water from the L-3 borrow canal when these discharges will not cause flooding in the S-8 Basin. There are two project canals in the S-8 Basin: the Miami Canal and the L-4 borrow canal. There are four project structures affecting flow in the S-8 Basin: S-3, S-8, S-354, and G-88.

The basins tributary to STA-3/4 are presented in Figure 7-1. STA-3/4 will treat stormwater flows from the Miami Canal Basin, the North New River Canal Basin, as well as runoff from the South Shore Drainage District and South Florida Conservancy District. In addition, STA-3/4 will treat Lake Okeechobee regulatory releases if available treatment capacity exists in the treatment area. Historic flow and water quality data from the following structures were compiled to generate the baseline data set:

S-7 pump station (DBKEY 15037)
S-8 pump station (DBKEY 15040)
S-150 gate (DBKEY 15041)
S-2 pump station and structure S-351 for Lake releases (DBKEY 15021)
S-3 pump station and structure S-354 for Lake releases (DBKEY 15018)
G-136 (C-139 basin runoff to the Miami Canal) (DBKEY 15195)
G-200 (inflow to Holey Land) (DBKEY 15736)

Historic flow and phosphorus data (Water Years 1990 – 1999) for these structures for the period of record are presented in Appendix 7-1 and 7-2. A summary of the historic data is presented in Figures 7-2 through 7-10 and Tables 7-1 and 7-2. Tables 7-1 and 7-2 also show the flow-weighted mean phosphorus concentration for Water Years 1996 through 1999 – the last four years with 100% of the EAA Best Management Practices in place.

Table 7-3. Summary of Simulated Inflows for Calendar Years 1965-1995 - STA-3/4

	Flow (acre-feet)	Phosphorus (metric tons)
Minimum annual	259,196	71.696
Average annual	645,787	29.156
Maximum annual	1,217,278	123.324

A summary of the combined baseline data set for STA-3/4 for the 31-year period (1965-1995) is presented in Table 7-4 and Figure 7-11. For purposes of this baseline data set, it was assumed that the outflow from STA-3/4 will be 50 ppb.

Table 7-4. Summary of Baseline Flow and Phosphorus Data - STA-3/4 Discharges

Calendar Year	Simulated Outflow acre-feet	TP Load metric tons	Calendar Year	Simulated Outflow acre-feet	TP Load metric tons
1965	571,273	35.236	1980	875,148	53.979
1966	790,108	48.734	1981	242,540	14.960
1967	750,132	46.268	1982	536,207	33.073
1968	761,151	46.948	1983	931,865	57.477
1969	1,096,013	67.602	1984	766,217	47.260
1970	1,205,758	74.371	1985	466,333	28.763
1971	575,219	35.480	1986	533,246	32.891
1972	408,872	25.219	1987	525,180	32.393
1973	394,551	24.336	1988	363,298	22.408
1974	514,085	31.709	1989	291,569	17.984
1975	591,016	36.454	1990	233,204	14.384
1976	405,294	24.999	1991	647,136	39.915
1977	472,943	29.171	1992	681,983	42.065
1978	621,270	38.320	1993	743,270	45.845
1979	859,472	53.012	1994	766,220	47.260
			1995	731,141	45.097
Mean	624,249	38.504			
Minimum	233,204	14.384			
Maximum	1,205,758	74.371			

Flow-weighted mean TP conc. (ppb) = 50

Figure 7-2. Summary of Historic Flows - S-7 Basin (S-7 & S-150)

