Lake Tarpon

Surface Water Improvement & Management (SWIM) Plan

Southwest Florida
Water Management District

July 2001

ACKNOWLEDGMENTS

Development of this update of the Lake Tarpon Surface Water Improvement and Management (SWIM) Plan was facilitated by Pinellas County's development of the Lake Tarpon Drainage Basin Management Plan or DBMP (PBS&J 1998). The Lake Tarpon Drainage Basin Management Plan was developed by Coastal Environmental/PBS&J in conjunction with the Lake Tarpon Management Committee.

Although there are too many individuals to list by name, the District would like to acknowledge the hard work of the members of the following groups or agencies represented on the Lake Tarpon Management Committee who contributed to the DBMP (PBS&J 1998) and ultimately the Lake Tarpon SWIM Plan.

Pinellas County Department of Environmental Management (PCDEM)
Florida Department of Environmental Protection (FDEP)
Southwest Florida Water Management District (SWFWMD)
Florida Fish and Wildlife Conservation Commission (FFWCC)
City of Tarpon Springs
Save Our Lake, Invite Discussion (SOLID)
East Lake Homeowners Association
Highland Lake Homeowners Association
The development community at large (represented by Lansbrook Development Corp.)

TABLE OF CONTENTS

EXECUTIVE SUMMARY

With a surface area of approximately four square miles (2,534 acres), Lake Tarpon is the largest freshwater lake in the three county (Pinellas, Hillsborough, Pasco) Tampa Bay area. In addition to being classified as an Outstanding Florida Water by the Florida Department of Environmental Protection, the lake was formally designated as a state Fish Management Area by a Special Resolution of the Pinellas Board of County Commissioners in 1963. This sport fishery, along with historically good water quality and the existence of two regional County parks on its shore make Lake Tarpon a significant environmental, economic and recreational resource for the Tampa Bay area.

However, in recent years, Lake Tarpon and its associated natural resources have begun to exhibit signs of ecological stress. In the summer of 1987, this stress was represented by a major blue-green algae bloom that covered about 80 percent of the lake. The bloom persisted for much of the summer and impeded recreational and aesthetic uses of the lake during the prime recreational season. This algae bloom was seen as an indication that the trophic state (or productivity) of the lake was increasing.

The algae bloom of 1987 and citizen concerns regarding the health of the lake prompted the Pinellas County Board of County Commissioners to pass Pinellas County Resolution 87-275, creating the Lake Tarpon Management Committee (LTMC). The LTMC was originally made up of representatives from the agencies charged with protecting the lake and its resources, including the Southwest Florida Water Management District (District), and of various representatives from local government, citizens groups and the development community.

Coincident with these events, during the late 1980's, concern for the quality of lakes, streams and estuaries throughout the State was increasing and this prompted the Legislature to pass the Surface Water Improvement and Management (SWIM) Act of 1987. The threat to the health of the lake represented by the algae bloom and its ecological, environmental and recreational importance prompted the District to include the lake as the seventh ranked waterbody on the District's SWIM Priority Waterbody List.

Subsequently, with assistance from the LTMC, the first Lake Tarpon SWIM Plan was developed and approved in 1989. This first SWIM Plan focused on diagnostic studies since little was known about water quality, hydrology and ecology of the lake. The diagnostic studies, completed in 1992, characterized existing water quality and hydrological and ecological conditions of the lake and established a scientific basis for setting a number of management goals for the lake and its watershed.

The 1994 revision of the Lake Tarpon SWIM Plan noted that there were still problems in Lake Tarpon including recreational user conflicts, increases in biomass of certain noxious aquatic plants, possible groundwater loading of nitrates from as yet undetermined sources and pollutant loading from areas developed prior to implementation of stormwater treatment regulations.

Pinellas County has monitored Lake Tarpon water quality monthly since 1987, and in 1993, they noted a decline in water quality. This, along with requirements in their Growth Management Plan, prompted the County to initiate the development of a comprehensive watershed management plan for the Lake Tarpon drainage basin. Therefore, this third revision of the Lake Tarpon SWIM Plan was deferred until the *Lake Tarpon Drainage Basin Management Plan* (PBS&J 1998) was completed. The *Lake Tarpon Drainage Basin Management Plan* (DBMP) was prepared with input from and consistent with the goals of the LTMC.

The primary concern with Lake Tarpon continues to be declining water quality as demonstrated by long-term water quality data collected by Pinellas County. Declining water quality can lead to the increase of undesirable blooms of algae, loss of more desirable rooted aquatic plants, changes to the fish community structure and other adverse ecological changes. This revision of the Lake Tarpon SWIM Plan, which is based on the DBMP (PBS&J 1998) identifies management issues, strategies and goals for maintaining and where feasible, restoring the hydrological and ecological integrity of the lake and its watershed.

Strategies to improve and protect water quality are aimed at reducing external nutrient loading through stormwater retrofit projects. Hydrologic and habitat restoration projects in the Brooker Creek watershed are identified which will improve the ecological condition of the natural systems and may assist in lowering external nutrient loads. Additionally, harvesting hydrilla after chemical treatment and an enhanced lake fluctuation schedule may be evaluated to determine whether they are feasible strategies for further improving water quality. Public education, although difficult to measure direct benefits to the lake, is necessary to inform the public about lake and watershed management issues and to solicit public support and volunteers to assist in the management of Lake Tarpon.

This revised Lake Tarpon SWIM Plan provides details for projects that implement the above strategies and for projects that will be used to refine the District and County's understanding of the lake system. The Lake Tarpon SWIM Plan serves as the guidance document for coordinating the efforts of the District, Pinellas County and the State of Florida to restore and protect Lake Tarpon.

INTRODUCTION

The SWIM Act

In recognition of the need to place additional emphasis on the restoration, protection and management of the surface water resources of the State, the Florida Legislature, through the Surface Water Improvement and Management (SWIM) Act of 1987, directed the state's water management districts to "design and implement plans and programs for the improvement and management of surface water" (Section 373.451, Florida Statutes). The SWIM legislation requires the water management districts to protect the ecological, aesthetic, recreational, and economic value of the state's surface water bodies, keeping in mind that water quality degradation is frequently caused by point and non-point source pollution, and that degraded water quality can cause both direct and indirect losses of habitats.

