Lake Tarpon Drainage Basin Management Plan Update

2006

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1.0 Introduction

Lake Tarpon is the largest lake in Pinellas County with a surface area of over 4 square miles. Due to historically excellent water quality and healthy fish and wildlife populations, the lake has served as an important recreation resource. However, anthropogenic eutrophication of the lake increased rapidly in the 1990s.

The lake was formerly tidally influenced from a sinkhole on the northwestern shore of the lake. In 1967, an earthen dam and outfall canal discharging to Old Tampa Bay were constructed on the southern shore. Two years later, the Southwest Florida Water Management District (SWFWMD) built an earthen dike around the sinkhole leaving the outfall as the only point of discharge and eliminating the tidal and salt-water influence. The saltwater tidal influence resulted in wide fluctuations of the lake level. Construction of the outfall canal and sinkhole dike made the levels more controllable, which was especially important during storm events.

Pinellas County and SWFWMD staffs have been sampling the lake for selected water quality parameters since May of 1988 following a lake-wide algae bloom in 1987. Declining water quality led to the formation of a multi-agency committee in 1988 to address lake water quality issues.

In October of 1998, over a decade of studies on the lake culminated with the release of the Lake Tarpon Drainage Basin Management Plan prepared for Pinellas County by PBS&J consultants (PBS&J, 1998). The plan featured a list of goals that addressed water quality, aquatic vegetation, habitat, and fisheries.

This report will summarize the Drainage Basin Management Plan goals and the respective targets listed within the goals that have been completed as of January 2006.

2.0 Fisheries

Goal addressed: "The fish populations of the lake should be managed to provide for sustained quality fishing opportunities." (PBS&J, 1998).

Discussion: In September of 2003, the University of Florida's Department of Fisheries and Aquatic Sciences released a final report on the fisheries of Lake Tarpon (Allen et al., 2003) based on fish sampled from 1998 through 2002.. Their main goal was to assess the relationship between water-level fluctuation, both man-made and natural, and fish populations. The resulting data were then used to evaluate fishery health in the lake. The researchers utilized a variety of sampling methods, including: block nets, electrofishing, and otter trawls to compile data on abundance and recruitment.

Bluegill, redear, and largemouth bass make up 85% of the total fish biomass with bluegill representing about 50% of the total biomass. Largemouth bass support a popular recreational fishery and Lake Tarpon is often included in the list of top ten bass lakes in Florida. Anglers advocate catch and release with few fish being culled.

The results of the study indicate that largemouth bass recruitment was stable. But researchers found a negative relationship between spring and summer low water level and bass recruitment. A drought in 2000 resulted in lower than usual water levels during bass spawning season.

The abundance of black crappie, another recreationally important species, was low in Lake Tarpon. Poor recruitment to adulthood has been found in many southeastern lakes and is currently a topic of research by several universities. The low abundance, on the other hand, allows rapid growth in the surviving fish. Lake Tarpon crappies have some of the highest growth rates in the state, reaching harvestable size in one year.

Conclusion: The study concluded that the sport fish populations of Lake Tarpon, with the exception of black crappie, are in excellent shape. The study also concluded that minor (<1m) water level fluctuations would not adversely affect either vegetative habitat or sport fish recruitment in the lake. Future recommendations for fisheries management on Lake Tarpon include the implementation of a 254-mm TL (total length) minimum length limit for black crappie, improvement of survivability of black crappie to spawning age, and continued monitoring of the lake fisheries.

3.0 Chestnut Park Water Quality Improvement Study

Goals addressed: "The lake and watershed should be managed to restore and enhance habitat abundance and diversity." "Construct and maintain enhanced stormwater treatment facilities in the priority MHUs and individual sub-basins" (PBS&J, 1998).

Discussion: In 2001, PBS&J presented a conceptual design report on the feasibility of treating stormwater run-off from the Group-C sub-basins and improving the ecological functions and overall water quality of the Chestnut Park recreational pond system. The recreational pond is located in John Chestnut Sr. Park, a County-owned facility located on the southeastern shore of Lake Tarpon. The Group-C sub-basins (sub-basins 45, 46, 47, and 48) are located just north of the park and encompass 337.2 acres (Appendix A). The report listed three objectives: provide water quality treatment for non-point source discharges from the Group-C sub-basins; improve water quality conditions in the Chestnut Park recreational pond system; and enhance the diversity and coverage of the native aquatic vegetation, and fish and wildlife habitat, in the Chestnut Park recreational pond (PBS&J, 2001).

To limit nutrient loading from the Group-C sub-basins, the report recommended the installation of an alum (aluminum sulfate) system to reduce levels of phosphorus, nitrogen, and bacteria from the run-off entering the pond. Due to lack of available land, wet detention systems were not considered a viable option. The proposed system would be installed at a box culvert along the Channel-U ditch system. Flocculent material, resulting from the injection of alum into the discharge, would settle into the 1500-foot long ditch. A diversion structure would also be constructed to divert large flow events over an existing wetland, minimizing flow into the alum system.

Conclusion: The results of the study indicate the main contributor to poor water quality in the Chestnut Park recreation pond was runoff from the Anchorage subdivision. The Chestnut Park recreational pond has been degraded by poor water quality, excessively shallow depths, and lack of native vegetation. The report recommended a series of steps to include:

- Severing the hydrologic connection between two small feeder ponds entering Chestnut pond

- Excavating the small ponds to form one large pond to treat runoff from the Anchorage subdivision

- Constructing an outfall system to divert flow from the treatment pond across an existing forested wetland to provide additional retention and attenuation for water quality treatment

Three recommendations were made to improve the vegetation and wildlife habitat in the pond. The report suggested dewatering the pond and removing accumulated sediment to deepen the ponds. While the pond was dewatered, grass carp would be netted or electro-fished and removed. When the pond was refilled, native plants would be placed along the shoreline based on both a forested and herbaceous zone scheme. Planting options were outlined in the report.

The Parks Department may pursue the Chestnut Pond project, but it is not yet on the Capital Improvement Project list through 2010.

4.0 Lake Tarpon Groundwater Nutrient Study

Goal addressed: "The lake should be managed such that good water quality is assured" (PBS&J, 1998).

Discussion: As part of the Drainage Basin Management Plan goal for water quality in the lake, Pinellas County and the Southwest Florida Water Management District entered into a cooperative funding agreement to assess groundwater nutrient loading to Lake Tarpon. The firm of Leggette, Brashears and Graham, Inc. was contracted for the study(Leggette, Brashears and Graham, Inc., 2004). The objectives of the study were to:

Establish a shallow ground-water monitoring network around the lake capable of providing long-term monitoring of surficial aquifer nutrient flux to the lake

Develop a ground-water flow net and nutrient flux model to provide updated nutrient flux estimates to the lake

Assess the nutrient load from existing septic tanks and evaluate the potential load reduction to the lake by replacing septic tanks with a central sewer system

Evaluate surficial aquifer water quality in the following geographic areas: 1) Highland Lakes Golf Club; 2) west and northwest regions of the lake; and 3) east and northeast regions of the lake. The installation of two monitoring wells planned for the Highland Lakes Golf Course was cancelled when site access was denied.

Establishment of a shallow ground-water monitoring network involved installation of 24 monitoring wells (Appendix B). The remainder of the network consisted of seven existing wells. The 31 monitoring wells sampled during the period of May 16, 2002 to June 4, 2002 representing dry season conditions, and the period of October 22, 2002 to October 28, 2002 representing wet season conditions. Additional samples from 17 wells were taken in October for nitrogen isotope analysis. This analysis determines if the nitrogen is organic (septic tanks, animal waste) or inorganic fertilizer.