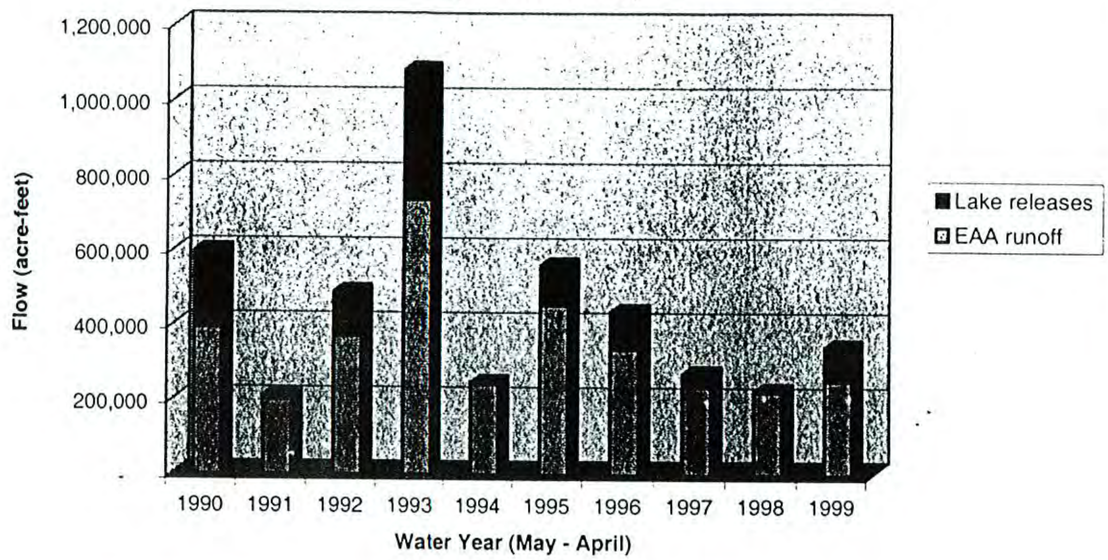


Figure 7-3. Summary of Historic Phosphorus Loads - S-7 Basin (S-7 & S-150)

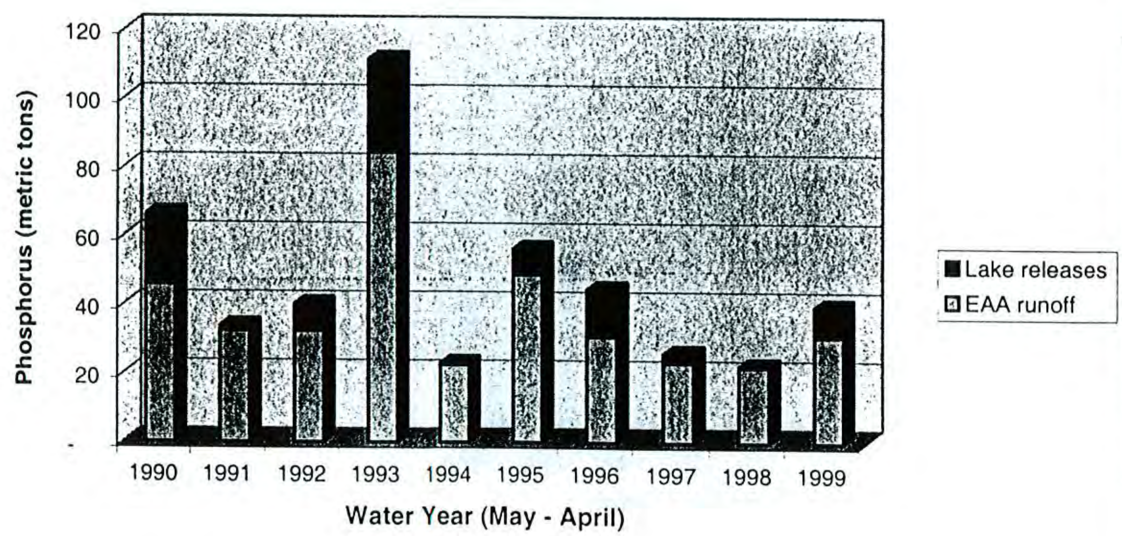


Figure 7-6. Summary of Historic Phosphorus Loads - S-8 Basin (S-8 & G-200)