Under the Act, water management districts prioritize water bodies based on their need for protection and/or restoration. This prioritization process is carried out in cooperation with the Florida Department of Environmental Protection (FDEP), the Florida Fish and Wildlife Conservation Commission (FFWCC, formerly the Florida Game and Freshwater Fish Commission or FGFWFC), the Department of Agriculture and Consumer Services (DACS), the Department of Community Affairs (DCA) and local governments.

Following the selection of the priority water bodies and in accordance with the SWIM Act, a SWIM Plan must be drafted, reviewed and approved, before SWIM funds can be spent on restoration, protection or management activities. The purpose of the Lake Tarpon SWIM Plan is to set forth a realistic course of action, identifying the projects and the efforts needed to accomplish them. The Act also requires that the plans be updated at a minimum once every three years. The history of Lake Tarpon SWIM Plans is discussed in the following section.

Lake Tarpon SWIM Plan - The Third Generation

In the summer of 1987, Lake Tarpon experienced a widespread bloom of blue-green algae (*Anabaena circinalis*). The bloom persisted for most of the summer and impacted recreational and aesthetic uses of the lake. Citizen concerns regarding the health of the lake prompted the Pinellas County Board of County Commissioners to initiate action by passage of Pinellas County Resolution 87-275, creating the Lake Tarpon Management Committee (LTMC). The LTMC was originally made up of representatives from the Southwest Florida Water Management District (District), the Florida Departments of Environmental Regulation and Natural Resources (now FDEP), FFWCC and various representatives from citizens groups and the development community. Later, the City of Tarpon Springs was invited to participate. As a result of the SWIM Act, the regional significance of Lake Tarpon and the blue-green algae bloom, Lake Tarpon was designated as the District's seventh ranked SWIM priority waterbody in late 1987.

The first Lake Tarpon SWIM Plan was approved in 1989 and focused on diagnostic studies since little was known about water quality, hydrology and ecology of the lake. A cooperatively funded project between the District and Pinellas County, *The Final Comprehensive Report: Lake Tarpon Diagnostic/Feasibility Studies* (KEA, Inc. 1992), was completed in 1992. This report provided much of the scientific data needed to characterize the existing water quality

and hydrological and ecological conditions of the lake. This report also established a scientific basis for setting a number of management goals for the lake and its watershed.

The 1994 revision of the Lake Tarpon SWIM Plan noted that there were still problems including recreational user conflicts, increases in biomass of certain noxious aquatic plants, possible groundwater loading of nitrates from as yet undetermined sources and pollutant loading from areas developed prior to implementation of stormwater treatment regulations.

Pinellas County has monitored water quality in Lake Tarpon monthly since 1987, and in 1993, they noted an increase in chlorophyll-a which represented degraded water quality conditions. This, along with requirements in their Growth Management Plan, caused the County to initiate the development of a comprehensive watershed management plan for the Lake Tarpon drainage basin and in 1994 the County entered into an agreement with Coastal Environmental, Inc. (now PBS&J) to develop such a plan. Therefore, this third revision of the Lake Tarpon SWIM Plan was deferred until the *Lake Tarpon Drainage Basin Management Plan* (PBS&J 1998) was completed. The *Lake Tarpon Drainage Basin Management Plan* (DBMP) was prepared with input from and consistent with the goals of the LTMC.

LAKE TARPON MANAGEMENT ISSUES

The DBMP (PBS&J 1998) identified management issues, goals and strategies aimed at maintaining and where feasible, restoring the hydrological and ecological integrity of the lake and its watershed. In preparing this revision of the Lake Tarpon SWIM Plan, District staff reviewed the DBMP (PBS&J 1998) and then selected management goals, issues and strategies that can be accomplished within the legislative charge of SWIM, which is improving or protecting water quality and natural systems. The following management issues, with the exception of the Hydrologic/Habitat Restoration and the Pollutant Load Reduction goals issues and strategies, were taken directly from the DBMP (PBS&J 1998), and are the basis for this revision of the Lake Tarpon SWIM Plan.

Water Quality

The algae bloom of 1987 has been seen as an indication that the trophic state (or productivity) of the lake is increasing. An increase in trophic state should not be surprising given that Lake Tarpon is located in the most densely populated county in Florida and that most of its watershed has been converted from its natural state to urban land uses. Therefore, the primary concern with regard to water quality in Lake Tarpon is related to cultural eutrophication which is caused by unnatural and excessive increases in nutrients entering the waterbody. This can lead to the increase of undesirable blooms of algae, loss of more desirable rooted aquatic plants and other adverse ecological changes.

The County has been monitoring water quality in Lake Tarpon since 1988. Annual average chlorophyll-a data show a substantial increase in chlorophyll-a from 1992 to 1993 (Figure 1). After 1993, chlorophyll-a concentrations continue to increase. This apparent increasing trend and the observance of a trophic state index (TSI) value of 58.96 for the period from May 1996

to April 1997 are of concern to lake managers for two reasons: 1) historical data indicate that Lake Tarpon had a TSI of about 50 (SWFWMD 1994); and 2) a TSI value of 60 appears to be a critical point in defining eutrophication, based on review of data from 573 Florida lakes (Huber et al. 1983 in DBMP PBS&J 1998).