Conclusion: The estimated TN discharge into Lake Tarpon during the dry season was 22.6 pounds/day. The majority of loading occurred in the southwest quadrant of the lake (19.03 pounds/day) and the northeast quadrant of the lake (4.57 pounds/day). The estimated TN discharge into Lake Tarpon during the wet season was 28.1 pounds per day. The majority of loading occurred in the southwest quadrant (14.11 pounds/day) of the lake. TP discharge into Lake Tarpon from May 2002 data was 1.4 pounds/day. The majority of loading occurred in the southeast quadrant (0.575 pounds/day) and southwest quadrant (0.523 pounds/day). Similarly, TP discharge into Lake Tarpon during the wet season was 1.59 pounds/day. The majority of loading occurred in the southwest (0.486 pounds/day) and southeast quadrants (0.481 pounds/day). Monitor wells NP-141, LT-18, and LT-1 account for 78% of the nitrogen discharges to the lake in the dry season. Monitor wells NP-141 and LT- 1 account for 70% of the nitrogen discharges to the lake for the wet season.

Monitor wells NP- 141 and TLV-177 accounted for 59% of the phosphorous discharges to the lake in wet season and 53% of the phosphorous discharges in the dry season. Both of these wells are in sewered residential areas. The isotope analysis for NP-141 indicates that fertilizer is the source of nitrogen. It is assumed that orthophosphate in this area is also from fertilizer.

The study estimated that septic tanks contribute 0.97 tons of TN and 0.05 tons of TP to Lake Tarpon. Fertilizer contributes 3.63 tons of TN and 0.21 tons of TP. The loading from septic tanks could easily be removed by conversion to sanitary sewer. Treatment of fertilizer loading is more problematic. The Basin Plan (PBS&J 1998) recommends that the immediate Lake Tarpon Basin be designated a “nutrient sensitive watershed” with appropriate ordinances and public education.

5.0 CIP Project Updates

Goal addressed: "Construct and maintain enhanced stormwater treatment facilities in the priority MHUs and individual sub-basins" (PBS&J, 1998).

Discussion: Three projects to improve water quality and reduce nutrient loading to the lake, as outlined in the Lake Tarpon Drainage Basin Management Plan, are in the current CIP (Capital Improvement Project) schedule:

1. Lake Tarpon Sub-basin 6, Florida Department of Transportation (FDOT) pond modification, fiscal year (FY) 2005 - FY 2007

This project will modify the existing FDOT pond located in sub-basin 6 (at E. Oakwood Dr. and U.S. 19) to enable total phosphorus to be precipitated much more efficiently through the use of an alum injection system. The approximately 3-acre pond was originally constructed to treat stormwater runoff from section of US19. An existing 72" pipe conveying untreated stormwater from the commercial, residential and light industrial areas north and west of this area was rerouted into the system to provide minimal stormwater treatment before release into an adjacent wetland area. The pond currently services an area of approximately 360 acres. The addition of the alum injection system will provide an estimated reduction of pollutants as follows: 90% of total suspended solids (14.13 tons/year), 85% of total phosphorus (0.66 tons/year), and 50% of total nitrogen (2.53 tons/year).

2. Lake Tarpon Water Quality Area 63, FY 2007 - 2008

This project has the potential to remove 40% of the total nitrogen (1.11 tons/year) and 90% of the total phosphorus (0.20 tons/year) load entering from the 570 acres of older residential and agricultural land uses that currently have little or no stormwater treatment. MHU (major hydrologic unit) A contributes the highest biological oxygen demand (BOD) and phosphorus load to Lake Tarpon (PBS&J, 1998). This project, combined with five additional stormwater rehabilitation projects within the basin, is necessary to meet the goals and objectives outlined the Lake Tarpon SWIM Plan, Pinellas County Comprehensive Plan, and the Tampa Bay Estuary Program Comprehensive Conservation Management Plan. This project consists of the design, construction, and operation of an off line alum system to treat water in sub-basins 60, 62, 63, 65 and 66 (MHU A) in the Lake Tarpon drainage basin. The prospective site is at the George Street (Hunt) canal at Old East Lake Road.

3. Lake Tarpon Water Quality Area 23, FY 2007 - 2008

This project will treat stormwater discharge from sub-basin 23 before it reaches Lake Tarpon. The project will consist of an alum system that will be located at the intersection of Schultz Rd., South Canal Dr. and Jodi Ln. This project has the potential to remove 40% of the total nitrogen (0.67 tons/year) and 90% of the total phosphorus (0.05 tons/year) load from 212 acres of residential and agricultural land uses.

6.0 Lake Tarpon and Tributary Water Quality Data

Goal addressed: "The lake should be managed such that good water quality is assured" (PBS&J, 1998).

Discussion: The Water Resources Management Section of the Pinellas County Department of Environmental Management conducted water quality monitoring for Lake Tarpon, the Outfall canal, and some of the major tributaries that flow into the system, as part of it's Surface Water Ambient Water Monitoring Program (SWARM). Continued monitoring of water quality in the lake and tributaries provides data used to estimate the lake's nutrient budget, nutrient loadings, and Trophic State Index.

The data was collected from a series of fixed sampling locations from 1997-2002. The open water fixed station sampling program was discontinued in 2002, and re-designed and implemented as a stratified random monitoring program in 2003. The Outfall Canal, Brooker Creek, and Cow Branch Creek sites remained as fixed monitoring location. The data is presented in Appendix C.

The fixed monitoring site descriptions are:

* Site 4-2 - Brooker Creek @ north side of bridge on Keystone Rd. over the creek
* Site 4-3 - Brooker Creek @ north side of Tarpon Woods Blvd bridge
* Site 6-3 - Cow Branch Creek @ northwest corner of Tampa Rd. and Lake St. George intersection, at entrance to strip mall
* Site 6-4 - Lake Tarpon Outfall Canal @ control structure on East Lake Rd., ¼ mile north of Curlew Rd.

Conclusion: An average annual multi-parametric Trophic State Index (TSI) value was calculated for Lake Tarpon for each year from 1988 to 2004 ((Appendix C, Fig. C.1)). According to the Drainage Basin Management Plan, the target TSI value for Lake Tarpon should be maintained at 55 or less. The average value from 1988 to 2004 is 54.64.

The total nitrogen (TN) concentration graphs show no clear trend (Fig. C.2). Site 4-2 reflected a large increase in 1999. No samples were taken in 2000 because it was a drought year and there was no flow at the site. The increased concentration in site 4-2 was likely due to accumulation of material during the drought that was flushed out when the rains returned.

Chlorophyll-a concentrations showed an increase in 2000 for Lake Tarpon, and sites 4-3 and 6-3 (Fig. C.3). This may be due to drought conditions in 2000 which likely reduced lake flushing. From 2000 through 2004 the concentration trend is declining for site 6-4, and stable for the rest.

Total phosphorus (TP) concentrations show a stable trend from 1997 through 2004 (Fig. C.4). There was a big decrease from 1997 to 1998 for site 4-3, then it remained stable. The 2000 drought did not appear to affect TP concentrations.

Total suspended solids concentration remained stable for all sites, except 4-2 which showed a large increase from 1998 to 1999 (Fig. C.5). This may be a result of the drought in 2000, which began in late 1999. The increased concentration in Site 4-2 was likely due to accumulation of material during the drought that was flushed out when the rains returned. After 2001, site 4-2 remained stable.

Periodic sampling at established stormwater outfalls was recommended in the Interim Task Report 3.2.11 Development of Monitoring Programs of the Lake Tarpon Drainage Basin Management Plan (Coastal Environmental, Inc., 1998). Monitoring involved sampling of the five priority basins and the gauged portion of Brooker Creek. Priority tributary sampling was conducted in 1997, 1998, 2000 and 2001. Sample frequency was determined in a stratified random method where the number of samples collected per month was determined from mean monthly rainfall and sampling dates selected at random within each month. Parameters measured included ammonia, nitrate-nitrite, total phosphorus, ortho phosphorus, total suspended solids and total organic carbon. Initially, total Kjeldahl nitrogen was measured, but the Southwest Florida Water Management District laboratory switched to direct measurement of total nitrogen in 2000. Results were used to calculate nonpoint source runoff loading to Lake Tarpon.