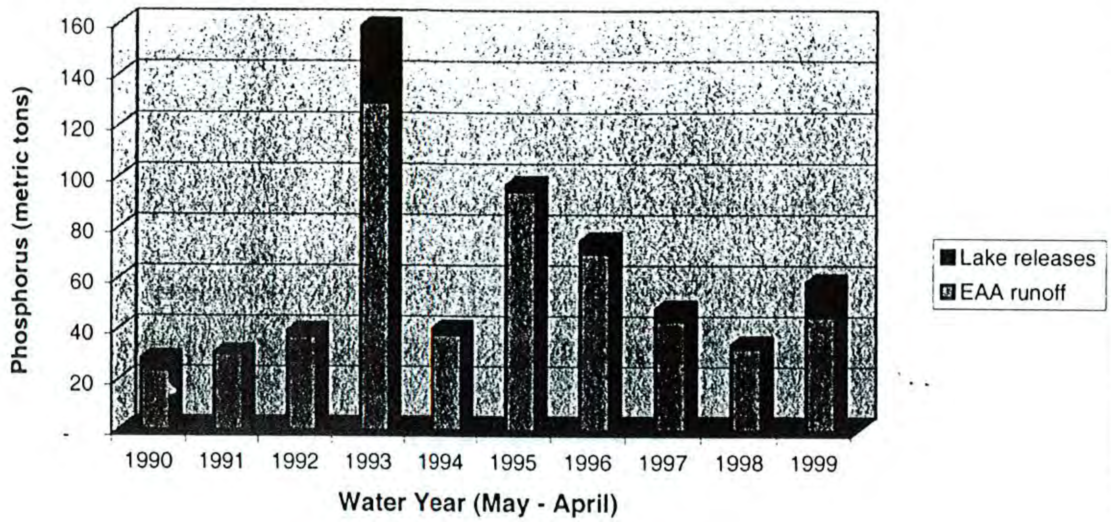


Figure 7-7. Summary of Historic Phosphorus Concentrations - S-8 Basin (S-8 & G-200)