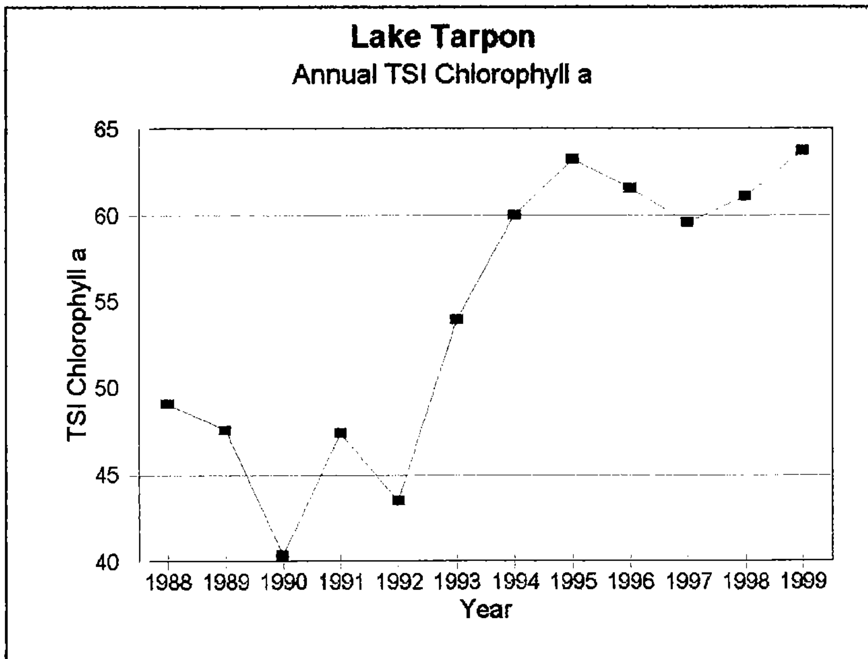


Figure 1-Annual average TSI(Chl-a) values for the period 1988 to 1999

Aquatic Vegetation
Hydrilla (*Hydrilla verticillata*), a rooted exotic submerged plant, and cattail (*Typha latifolia*), a native emergent species, are the focus of aquatic plant issues in Lake Tarpon. The proliferation of cattail appears to have decreased diversity in the emergent plant community over the last 25 years. Management of hydrilla has been correlated with degraded water quality as a result of nutrients released into the water column from degrading plant tissue. Lakes with healthy submerged aquatic plant communities tend to have fewer problems with severe nuisance algal blooms. Therefore, Lake Tarpon should be managed to promote the expansion of desirable endemic submerged aquatic vegetation, as well as, to increase the diversity of the emergent community. However, due to the lack of a consistent quantitative monitoring program, trends in the coverage of desirable native submerged aquatic vegetation have been difficult to assess. Additionally, quantitative data for submerged and emergent aquatic species are necessary to evaluate the effects of implemented lake management strategies such as an enhanced lake level fluctuation.

Fisheries
Lake Tarpon is an important sport fishing lake in Florida and was formally designated as a State Fish Management Area by a Special Resolution of the Pinellas Board of County Commissioners in 1963. The FFWCC has monitored sport fish populations in the lake since the 1970's. Studies in the early 1990's indicated that the largemouth bass and panfish fisheries were healthy, however, a study conducted during 1995/1996 indicated that fish biomass in Lake Tarpon had increased substantially (Champeau 1996). This is of concern since the rise in fish biomass could be a result of increasing productivity (eutrophication). The FFWCC asserts that continued increases in trophic state could lead to a decline in the sport fisheries of Lake Tarpon and they recommend that strategies be implemented to minimize nutrient loadings to the lake (Champeau 1996).

Flood Control
Flood control is not a primary management issue for the Lake Tarpon SWIM Plan. Construction of the Lake Tarpon Outfall Canal and Structure in the 1970's effectively addressed the severe flooding problems that previously existed in the basin. This SWIM Plan

does not recommend any additional management strategies to address this issue. However, maintenance of the current level of flood protection provided by the outfall structure will be a primary consideration in implementing management strategies to address other lake management goals.

Hydrologic and Habitat Restoration
The Lake Tarpon watershed is highly urbanized and many of the wetlands, especially on the western shore, were filled prior to 1984 to accommodate lakeshore development. (Since passage of the Warren G. Henderson Wetlands Protection Act of 1984, wetlands have been protected by both state and federal laws.) The Brooker Creek watershed, which extends into the lake region of northwest Hillsborough County, was until relatively recently, characterized by agricultural and low density rural residential uses. A large portion of the Brooker Creek watershed in Pinellas County is now protected by the Brooker Creek Preserve (Preserve). Many of the wetlands in the Preserve and those in Hillsborough County do not appear to have been filled to the extent they were near the shores of Lake Tarpon, however, they have been impacted to varying degrees by anthropogenic activities.

Public Education
Residential surveys of people living in the Lake Tarpon basin indicate that the public is generally not well informed regarding lake and watershed management issues. However, these same surveys indicate that many residents are interested in helping to monitor and improve environmental conditions in the lake and watershed. Thus, there is a need to better inform the public of issues facing Lake Tarpon and to solicit public support and volunteers in the implementation of the Lake Tarpon SWIM Plan.

Pollutant Load Reduction Goal
Pursuant to State Water Policy, Chapter 62-40, Florida Administrative Code (FAC), a pollutant load reduction goal (PLRG) is to be developed for each SWIM waterbody and adopted as part of the SWIM Plan. By definition a "PLRG means estimated numeric reductions in pollutant loadings needed to preserve or restore designated uses of receiving bodies of water and maintain water quality consistent with applicable state water quality standards" (Chapter 62-40.210(18)). Chapter 62-40.432(5)(c) and (d) further discuss the intent of PLRGs which is to reduce pollutants from older stormwater management systems to restore or maintain the beneficial uses of waters.

One method for setting a PLRG is referencing a desired TSI value and establishing the PLRG as the reduction in nutrients needed to meet the desired TSI. The 1994 Lake Tarpon SWIM Plan proposed an interim PLRG for Lake Tarpon of zero for both nitrogen and phosphorus. This PLRG was established as an interim goal to allow the County time to determine the feasibility of reducing nutrient loading sufficiently so that decreases in the TSI could be achieved.

Pinellas County through development of the DBMP (PBS&J 1998) identified a multi-parametric TSI goal for Lake Tarpon of 55. In order to reach the TSI goal of 55, a 4-point reduction in TSI would be needed from the annual average TSI value of 58.96 calculated for the period from May 1996 to April 1997. The DBMP (PBS&J 1998) proposed internal and external pollutant load reduction strategies that if implemented would achieve a 4-point reduction in the annual

average TSI. (More recent data for the period from January 1999 to December 1999 show that the annual average multi-parametric TSI was 60.64.)

Management strategies to address external anthropogenic pollutant loadings, including stormwater treatment and installation of central sewer systems were identified (PBS&J 1998). Based on the modeling work done by PBS&J, these external load reduction strategies were estimated to reduce the TSI by about 2.5 points. Therefore, PBS&J (1998) noted that additional management actions to control the internal cycling of nutrient will be required to reach the desired TSI goal. PBS&J (1998) concluded that internal pollutant loads could be reduced by controlled harvesting of cattails and hydrilla and by increased lake flushing and dilution. However, load reductions achieved by macrophyte harvesting and lake flushing and dilution are difficult to quantify due to a number of variables. Further evaluation is needed to determine whether these or other internal nutrient cycling management strategies will be feasible and effective in improving water quality.