For site 4-3, the tributary data were combined with the SWARM and available flow data to estimate nutrient loading to Lake Tarpon. The SWARM data are presented with and without tributary sampling results. SWARM and flow data were also collected at site 4-2 to determine loading from Lake Tarpon into Tampa Bay. The data for both sites are presented in Appendix B.

Loadings for TN, TSS, and TP at site 4-3 with tributary and SWARM data show an increase from 1998 to 1999, then a decrease through 2001 (Fig. C.6 and C.7). Further calculations using SWARM data show an increase in loading for all three parameters to 2003, then a decrease in 2004 (Fig. C.8 and C.9).

Loadings for TN, TSS, and TP at site 4-3 with tributary and SWARM data show a decrease from 2003 to 2004 (Fig. C.10 and C.11). Flow was slightly higher at site 4-2 in 2003 than 2004, but the opposite was true for site 4-3, so it is unlikely that flow was a factor in the difference in loadings between 2003 and 2004.

7.0 Lake Tarpon Nutrient Budget

Goal addressed: "The lake should be managed such that good water quality is assured" (PBS&J, 1998).

Discussion: Target five under the goal recommended that a lake nutrient budget be calculated yearly. This was not possible until recently when outfall data became available. Budgets were calculated for 1997, 1998, 2000, 2001, 2002, 2003, and 2004.

An average budget was calculated from the available data and compared to the Basin Plan budget (Appendix D). Direct runoff was calculated using the loads determined from four years of Priority Tributary sampling. The atmospheric deposition portion of the total budget was estimated from the Basin Plan budget. WRMS staff collected bulk atmospheric deposition samples at Chestnut Park from June 1997 to June 1999.

Conclusion: The average TN load was higher than previously estimated, but within 7% of the value in the Basin Plan. The average TP load, calculated from the tributary study, was lower and differed 19% from the modeled figure. Annual loading of TN was 10.72 tons/year, while TP loading was 0.55 tons/year (Baltus & Squires, 1999). The Tampa Bay Estuary Program (TBEP) reported a baywide loading of 838 tons/year (Poor et al., 2001). Extrapolation of the area of Lake Tarpon relative to total baywide loadings resulted in a value of 8.38 tons/year for TBEP data. The average of the Baltus & Squires (1999) and TBEP (2001) data is 9.55, which is close to the 9.9 tons/year value used in the Basin Management Plan.

In the Average Annual Nitrogen Inflow Budget there is 4.29 tons/year of unaccounted nutrients. Possible sources for this loading may come from Boot Ranch development, ungauged portions of Brooker Creek, nitrogen fixation by blue-green algae, or Lake St. George.

8.0 Aquatic Vegetation

Goal addressed: "Vegetation shall be managed to maintain nuisance aquatic plants to the lowest feasible level while encouraging beneficial native plants to establish" (PBS&J, 1998).

Discussion: The Southwest Florida Water Management District is responsible for treatment and removal of nuisance and invasive vegetation on the lake proper, while Pinellas County is responsible for maintaining the canal system of the lake. The Florida Department of Environmental Management oversees the vegetation removal program and performs a survey each year on Lake Tarpon. According to the targets outlined in the goal, native plants should ideally cover 600 acres, or >24% of the lake bottom, while hydrilla should be managed to less than 100 acres. Hydrilla coverage is within target but native plant coverage is still under the ideal acreage goal.

Conclusion: In 2003, the survey counted 143 acres of coontail (*Ceratophyllum demersum*), which is a desirable native aquatic plant. Coontail was present in 2004 and 2005 , but not quantified in the survey. Cattails (*Typha* spp.) covered 76 acres of the lake in 2003, and were present in 2004, but not 2005. Cattails are native plants, but can become invasive in a nutrient-rich environment. Hydrilla (*Hydrilla verticillata*), an invasive exotic, covered 76 acres of the lake in 2003, 147.6 acres in 2004, and 126 acres in 2005.

9.0 Aquifer Storage and Recovery Study

Goal addressed: "Construction of pump stations and distribution lines for the storage and beneficial reuse of lake discharge water" (PBS&J, 1998).

Discussion: In 2001, PBS&J released a report on a study to evaluate the feasibility of storing, recovering, and using surface water discharged from Lake Tarpon into Tampa Bay. The Lake Tarpon Outfall Canal is used to manage lake level fluctuations. The Drainage Basin Management Plan recommended altering the operational schedule off the outfall structure to enhance lake level fluctuations. The excess fresh water discharged into Tampa Bay could possibly be a resource; direct withdrawal from the lake could have additional benefits.

Conclusion: The report recommended Aquifer Storage Recovery (ASR) as the primary mechanism for storage. The report listed the best reuses of stored Lake Tarpon surface water: lake management (i.e. to replenish lake levels if there is a long term drought) and augmentation of the County reclaimed water supply. The report found that two test well sites, one at Chestnut Park and the other at the Outfall Canal, were both feasible for Aquifer Storage and Recovery. However, following the 2001 study, the site at the outfall was considered unsuitable after it was discovered that the storage zone contained mineralized water (salty) and inadequate confinement. Pinellas County Utilities has constructed an exploratory well at Chesnut Park and results indicate a suitable storage zone exists. FDEP has issued an ASR test well permit for this site and construction should commence in FY 2006.

10.0 References

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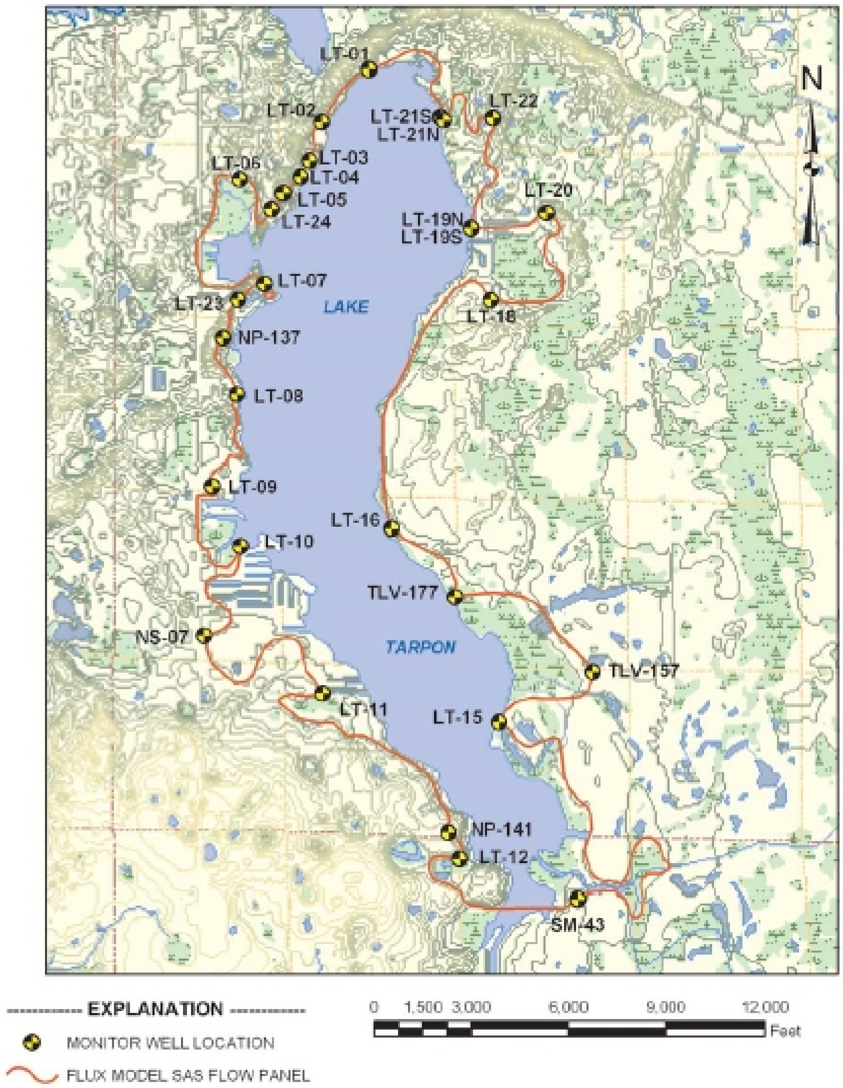
Poor, N., Pribble, R., & Greening, H. (2001). Direct wet and dry deposition of ammonia, nitric acid, ammonium and nitrate to the Tampa Bay Estuary, FL, USA. *Atmospheric Environment, 35,* 3947-3955.