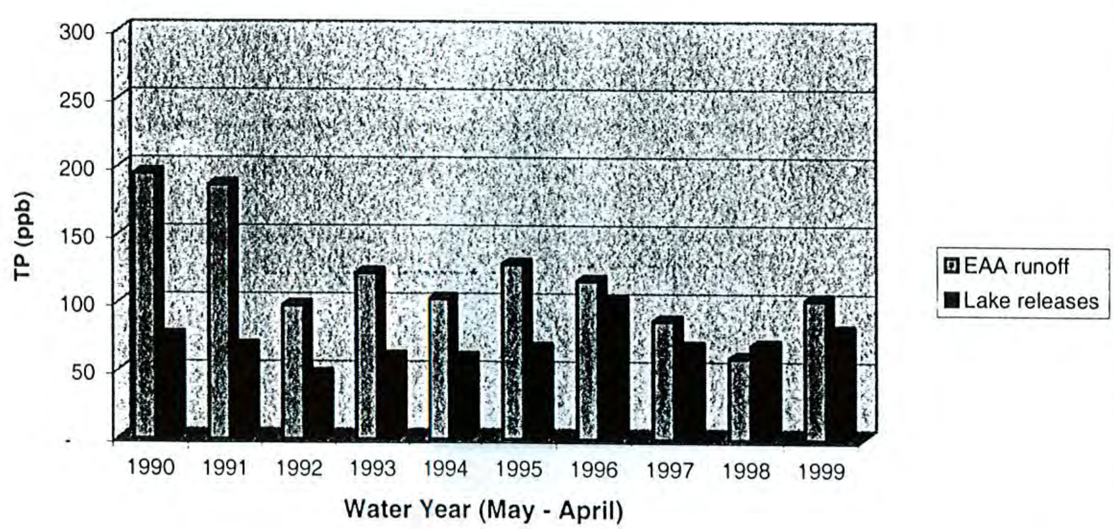


Figure 7-10. Summary of Historic Phosphorus Concentrations - G-136

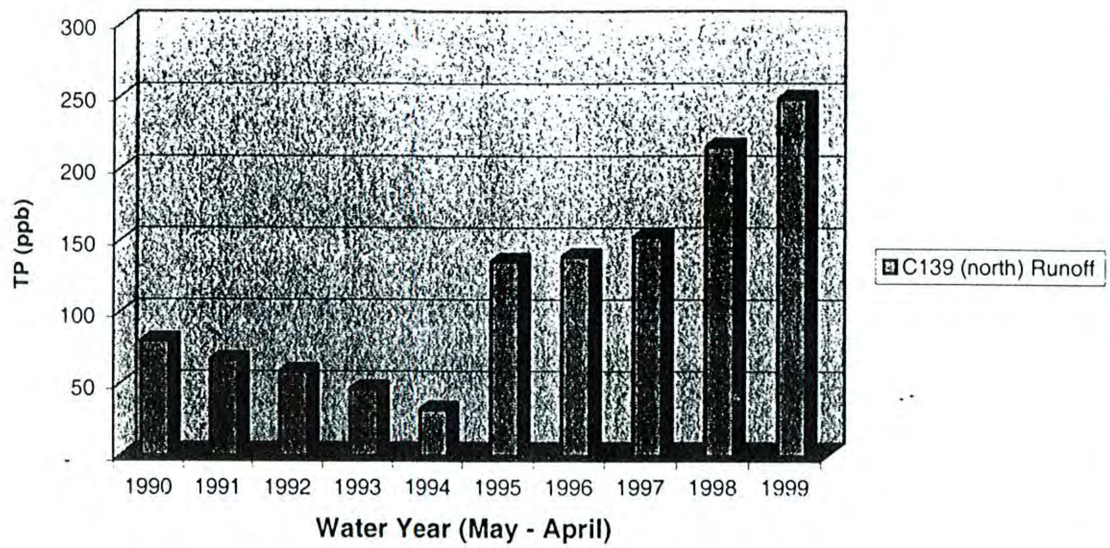
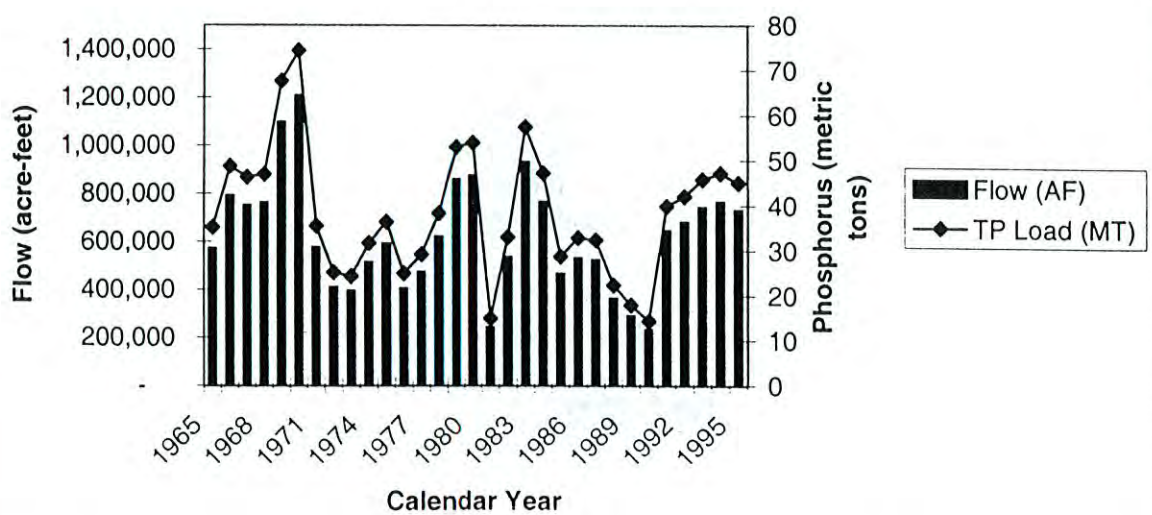


Figure 7-11. Summary of Baseline Flows and Phosphorus Loads - STA 3/4 Discharges



The SFWMM uses estimated flows – and not simulated flows - in the C-139 basin as inflow for STA-5. The estimates are based on a regression equation between monthly rainfall and monthly runoff for the period January 1990 – December 1994. For the 1965-1995 period, flows were estimated based on this regression, except for the years 1990-1994 when actual flows were used. A summary of simulated inflows for STA-5 for the 31-year period (1965-1995) is presented in Table 8-2. The annual inflow data set is found in Appendix 8-2.

Table 8-2. Summary of Simulated Inflows for Calendar Years 1965-1995 - STA-5

	Flow (acre-feet)	Phosphorus (metric tons)
Minimum annual	55,510	13.927
Average annual	132,047	32.944
Maximum annual	308,664	79.780

A summary of the combined baseline data set for STA-5 for the 31-year period (1965-1995) is presented in Table 8-3 and Figure 8-5. For purposes of this baseline data set, it was assumed that the outflow from STA-5 will be 50 ppb.

Table 8-3. Summary of Baseline Flow and Phosphorus Data - STA-5 Discharges

Calendar Year	Simulated Outflow acre-feet	TP Load metric tons	Calendar Year	Simulated Outflow acre-feet	TP Load Metric tons
1965	153,472	9.466	1980	48,380	2.984
1966	174,658	10.773	1981	50,736	3.129
1967	153,472	9.466	1982	136,465	8.417
1968	181,676	11.206	1983	108,007	6.662
1969	176,248	10.871	1984	83,576	5.155
1970	140,964	8.695	1985	130,085	8.024
1971	130,301	8.037	1986	123,966	7.646
1972	91,583	5.649	1987	92,296	5.693
1973	102,624	6.330	1988	71,284	4.397
1974	191,532	11.814	1989	71,637	4.419
1975	195,843	12.080	1990	59,883	3.694
1976	100,679	6.210	1991	92,311	5.694
1977	120,975	7.462	1992	118,638	7.318
1978	142,898	8.814	1993	121,670	7.505
1979	107,133	6.608	1994	204,572	12.618
			1995	315,210	19.442
Mean	128,799	7.944			
Minimum	48,380	2.984			
Maximum	315,210	19.442			