LAKE TARPON SWIM PLAN GOALS

The goals of the Lake Tarpon SWIM Plan focus on the issues identified by Pinellas County and the LTMC in the DBMP (PBS&J 1998). These goals and the District's PLRG are listed below.

- Maintain the mean annual chlorophyll-a concentration at or below 14 μg/L.
- Maintain the mean annual multi-parametric TSI value at or below 55.
- Limit the areal coverage of hydrilla to 100 acres or less and, limit the areal coverage of cattails to 60 acres or less.
- Expand the coverage of desirable endemic submerged aquatic vegetation to 600 acres and maintain the areal coverage of emergent aquatic vegetation at 120 acres or more. (Note: cattail should not account for more than 60 acres of this coverage.)
- Maintain a fish community balance of F/C = 3.0-6.0 (e.g., the ratio of forage fish biomass to carnivorous fish biomass)
- Maintain indices of Relative Stock Density for major sport fish species of: 20-40 percent >14 inches for largemouth bass; 40-60 percent > 6 inches for bluegill; 40-60 percent > 7 inches for redear sunfish; and 40-60 percent > 9 inches for black crappie
- Manage water levels to improve water quality and aquatic vegetation while maintaining the existing degree of flood control provided by the Lake Tarpon Outfall Structure.
- Restore hydrologic and ecologic functions of wetlands and tributaries in the Lake Tarpon and Brooker Creek watersheds where opportunities for such restoration exist.
- The PLRG for Lake Tarpon is established as a 8.08 ton reduction in total nitrogen and a 1.22 ton reduction in total phosphorus on an annual basis.

- Provide educational opportunities through programs such as Florida Yards and Neighborhoods, related to other goals of the Lake Tarpon SWIM Plan.

LAKE TARPON MANAGEMENT STRATEGIES

The focus of the Lake Tarpon DBMP (PBS&J 1998) was the development and evaluation of various strategies to reduce external and/or internal nutrient loadings to improve and maintain good water quality. Staff from the District participated in the development of the DBMP (PBS&J 1998) through their membership on the LTMC. Strategies included in this update of the Lake Tarpon SWIM Plan are those identified in the DBMP (PBS&J 1998) that are consistent with the legislative directive of SWIM, which is to protect or restore water quality and natural systems. Analysis of the management issues and development of the management strategies are briefly discussed in Appendix A. For more detail the reader is directed to the *Lake Tarpon Drainage Basin Management* Plan developed for Pinellas County (PBS&J 1998).

Management Strategies for Water Quality
As previously discussed in the Management Issues section and in more detail in Appendix A, the primary concern with regard to water quality in Lake Tarpon is increasing productivity as measured by the amount of algae (chlorophyll-a) in the water. This condition results from an increase in nutrients entering the lake and from the recycling of these nutrients once they have entered the lake. Management strategies to control nutrients may focus on external and/or internal sources.

Based on the water and nutrient budgets shown in Appendix A (PBS&J 1998), external nutrient loading sources to Lake Tarpon include atmospheric deposition, direct runoff (modeled), Brooker Creek, septic tanks, and seepage from the surficial and Floridan aquifers. Internal nutrient sources include sediment resuspension, movement of nutrients from the sediment into the overlying water and decomposition of organic matter. Outflows of nutrients occur by discharge through the Lake Tarpon Outfall Canal, fish harvest, sedimentation and uptake by aquatic plants.

External Nutrient Loading: PBS&J (1998) identified stormwater runoff and septic tank leachate as the only external sources of nutrients to Lake Tarpon that could be realistically managed. Nutrients from atmospheric deposition, precipitation and groundwater inflows are not considered to be manageable from a practical standpoint.

Based on the work done by PBS&J (1998), loads of total nitrogen (TN) and total phosphorus (TP) from modeled sub-basins in the Lake Tarpon watershed equals to 6.32 and 0.73 tons per year, respectively. This equates to 11.2 percent and 12.5 percent of the total loading of the two nutrients. Stormwater retrofit projects are designed to provide treatment for stormwater from previously untreated urban areas. The most common stormwater retrofit design includes the construction of wet detention ponds. However, stormwater treatment may be enhanced by the addition of alum treatment systems to remove phosphorus. The DBMP (PBS&J 1998) identified enhanced stormwater treatment as a management strategy to control nutrients entering the lake from runoff and this SWIM Plan has recommended enhanced stormwater retrofit projects in the priority projects section.

The *Lake Tarpon Ground-water Nutrient Study* (Upchurch 1998), determined that inputs of TN and TP from the surficial and Floridan aquifers are 2.13 and 0.2 tons per year, respectively. This equates to 3.7 percent of the TN and 3.4 percent of the TP loadings in the nutrient budget for the lake (PBS&J 1998) and these loads are relatively low compared to the inputs from surface water inflows. However, based on modeling results, PBS&J (1998) concluded that TN and TP inputs from septic tank leachate comprised 11.5 and 14.0 percent of the nitrogen and phosphorus budgets. Unlike groundwater seepage, which is difficult to control, the conversion of septic tanks to central sewer facilities would effectively remove the nutrient inputs contributed by the septic tanks. However, based on groundwater monitoring conducted by Upchurch (1998), the impact of septic tank leachate on the lake is not conclusive. Therefore, this SWIM plan recommends the collection of additional groundwater data in the vicinity of the area served by septic tanks to better understand the relationship between septic tank leachate and water quality degradation. This additional data will also be useful in refining the nutrient budget for the lake.

Internal Nutrient Loading: The annual nutrient budget for Lake Tarpon indicates that approximately 36.5 percent of the TN and 72.2 percent of the TP inputs are retained within the lake and this is likely through sediment deposition and/or plant assimilation. Quantifying the actual nutrient loading potential from these sources is difficult, but water quality monitoring data appear to indicate that this loading may be significant following large scale chemical treatment of hydrilla. Therefore, these internal nutrient stores represent a potentially major source of nutrient loadings to the water column under certain conditions. Various strategies for managing internal nutrient cycling were reviewed and increased lake flushing/dilution and selected mechanical harvesting of nuisance aquatic plants were recommended to lower in-lake nutrient concentrations. Additionally, these strategies should aid in attaining goals related to maintaining submerged and emergent plant species diversity and improving fisheries habitat.