Tihansky, A. B. & Sacks, L. A. (1997). *Evaluation of nitrate sources using isotope techniques in shallow ground water within selected lake basins in Central Lake District, Polk and Highlands Counties*, *Florida*. U. S. Biological Survey Water-Resources Investigations Report.

Appendix A


Figure 1-1 Project Location Map
Basin Boundary
3500
0
3500 Feet
Lake Tarpon
Group-C Sub-Basins
Sub-Basin 44

Appendix B



LAKE TARPON
GROUNDWATER NUTRIENT STUDY

MAP VIEW OF FLOW PANELS USED FOR THE
NUTRIENT FLUX CALCULATIONS FOR LAKE TARPON

DATE	REVISED	PREPARED BY:
		LEGGETTE, BRASHEARS & GRAHAM, INC. Professional Ground-Water And Environmental Engineering Services 10014 N. Dale Mabry Hwy, Suite 205 Tampa, Florida 33618 (813) 968-5882
		DATE: 8/2004 FIGURE: 28

Figure28.CDR

Appendix C

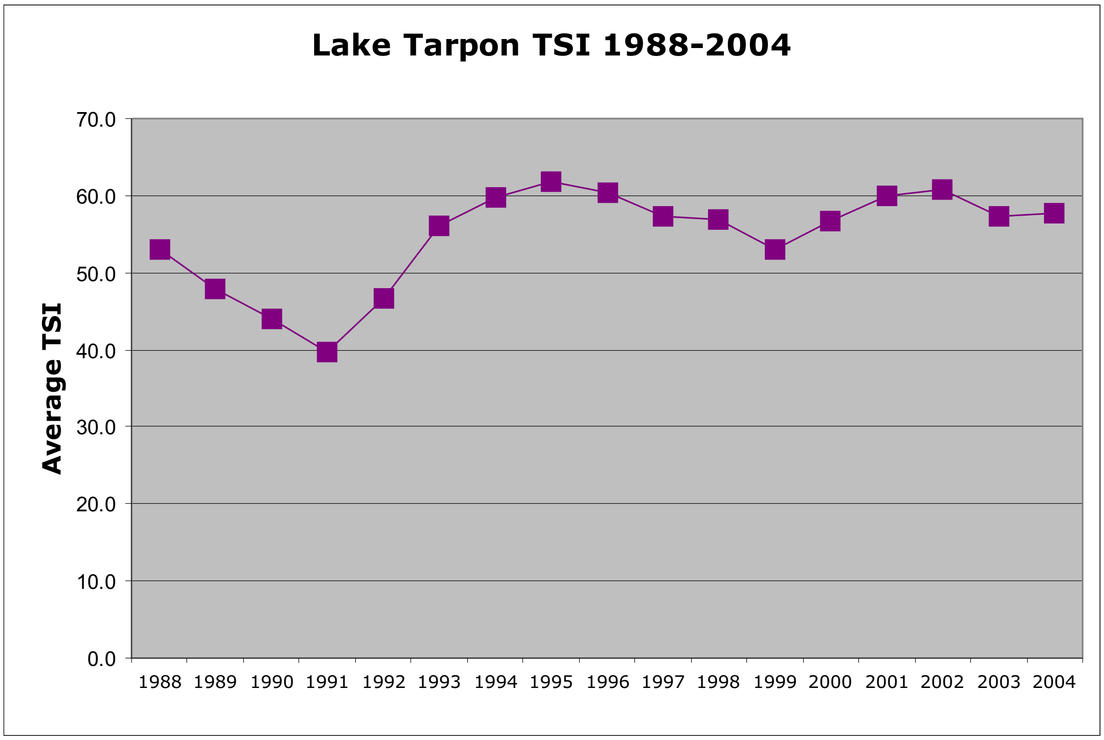


Fig. C.1 Lake Tarpon Average TSI

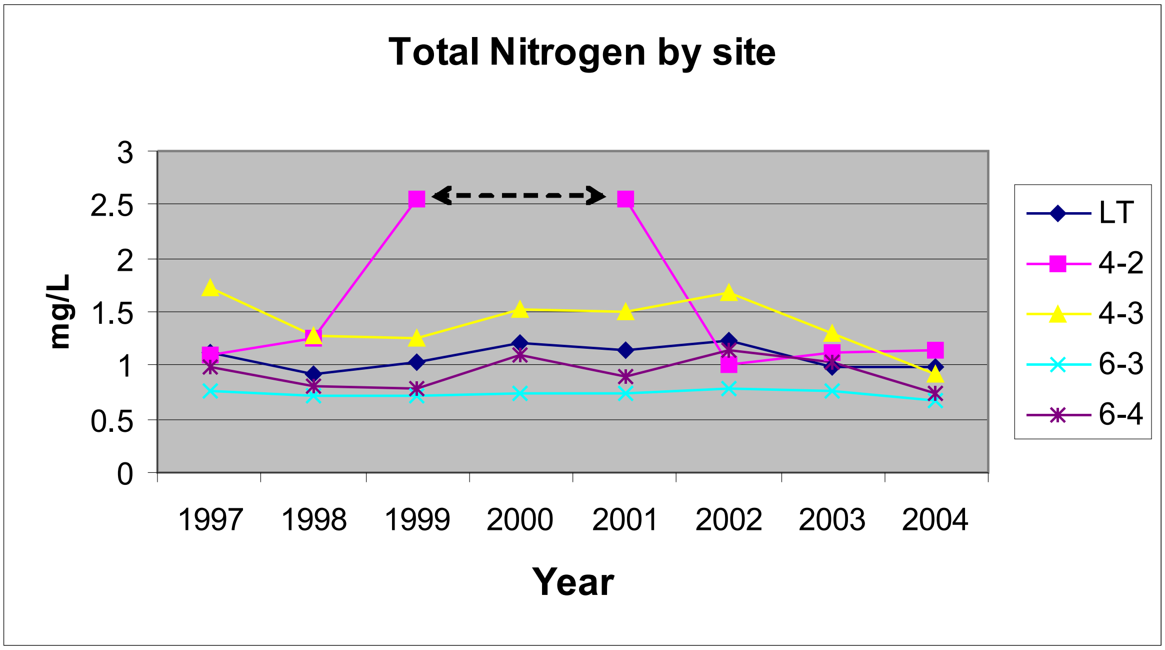


Fig. C.2 Total Nitrogen by Site (2000 was drought year- no samples taken at site 4-2)