Flow-weighted mean TP conc. (ppb) = 50

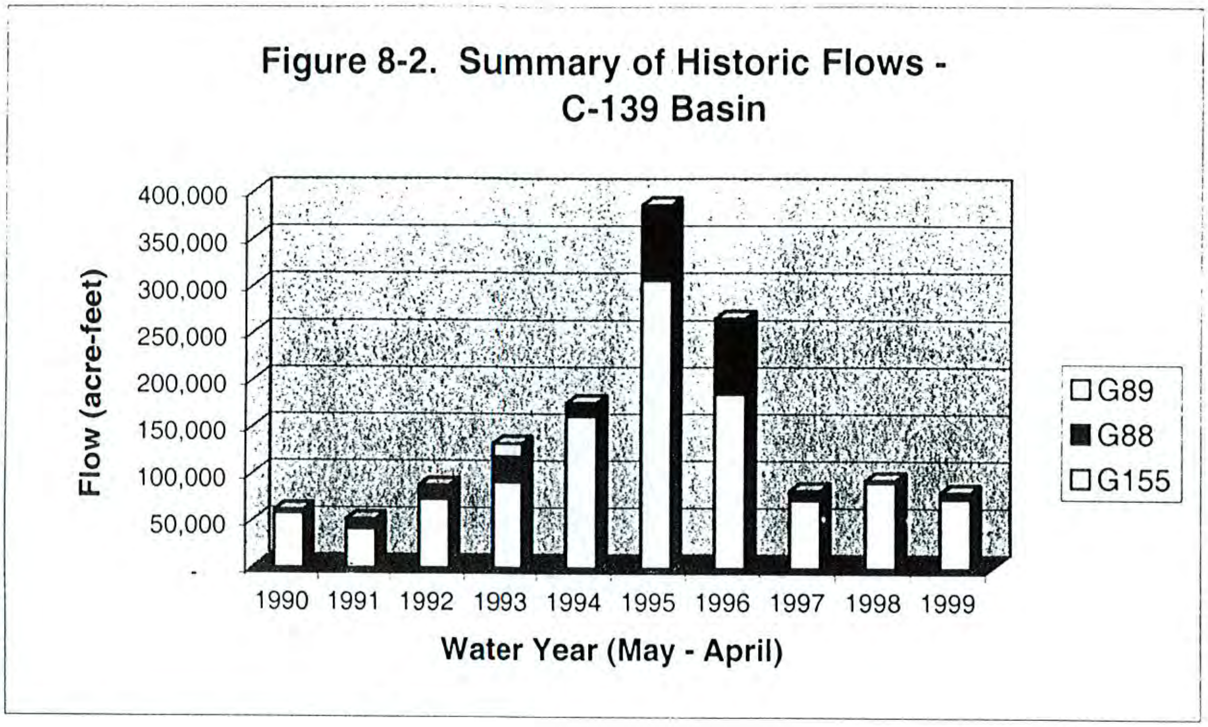


Figure 8-2. Summary of Historic Flows - C-139 Basin
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
-
Flow (acre-feet)
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999
Water Year (May - April)
G89
G88
G155