Management Strategies for Aquatic Vegetation

Aquatic plant (macrophyte) dominated lakes tend to have better perceived water quality than phytoplankton dominated lakes. PBS&J (1998) asserts that, based on the observed increase in TSI in 1993 following the large scale chemical treatment of hydrilla, if Lake Tarpon could be converted from a phytoplankton dominated lake to one dominated by desirable macrophytes then this could help to achieve water quality goals for the lake. Additionally, aquatic vegetation is important as fish and wildlife habitat. Periodic mapping and monitoring of aquatic vegetation are recommended to assess status and trends in the macrophyte community and to evaluate attainment of aquatic plant goals.

Management Strategies for Fisheries

Historically, Lake Tarpon has supported an excellent sport fishery (Champeau 1992). However, 1995 data indicate that fish standing crop (biomass) increased by approximately 500 percent (Champeau 1996). The FFWCC considers this observed increase in fish biomass an indicator of increasing eutrophication that, if left unchecked, could threaten the future quality of sport fishing in the lake.

At this time no specific management strategies are proposed to manipulate the fish community structure in Lake Tarpon. Management strategies to maintain or improve fisheries in Lake Tarpon focus on strategies to reduce internal and external nutrient loading thus slowing or

reversing the increasing trophic state of the lake. These strategies will result in improved water quality and a more stable trophic state. Additionally, the management strategies for aquatic vegetation will be aimed at optimizing fisheries habitat. Monitoring of fish biomass and species composition is recommended to evaluate the success of these management strategies and to determine whether other management strategies should be proposed.

Management Strategies for Hydrologic and Habitat Restoration
Wetlands within the Lake Tarpon and Brooker Creek watersheds have been impacted to varying degrees by anthropogenic activities. Hydrologic restoration of these wetlands to restore historic surface water flow patterns (i.e., ditch blocks and rehydration) would provide multiple benefits. Initially, the restored wetlands would provide habitat for wetland dependant animals and plants. Hydrologic restoration could result in increased flows through the historic channels of Brooker Creek and other unnamed tributaries to Lake Tarpon. Ultimately, increased surface inflows to Lake Tarpon could lead to increased flushing and dilution of the lake, which could lead to improved water quality. Hydrologic and habitat restoration projects should be pursued where opportunities exist to improve or enhance water quality, water quantity or wetland and aquatic habitat.

Management Strategies for Public Education
The LTMC was first established in July 1987 by a special Resolution of the Pinellas County Board of County Commissioners. The intent of the Resolution was to create a multi-agency committee to formulate a Plan of Action whereby a long term lake management plan would be developed and implemented for Lake Tarpon. Following the implementation of the Lake Tarpon Drainage Basin Management Plan, the focus of the LTMC will likely shift more towards the monitoring and evaluation of the implemented DBMP (PBS&J 1998) components. Other than the LTMC, no formal community involvement or public outreach program exists to further the adopted Lake Tarpon management goals. Future activities should involve Pinellas and Hillsborough County Cooperative Extension offices, especially the Florida Yards and Neighborhoods Program. These programs should educate residents and businesses about habitat improvement and pollutant load reduction strategies and water conservation practices that would ultimately improve habitat and water quality in the Lake Tarpon and Brooker Creek watershed.

LINKAGE TO OTHER WATER RESOURCE MANAGEMENT ACTIVITIES

In addition to the projects that are implemented through SWIM, the SWIM Program is able to accomplish its objectives more effectively and efficiently by coordinating internally with other District programs and externally through partnerships with local governments and other state and federal agencies.

Internal Linkages
The District has many tools available to implement the legislative intent of the SWIM Program, including but not limited to, integrated planning and coordination, regulatory authority, land acquisition programs and the SWIM program itself. Each of these areas provides opportunities to assist in the management of Lake Tarpon.

The District's Water Management Plan - As required in Chapter 373, Florida Statutes, the District prepared its Water Management Plan (DWMP) in 1995. Within this plan the District organized its mission into four areas of responsibilities; water supply, flood protection, water quality management and natural systems management. The DWMP recognizes that the integration of all these areas is essential to effective planning and management of the resource. The DWMP supports the SWIM Program and has policies that relate to the restoration, protection and management of Lake Tarpon.

Comprehensive Watershed Management - The District has recognized the need to take a more aggressive and unified approach to surface water management and has created an initiative which would prioritize resource management needs by watershed throughout the District. It is intended to combine water quantity (i.e., flood) management with water quality and natural systems objectives, as well as water supply when applicable. Ultimately regulation, land acquisition, facilities and land use controls would be combined into a comprehensive surface water management strategy including appropriate policies, on a watershed specific basis. This effort is the District's embodiment of the EPA's watershed planning approach and the FDEP's Ecosystem Management Initiative.

Local governments, as the parties responsible for land planning and development and service provision, will be key players in this integrated management approach. Similarly, the State's Ecosystem Management Initiative will provide an impetus to collective efforts as it implements an environmental strategy that encourages innovation, pollution prevention, incentive-based regulatory alternatives, public education and individual stewardship.

Regulation

Wetlands Protection Through Regulatory Programs - One way that the District achieves wetlands protection is through regulatory programs. Wetland protection is addressed under Chapters 40D-2, 40D-3, 40D-4, 40D-40 and 40D-45, F.A.C. The District's surface water permitting rules (40D-4, 40 and 45, F.A.C.) require that any impact to wetlands not specifically exempted must either be avoided or compensated. Compensation varies depending upon the function and value of the impacted wetland. Different types of compensation may be utilized, including preservation of associated upland areas, alternate types of wetland creation, protection of exempt wetlands, and restoration for previously impacted wetlands. The intent is to ensure that the habitat necessary for the survival of fish and wildlife is maintained.

Minimum Flows and Levels - Another management tool available for water and related natural resource protection is through the District's Minimum Flows and Levels (MFLs) program. Maintaining minimum flows and levels is a significant statutory charge for Florida's water management districts. District programs for minimum flows and levels originate in Chapter 373.042, F.S., as well as, from the District's desire to treat the environment as a rightful "user" of water. If water resources and associated natural systems are to be protected and maintained, the identification and establishment of water levels and flows are essential. Such activities will also serve to balance water withdrawals for human needs with protection of surface water levels for navigation, recreation and related functions.

Once established, MFLs are implemented through a variety of means. Most prevalent is the application of these flows and levels to the District's water use permitting program. As directed by Chapter 373.042, F.S., the District may restrict withdrawals of water which would cause flows and levels to drop below their established minimums and which would be significantly harmful to the water resources or ecology of an area. The District's water use permitting rules, which include criteria to prevent adverse impacts from occurring as a result of withdrawals, effectively establish MFLs for specific sources throughout the District.