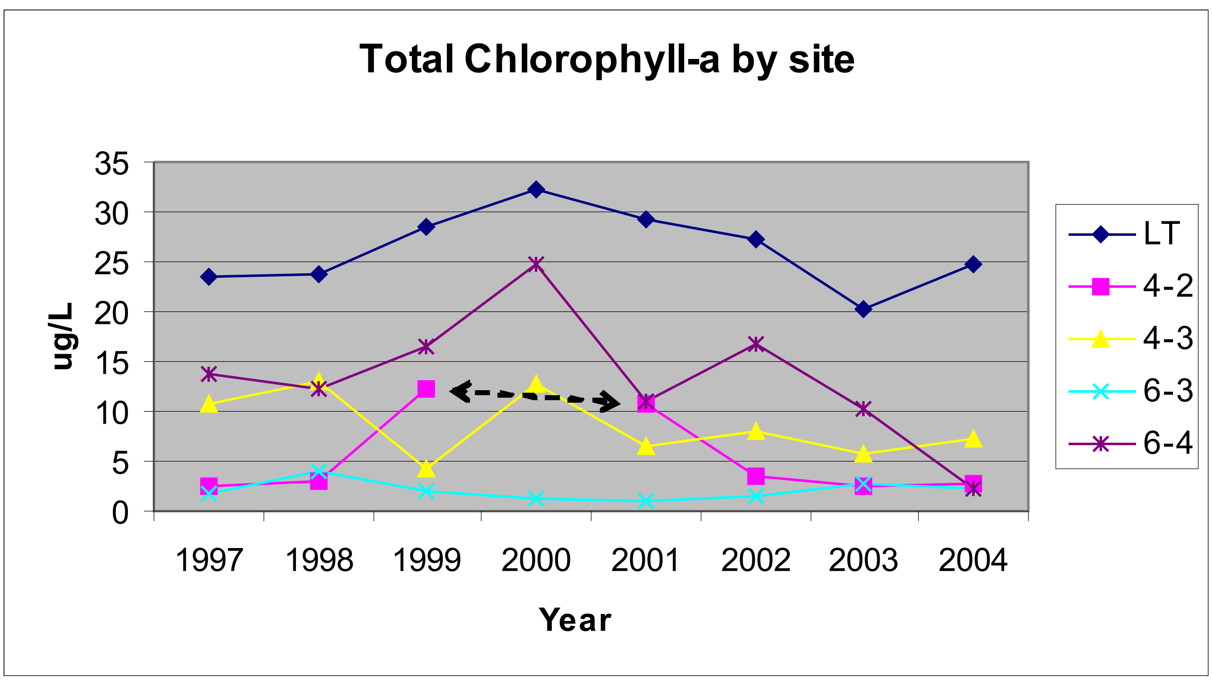


Fig. C.3 Total Chlorophyll-a by Site (2000 was drought year- no samples taken at site 4-2)

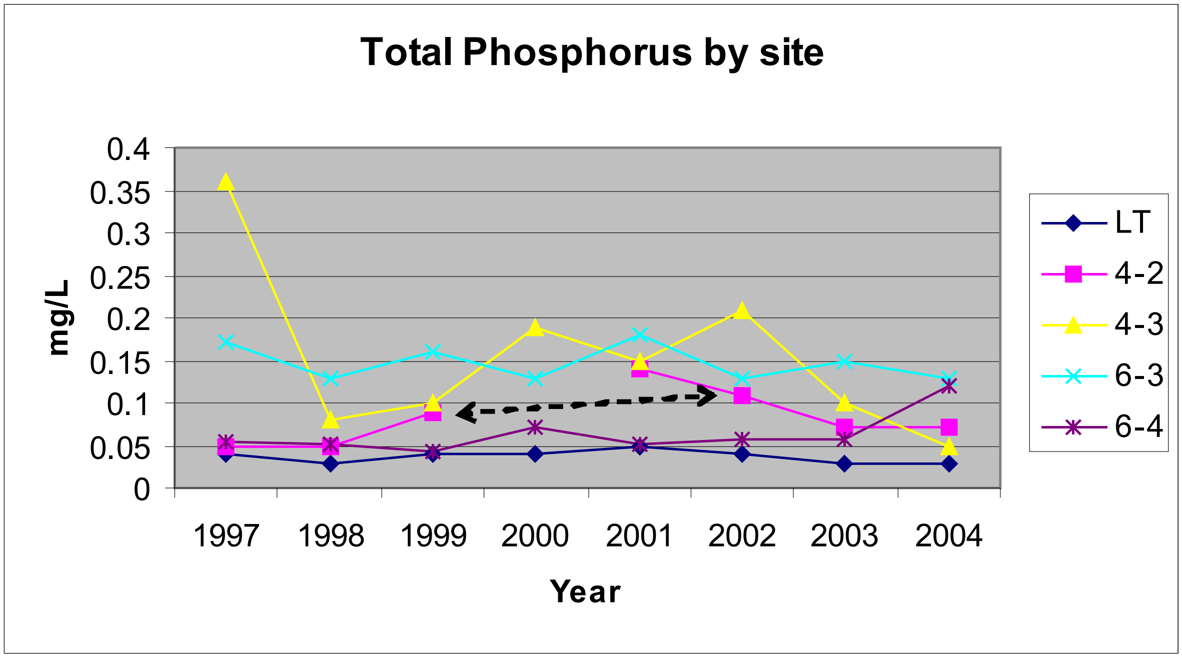


Fig C.4 Total Phosphorus by Site (2000 was drought year- no samples taken at site 4-2)

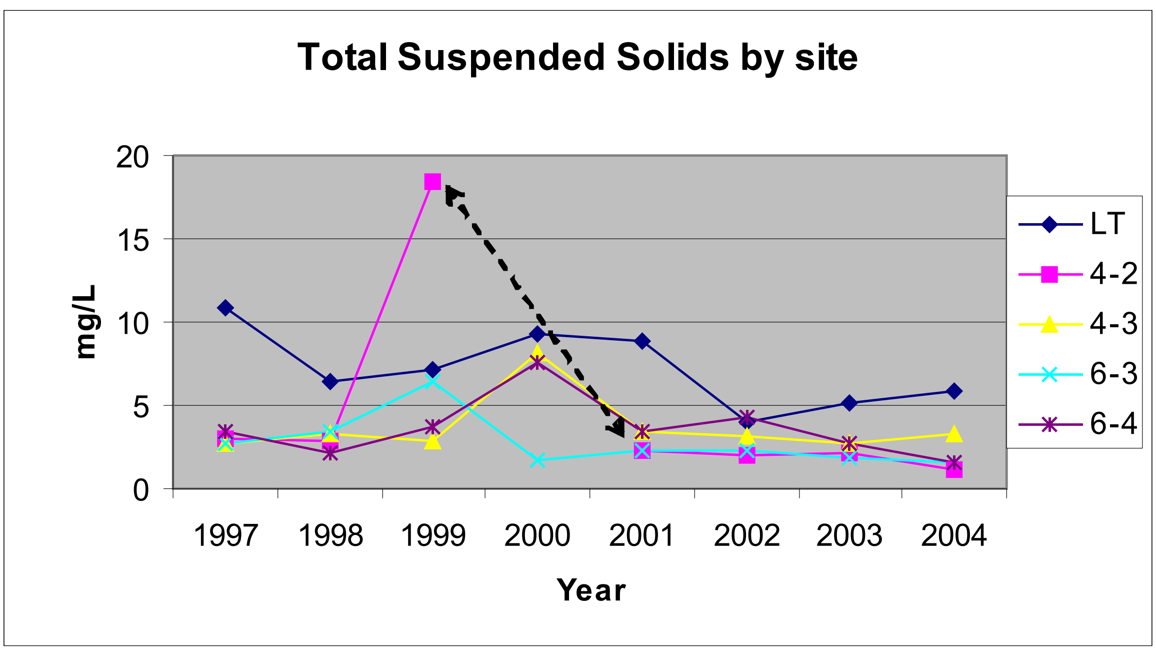


Fig. C.5 Total Suspended Solids by Site (2000 was drought year- no samples taken at site 4-2)