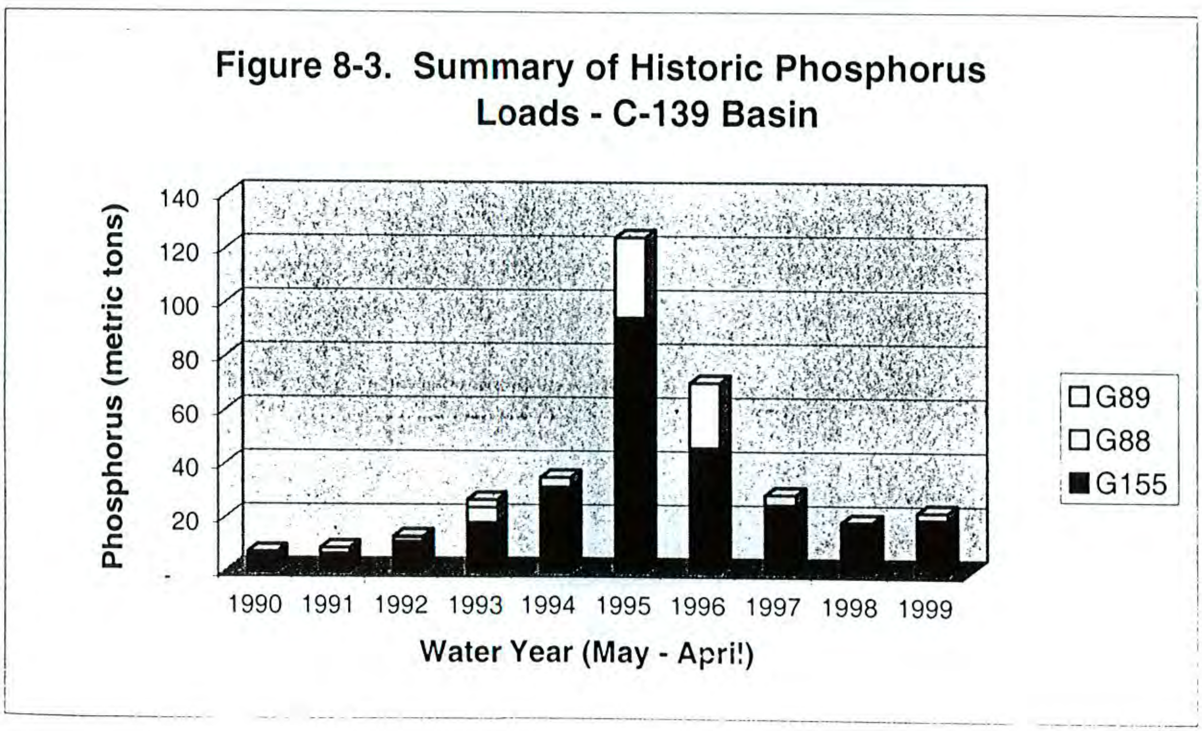


Figure 8-3. Summary of Historic Phosphorus Loads - C-139 Basin
140
120
100
80
60
40
20
-
Phosphorus (metric tons)
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999
Water Year (May - April)
G89
G88
G155

SECTION 9. STA-6

The basins tributary to STA-6 are presented in Figure 9-1. STA-6 will treat stormwater flows from approximately 10,000 acres north of the treatment area and south of STA-5 and west of the Rotenberger Wildlife Management Area. In the near future, STA-6 will be expanded to include approximately 1,400 additional acres for treatment of C-139 and C-139 Annex flows. These adjustments to the baseline data set will be estimated during a future work effort.

Because STA-6 has been operating less than two years, limited historic data were used in this analysis. A summary of the available data for the G-600 inflow pump station (DBKEY GG955) and G606 discharge location (DBKEY HD889) is presented in Table 9-1. Monthly data for the period December 1997-April 1999 are presented in Figures 9-2 through 9-4 and in Appendix 9-1.

Table 9-1. Summary of Historic Flow and Phosphorus data – STA-6

	Inflow	**Outflow**
Flow (Period of record: December 1997 – April 1999)		
WY 1999 annual (acre-feet)	46,932	34,032
Phosphorus (Period of record: December 1997– April 1999)		
Minimum composite sample value (ppb)	10	9
Flow-weighted average (ppb)	57	20
Maximum composite sample value (ppb)	92	90

A summary of simulated inflows to STA-6 for the 31-year period (1965-1995) is presented in Table 9-2, using 57 ppb as the average inflow phosphorus concentration. The complete simulated annual inflow and phosphorus data set is found in Appendix 9-2.

Table 9-2. Summary of Simulated Inflows for Calendar Years 1965-1995 – STA-6

	Flow (acre-feet)	**Phosphorus (metric tons)**
Minimum annual	9,953	0.706
Average annual	24,445	1.733
Maximum annual	47,559	3.371

A summary of the combined baseline data set for STA-6 for the 31-year period (1965-1995) is presented in Table 9-3 and Figure 9-5. For purposes of this baseline data set, it was assumed that the outflow from STA-6 will be 25 ppb. This is 25% above the 17-month mean of 20 ppb, and is considered a reasonable estimate for the relatively young system