Minimum levels have been set for several lakes in northwest Hillsborough which are part of the headwaters of Brooker Creek, the primary surface water flow to Lake Tarpon. A Minimum Flow is anticipated to be established for Brooker Creek during the 2006-2010 time frame based on the 1998 MFL Priority List and Schedule approved by the District Governing Board in October 1998.

Mitigation Banking - Mitigation banking allows developers to compensate for wetland losses in one place by preserving, restoring or creating wetlands in the same basin to achieve a no net loss of wetlands. The rule allows mitigation banking in some instances, although it remains a controversial issue.

Land Acquisition - Land acquisition at the District historically has been guided and funded by two major Statewide initiatives: the Water Management Lands Trust Fund (a.k.a. Save Our Rivers Program or SOR), and Preservation 2000 (P-2000). In 2000, the P-2000 Program for land acquisition was "sunset." Funds for land acquisition and management were available through the SOR Program through 2000, however, the SOR funds may not be used for land acquisition after 2001. The Florida Forever Act, passed by the Florida Legislature in 1999, will make funds available, beginning in 2001, to the water management districts for both land acquisition and restoration, including funding for SWIM projects.

The District's land acquisition program targets the protection of natural resources at the regional level. Lands of importance to water resources and water management are acquired along with lands of unique environmental value that are endangered by development activities. The District owns more than 320,000 acres, the majority of which were purchased through the SOR and P2000 programs. Many recent land purchases have been a joint acquisition between the District and a partner such as Pinellas County in the case of Brooker Creek Preserve, or with other state agencies. Leveraging District land acquisition funds with those of local governments and other agencies can and has resulted in significant acquisitions that would otherwise not be made. These programs have been coordinated with SWIM Plans by focusing on critical habitats, such as wetlands and their interconnected upland communities that are part of the Lake Tarpon and Brooker Creek ecosystem that should be acquired for preservation or for restoration.

Basin Board Activities - The District's eight Basin Boards have specific functions and duties that are consistent with Chapter 373, F.S., and the programs of the Governing Board. Their purpose is to identify and evaluate key water resource management issues in order to develop and fund management strategies to address them. The Basin Boards are facilitators in the resolution of non-regulatory water management issues for a number of other governments. It is at the Basin Board level that intergovernmental water resource programs are

implemented, monitored and evaluated for improvement. The Basin Boards serve as a sounding board for the District by obtaining feedback from local governments and citizens and as funding partners for local governments and others in addressing mutually beneficial water resource solutions. The Basin Boards also provide the District's SWIM funding match for approved SWIM projects within their basins.

The District, through the eight basin boards, has an established Cooperative Funding Program which provides financial assistance on a cost-share basis primarily to local governments for regional water resource projects. Projects can also be funded through "Basin initiatives" where a Basin Board decides to provide the impetus for a water management solution, with or without a local partner. The Basin Boards presently have in place a five-year plan which outlines the types of activities it expects to undertake in the next five years and provides an estimate of the funding required to support these projects. The Basin plans were prepared in close coordination with local governments demonstrating another opportunity for integration with local governments and ensuring the most efficient and cost-effective approach to addressing the mutual water resource management goals and objectives.

Lake Tarpon is located within the boundaries of the Pinellas-Anclote River Basin Board (PABB). The *Pinellas-Anclote River Basin Board Five-Year Basin Plan FY 2000-2004* identifies the water quality and natural systems areas of responsibility (AOR) as the PABB's priorities, and as such, supports the *Lake Tarpon SWIM Plan*. The fisheries study and the habitat restoration and stormwater retrofit projects in the *Lake Tarpon SWIM Plan* are consistent with the AOR priorities of the PABB.

External Linkages

FDEP - Ecosystem Management Initiative - Ecosystem management is a process for managing environmental resources that originated at the State level. The FDEP is required by the Florida Environmental Protection Act of 1993 to develop and implement measures to "protect the functions of entire ecological systems through enhanced coordination or public land acquisition, regulatory and planning programs."

FDEP has defined ecosystem management as an integrated, flexible approach to management of Florida's biological and physical environments - conducted through the use of tools such as planning, land acquisition, environmental education, regulation and pollution prevention - designed to maintain, protect and improve the State's natural, managed and human communities. The primary goal of this effort is to provide for the maintenance of a healthy, sustainable environment for the benefit of present and future generations.

The District has been an active participant in this evolving process in terms of statewide program development. A strong correlation is apparent between the District's Comprehensive Watershed Management Initiative (CWM) and Surface Water Improvement and Management (SWIM) Program and FDEP's Ecosystem Management Initiative.

FDOT - Mitigation Program - Pursuant to 373.4137, Florida Statutes, the FDOT, FDEP and water management districts (WMDs) are required to work together to develop long-range mitigation plans for environmental mitigation of impacts from transportation projects. It was the intent of the Legislature that mitigation to offset the impacts of transportation projects be

funded by the FDOT and be carried out by the FDEP and WMDs, including the use of mitigation banks.

Through this process, the FDOT provides FDEP and WMDs with a copy of its adopted work program and an inventory of habitats which may be impacted by the projects on the work program. The FDEP, WMDs, other appropriate federal, state and local governments and other interested parties develop a plan to provide the mitigation required to compensate for the impacts identified by the FDOT. Pursuant to the statute, the "FDOT Mitigation Plan" is to be developed using sound ecosystem management practices to address significant water resource needs and to focus on the activities of the FDEP and WMDs, such as surface water improvement and management (SWIM) waterbodies and lands identified for potential acquisition for preservation, restoration, and enhancement.

Once the mitigation projects have been identified and included in the plan, the FDEP, WMD or other entity implements the mitigation project and bears the costs of design and construction. Upon completion of the project, whether it be wetland restoration or creation, the entity that constructed the project may then apply to the FDOT for reimbursement of the costs to complete the mitigation project.

<u>Local Government Coordination and Partnering</u> - Building on the relationships and partnerships that have been developed over the past decade of management activities for Lake Tarpon is central to the future of managing Lake Tarpon and is the core to this update of the SWIM Plan. Pinellas County and the City of Tarpon Springs are key to the implementation of any management activity that is proposed for the lake.