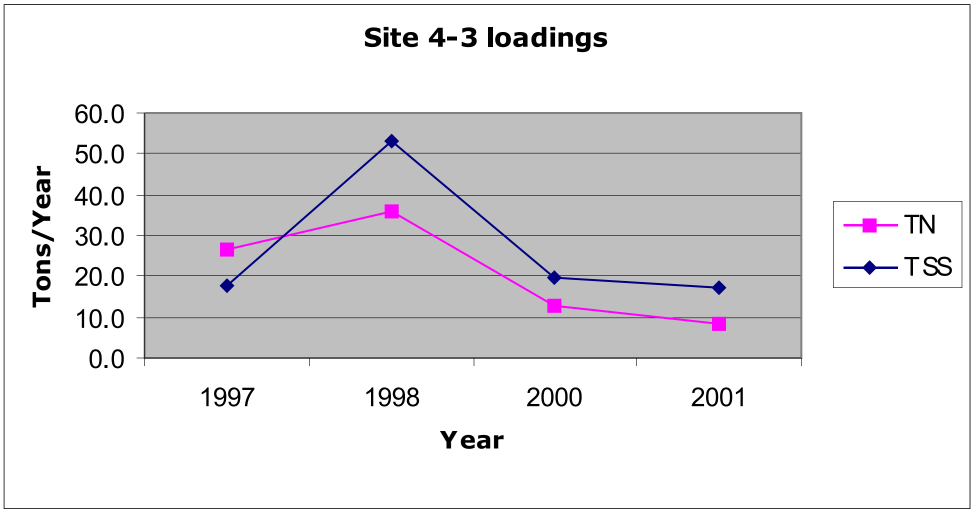


Fig. C.6 Estimated Total Nitrogen and Total Suspended Solids Loadings from Site 4-3.

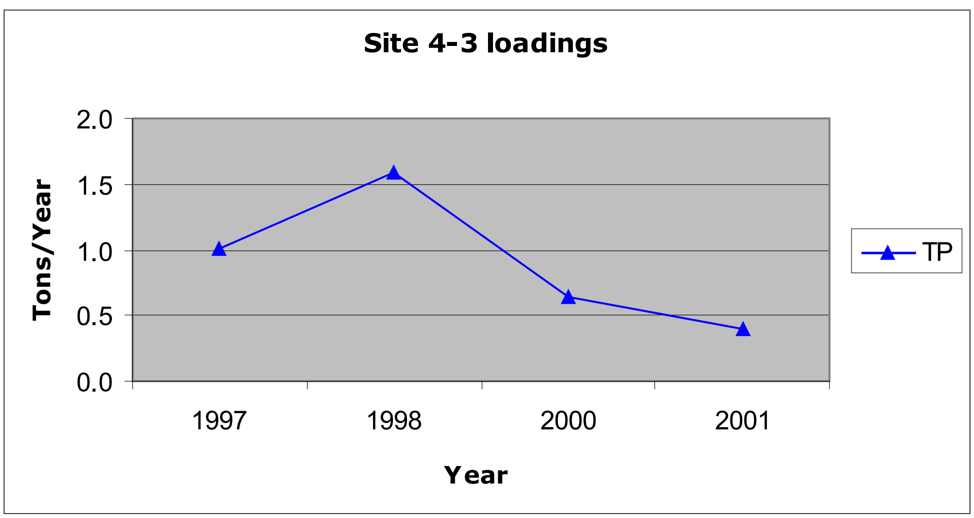


Fig. C.7 Estimated Total Phosphorus Loadings from Site 4-3.

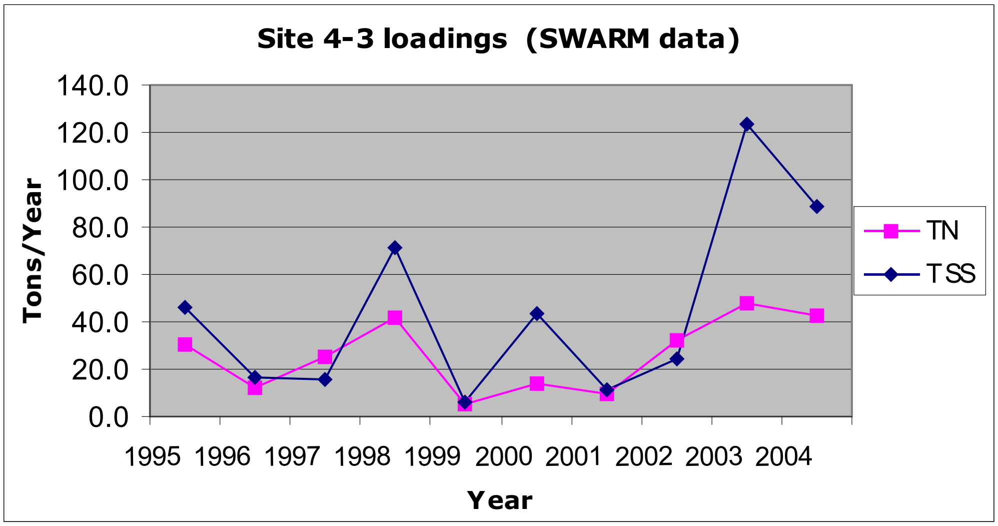


Fig. C.8 Estimated Total Nitrogen and Total Suspended Solids Loadings from Site 4-3.

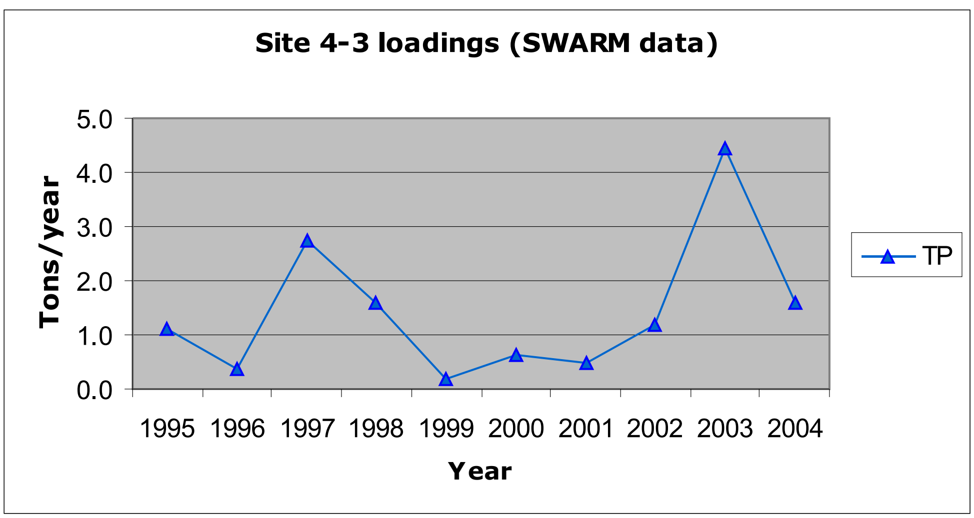


Fig. C.9 Estimated Total Phosphorus Loadings from Site 4-3.

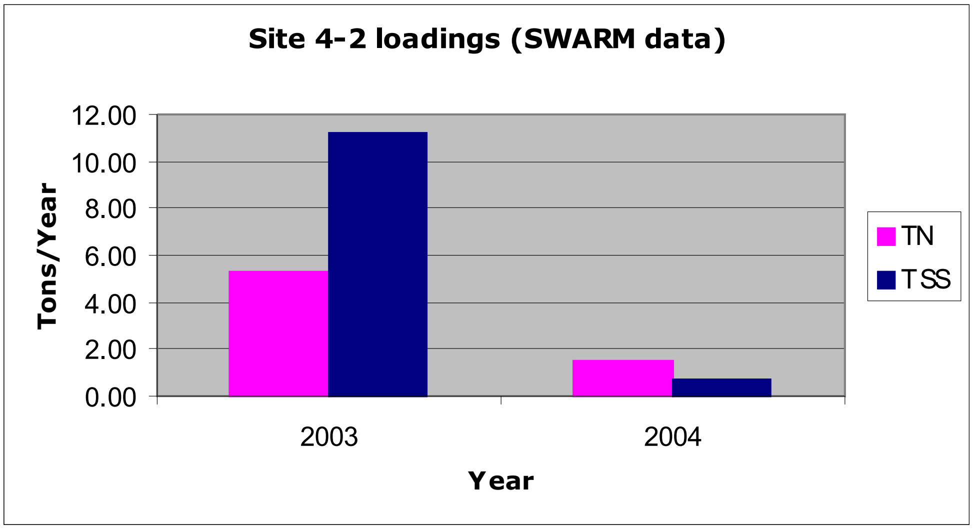


Fig. C.10 Estimated Total Nitrogen and Total Suspended Solids Loadings from Site 4-2.

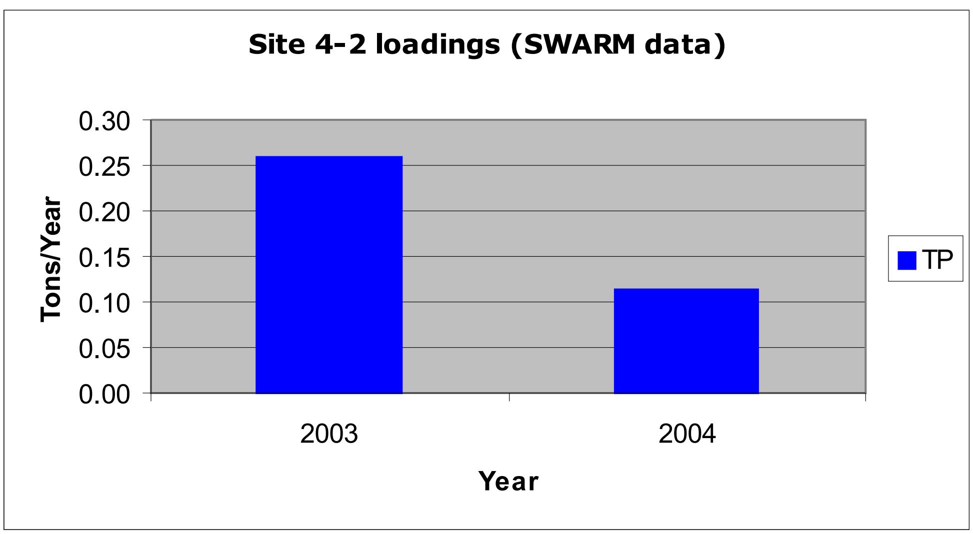


Fig. C.11 Estimated Total Phosphorus Loadings from Site 4-2.

Appendix D

Estimated Annual Total Nitrogen Budget			
	Tons/year	% of Total	References
INFLOWS			
Direct Runoff	29.43	39.5%	Priority Tributary Data and PBS&J 1998
Atmospheric Deposition	9.99	13.4%	PBS&J 1998
Brooker Creek (gauged)	25.43	34.1%	1995 - 2004 DEM data
South Creek	0.30	0.4%	2003-2004 DEM data
Septic Tanks (OWTS)	0.97	1.3%	LBG 2004
Surficial Aquifer Seepage	3.63	5.2%	LBG 2004
Florida Aquifer Seepage	0.35	0.5%	Upchurch 1998
Unaccounted Nutrients	4.29	5.8%	Boot Ranch, ungauged Brooker Creek, Lake St. George
TOTAL	74.48	100.0%	
OUTFLOWS			
Outfall Canal Discharge	73.47	98.7%	2001-2002 DEM data
Fish Harvest	0.7	0.9%	PBS&J 1998
Sedimentation and Macrophyte Biomass	0.3	0.4%	calculated as the difference between total inflow and the sum of the outfall canal discharge and fish harvest outflows
TOTAL	74.48	100.0%	

Table D.1 Total Nitrogen Nutrient Budget

Estimated Annual Total Phosphorus Budget			
	Tons/year	% of Total	References
INFLOWS			
Direct Runoff	3.26	60.7%	Priority Tributary Data and PBS&J 1998
Atmospheric Deposition	0.2	3.7%	PBS&J 1998
Brooker Creek (gauged)	1.25	23.3%	1995 - 2004 DEM data
South Creek	0.05	0.9%	2003-2004 DEM data
Septic Tanks (OWTS)	0.05	0.9%	LBG 2004
Surficial Aquifer Seepage	0.21	3.9%	LBG 2004
Florida Aquifer Seepage	0.35	6.5%	Upchurch 1998
TOTAL	5.04	100.0%	
OUTFLOWS			
Outfall Canal Discharge	3.62	67.4%	2001-2002 DEM data
Fish Harvest	0.24	4.5%	PBS&J 1998
Sedimentation and Macrophyte Biomass	1.51	28.2%	calculated as the difference between total inflow and the sum of the outfall canal discharge and fish harvest outflows
TOTAL	5.37	100.0%	