Pinellas County's Comprehensive Plan calls for the systematic development of watershed/waterbody-specific management plans for all major drainage basins in the County. Subsequently, the County contracted with a consultant to prepare the *Lake Tarpon Drainage Basin Management Plan* (PBS&J 1994). This Plan built upon the work of the first SWIM Plan and other diagnostic studies to develop management policies and best management practices aimed at restoring and/or maintaining the hydrological and ecological integrity of the lake and its immediate watershed. The County's Plan forms the basis of this revision of the Lake Tarpon SWIM Plan.

As part of the District Water Management Plan, the District is in the process of updating Integrated Plans for every county whose boundaries lie largely within in the District. The purpose of an integrated plan is to identify and evaluate key water resource management issues within the local government's jurisdiction and to develop common District and local government strategies to address these issues. The integrated plan is intended to serve as a tool to foster the integration of land use planning and growth management activities of local governments with the water use planning and management activities of the District. This effort will strengthen the local government's comprehensive plan by linking local water resources planning to the best available data and other resources of the District. The development of the integrated plans is a cooperative effort of the District, local governments and citizens. This endeavor is best viewed as a process, however, since it is intended to promote continuing relations and mutual planning in the best interest of the resource. It is hoped the action

strategies identified will end up back in the local government plan where local and District energies, and funding, can be directed toward them.

Local governments and other state and regional agencies offer not only a funding partner but a wide range of services -- from land acquisition and technical assistance to providing equipment and personnel -- all of which when combined with District and State resources can make for a substantial effort. As an example, Pinellas County acquired thousands of acres of land to establish the Brooker Creek Preserve. The District also purchased lands in this area and the County is responsible for land management activities on their lands as well as those owned by the District. Some of these lands are in need of restoration and the District and the County will be working together to accomplish these projects.

PRIORITY PROJECTS

The priority projects for Lake Tarpon focus on preservation and improvement of existing water quality and habitat in the watershed. Projects are included to monitor the effects of the management strategies and to provide information to be used by lake managers to refine the nutrient budget for the lake. The following project summaries describe the projects and provide a project timeline and estimated budget.

Project Title: Stormwater Rehabilitation within Pinellas County
This project involves the construction of stormwater treatment facilities at the outfall of the priority manageable hydrologic units (MHUs) and individual sub-basins identified in the Lake Tarpon Drainage Basin Management Plan (PBS&J 1998). Based on modeled pollutant loading estimates, the MHUs and sub-basins are, in the order of decreasing priority, Group B MHUs, Group D MHUs, Group A MHUs, Group C MHUs and individual sub-basin 23 and individual sub-basin 21. The locations of these MHUs and sub-basins are shown in Appendix A.

Given the potentially high cost and low availability of land for development of these enhanced stormwater treatment facilities, the use of more intensive treatment systems such as alum injection represent a more cost effective approach per unit area of land. Therefore, alum injection facilities are the recommended technology.

Annual Budget Estimates:

	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
Salaries			$15,000	$15,000	$15,000
Contracts			$450,000	$450,000	$450,000
Expenses			$1,200	$1,200	$1,200
Total			$466,200	$466,200	$466,200

Agency or Local Government Partnering:
Pinellas County, through the development of the Lake Tarpon Drainage Basin Management Plan, identified the priority MHUs and individual sub-basins that were feasible for stormwater

retrofit projects. The District through the cooperative funding program of the Pinellas-Anclote River Basin Board and through SWIM funding can join with Pinellas County to share the costs of construction.

Project Title: **Stormwater Rehabilitation within the City of Tarpon Springs**
The City of Tarpon Springs has proposed several conceptual project alternatives which may reduce stormwater pollutant loadings from within the City's jurisdiction. The District will work with the City to refine these projects as requested. If the projects are determined to be feasible, then the District will work with the City to design and construct the projects.

Annual Budget Estimates:

	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
Salaries				$15,000	$15,000
Contracts				$450,000	$450,000
Expenses				$1,200	$1,200
Total				$466,200	$466,200

Agency or Local Government Partnering:
The District through the cooperative funding program of the Pinellas-Anclote River Basin Board and through SWIM funding can join with the City of Tarpon Springs to share the costs of design and construction.

Project Title: **Feasibility/Conceptual Design for a Stormwater Facility at Chesnut Park**
The Stormwater Rehabilitation project described previously, identifies four manageable hydrologic units (MHUs) and two individual sub-basins as possible sites for implementation of stormwater retrofit projects. The Group C MHU was identified as contributing the fourth highest pollutant load to the lake, which equates to 0.85 tons per year of TN and 0.08 tons per year of TP. A project to determine the feasibility of designing, permitting and constructing a treatment system for Group C is scheduled to be completed in August 2001. The feasibility and conceptual design report will contain a cost-benefit analysis if the project were to be constructed.

Annual Budget Estimates:

	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
Salaries	$2,500			$2,500	
Contracts	$45,000			$600,000	
Expenses	$500			$500	
Total	$48,000			$603,000	

Agency or Local Government Partnering:
Pinellas County submitted the feasibility study for cooperative funding during the FY 2000 funding cycle. The County has initiated the study and if determined feasible, money for construction could be budgeted in FY 2003 with the District sharing the cost of construction.

Project Title: Fisheries Monitoring
Lake Tarpon historically has supported a healthy, well balanced fish population. Recent increases in fish biomass have concerned lake managers since this may be indicative of increasing eutrophication (productivity) of the lake. Monitoring of the fish community structure and fish biomass are necessary to document changes in these conditions as a result of management strategies implemented to decrease lake productivity.

Annual Budget Estimates:

	FY 2000	FY 2001	FY2002	FY 2003	FY 2004
Salaries	$5,000	$5,000	$5,000	$2,000	
Contracts	$41,800	$23,300	$23,300	$7,000	
Expenses	$1,000	$1,000	$1,000	$1,000	
Total	$47,800	$29,300	$29,300	$10,000	

Agency or Local Government Partnering:
Pinellas County has entered into a multi-year agreement with the University of Florida to conduct fisheries studies on the lake which will be used to evaluate responses to implemented management strategies. The County is paying for the total cost of the first year of the study and they submitted a cooperative funding request to fund the remaining 4 years. This funding request has been approved and an agreement between the County and District has been executed.