Table D.2 Total Phosphorus Nutrient Budget

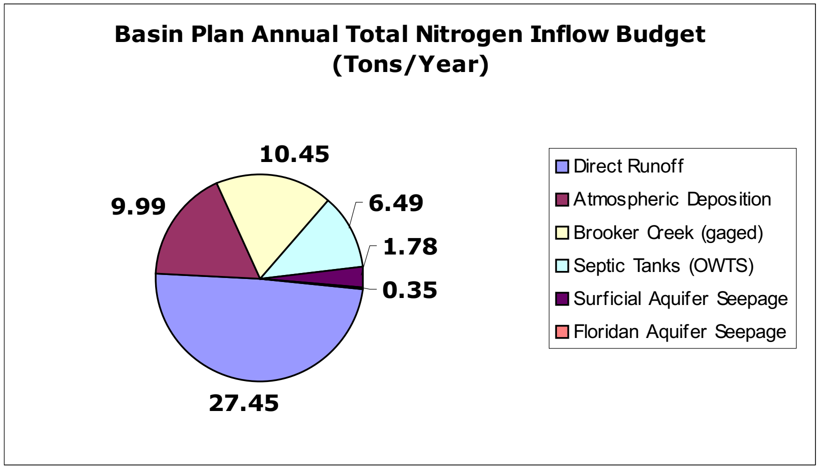


Fig. D.3 Basin Plan Nitrogen Inflow Budget

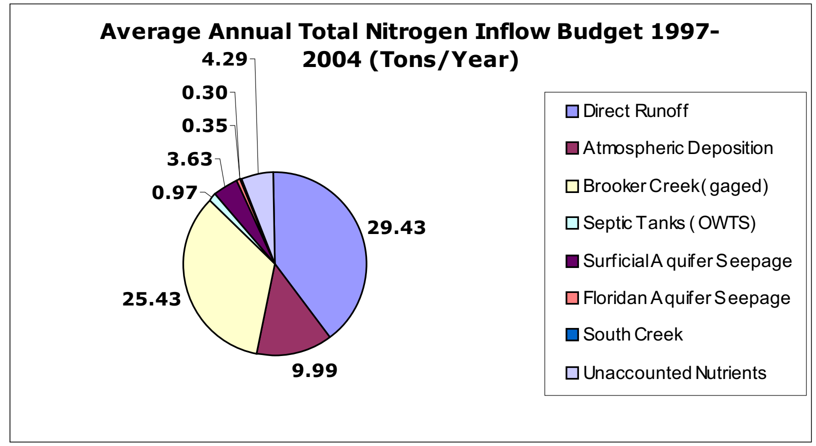


Fig. D.4 Average Annual Nitrogen Inflow Budget

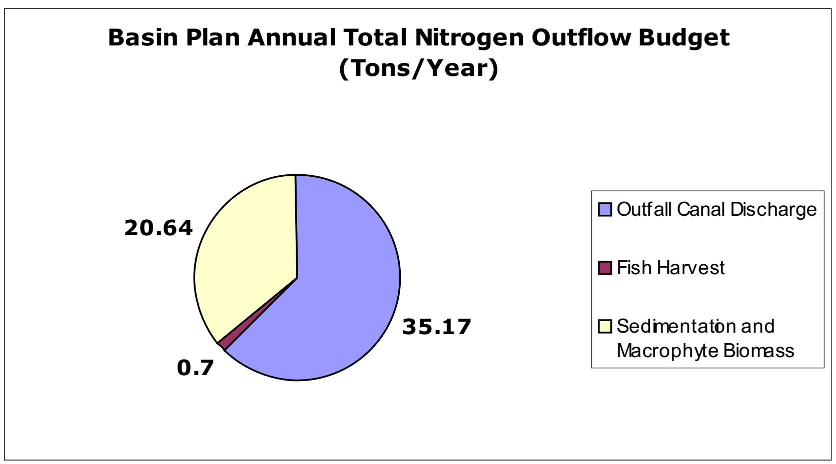


Fig D.5 Basin Plan Nitrogen Outflow Budget

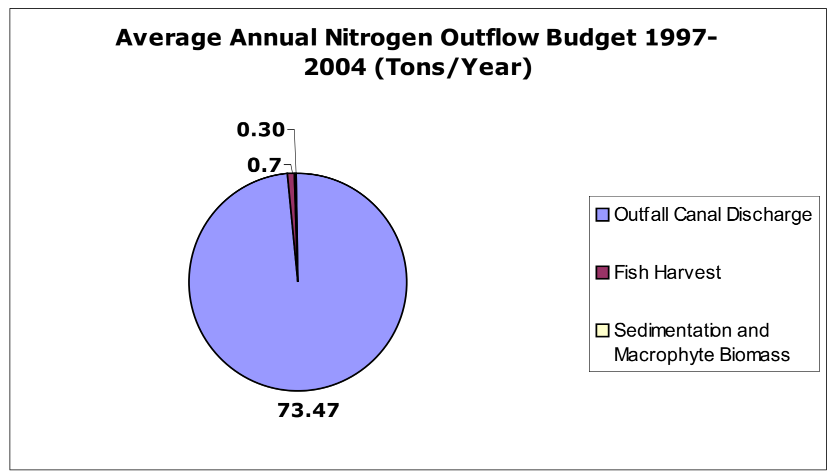


Fig. D.6 Average Annual Nitrogen Outflow Budget

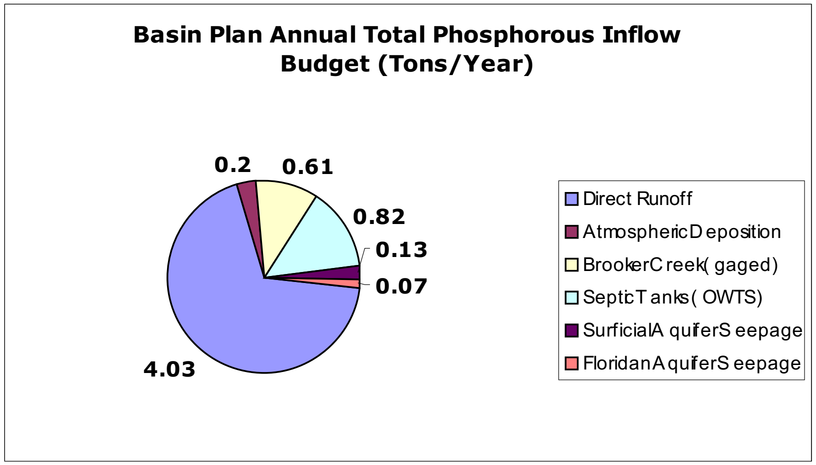


Fig. D.7 Basin Plan Phosphorus Inflow Budget

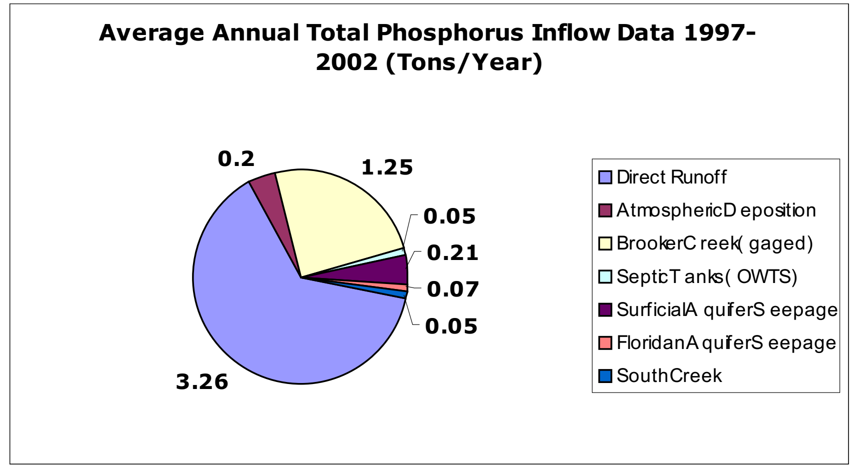


Fig. D.8 Average Annual Phosphorus Inflow Budget

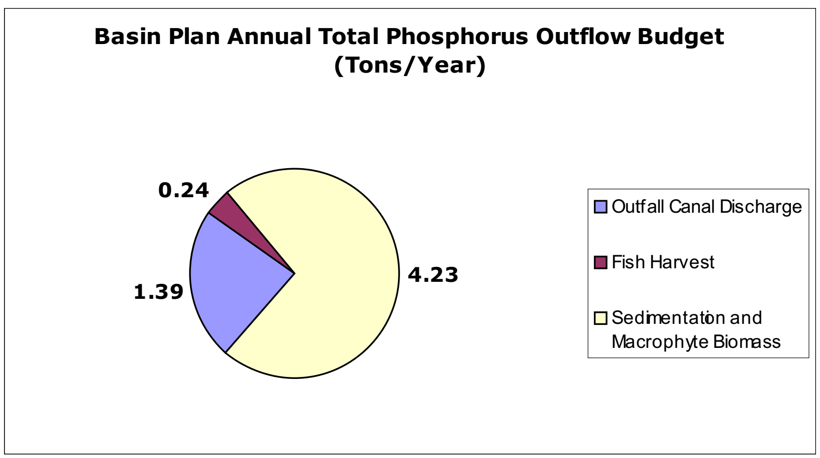


Fig. D.9 Basin Plan Phosphorus Outflow Budget

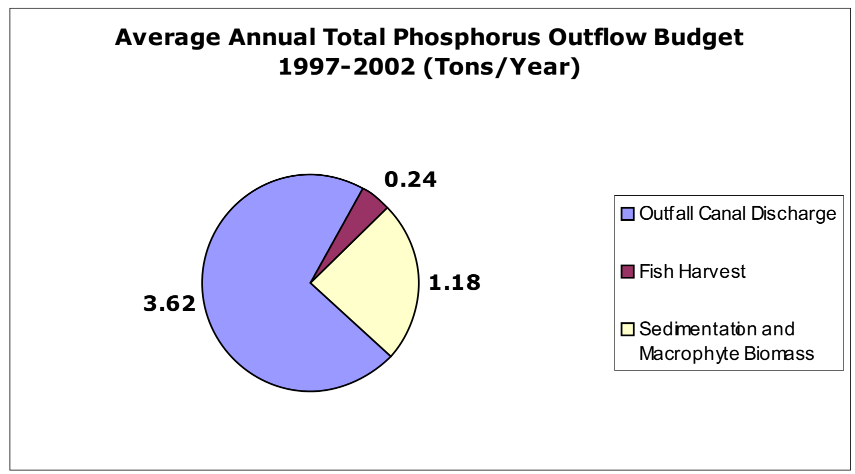


Fig. D.10 Average Annual Phosphorus Outflow Budget