Project Title: Refinement of Stage & Flow Measurements at the Lake Tarpon Outfall Structure
The Lake Tarpon Outfall Canal provides a convenient structure for measuring flow and collecting water samples; however, instrumentation for accurately measuring and recording stage and flow volumes does not exist at the outfall control structure. The installation of state-of-art instrumentation is needed to address the defined monitoring objective of calculating annual water and nutrient budgets for Lake Tarpon. The estimation of mean annual TN, TP, and hydrologic loads discharged from the lake combined with estimates of mean annual loads entering the lake are needed to calculate lake water and nutrient budgets. To balance a water/nutrient budget, direct measurement of outflows from the lake are needed. Annual estimates of loads leaving the lake will enable the calculation of net loadings into the lake, loads which should be related to mean annual chlorophyll-a concentrations and TSI values.

Annual Budget Estimates:

	FY 2000	FY 2001	FY 2002	FY 2003	FY 004
Salaries	$5,000	$5,000	$5,000		
Contracts	$40,000				
Expenses	$2,000	$2,000	$2,000		
Total	$47,000	$7,000	$7,000		

Agency or Local Government Partnering:
The District would be the lead agency to implement instrumentation and collection of data and funds were included in the District's FY 2000 budget to begin this project.

Project Title: Enhanced Lake Level Fluctuation
This project involves modifying the operational schedule of the Lake Tarpon Outfall Canal control structure (S-551) to provide for greater intra-annual lake level fluctuation, and inter-annual variability. An enhanced lake level fluctuation schedule is not meant to be implemented rigidly, but rather it is to serve as a guideline for improved lake management. The design capabilities of the Lake Tarpon Outfall Canal and control structure (S-551) allow for maximum flexibility in the management of lake levels. To date, the outfall structure has been rather conservatively managed solely for the purpose of flood control.

It is difficult to quantify the water quality benefits of periodic lake flushing because of the complex biological, hydrogeological and chemical interactions. There is, however, empirical evidence that short-term lake drawdowns in Lake Tarpon can have significant positive impacts on water quality. An accidental short term lake drawdown which occurred in March 1990 appears to have resulted in the reduction of in-lake chlorophyll-a concentrations for the remainder of that year. More information is found in Appendix A.

Annual Budget Estimates:

	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
Salaries		$5,000	$5,000		
Contracts					
Expenses		$2,000	$2,000		
Total		$7,000	$7,000		

Agency or Local Government Partnering:
The U.S. Army Corps of Engineers must approve any major deviations from the existing operational range and schedule for structure S-551. The District has the responsibility for operation and maintenance of structure S-551, and would be responsible for operating the structure to attempt to achieve the target monthly lake levels. Pinellas County would be responsible for monitoring of fisheries, aquatic vegetation and water quality to document the impacts of implementing the enhanced lake level fluctuation schedule and for initiating public

meetings to educate the public about the benefits of greater lake level fluctuation prior to the District implementing a revised fluctuation schedule.

Project Title: Aquatic Vegetation Mapping and Management
Proliferation of hydrilla and cattails have decreased the diversity of the aquatic plant community in Lake Tarpon. Harvesting of these two species has been proposed as a management strategy to improve water quality (by removing nutrients bound in the plant matter) and to improve habitat diversity. The Lake Tarpon DBMP (PBS&J 1998) recommended that Lake Tarpon be managed to promote the expansion of desirable endemic submerged aquatic vegetation as well as to increase the diversity of the emergent community. However, due to the lack of consistent qualitative monitoring program, trends in the coverage of these species has been difficult to assess. Therefore, a project is proposed to collect the necessary baseline data for aquatic plants against which future management activities can be evaluated.

Annual Budget Estimates:

	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
Salaries	$5,000	$5,000			
Contracts	$25,000	$25,000			
Expenses	$500	$500			
Total	$35,500	$35,500			

Agency or Local Government Partnering:
Opportunities exist to develop cooperative agreements with the University of Florida and Pinellas County to accomplish this project.

Project Title: Hydrologic and Habitat Restoration
Wetlands within the Lake Tarpon and Brooker Creek watersheds have been impacted to varying degrees by anthropogenic activities. Brooker Creek, the primary surface water inflow to Lake Tarpon, has fourteen identified channels that eventually converge and form the main channel which flows into Lake Tarpon on its southeastern shore. Headwaters for five of these channels begin in the lakes region of northwest Hillsborough County. These channels flow in a west to southwesterly direction toward the Brooker Creek Preserve in Pinellas County.

The Brooker Creek Preserve, which covers almost 8,000 acres, is made up of lands owned by the District and County and the County is responsible for management. Additionally, Pinellas County owns and manages the John Chesnut Sr. and Anderson Parks directly on Lake Tarpon. Hillsborough County and the District have jointly purchased about 1,400 acres in the Brooker Creek watershed in Hillsborough County. Additionally, Hillsborough County has identified another approximately 2,900 acres for future acquisition. Opportunities for hydrologic and/or habitat restoration projects exist on the acquired properties in both Counties and other opportunities may become available as more lands are acquired in the Lake Tarpon and Brooker Creek watersheds.

Hydrologic and habitat restoration projects that restore historic surface water flow patterns (i.e., ditch blocks and rehydration) and wetland habitat would provide multiple benefits. These projects may also provide opportunities for attenuation of sediment and nutrient loadings. One project has already been identified and it is described separately, under Brooker Creek Restoration - Channel L.

Annual Budget Estimates:

	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
Salaries	$15,000	$15,000	$15,000		
Contracts	$500,000	$500,000	$500,000		
Expenses	$1,200	$1,200	$1,200		
Total	$516,200	$516,200	$516,200		

Agency or Local Government Partnering:
Currently, Pinellas County is in the process of developing a hydrologic restoration plan for the Brooker Creek Preserve. As additional projects are identified it is expected that they will be proposed for funding through the SWIM Program. There is the potential that Hillsborough County may propose hydrologic and habitat restoration projects in the part of the Brooker Creek watershed which extends into Hillsborough County.

Project Title: Brooker Creek Habitat Restoration - Channel L (Pinellas County)
This project proposes to design and construct a restoration project to restore the historical hydrologic connection of Channel L of Brooker Creek on Pinellas County's Brooker Creek Preserve. Construction of a large power line corridor and its access road have bisected the channel and redirected the flow as it enters the Preserve. The project will also result in habitat enhancement as a result of rehydration of flood plain wetlands.

Annual Budget Estimates:

	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
Salaries	$2500	$2500			
Contracts	$87,500	$87,500			
Expenses	$500	$500			
Total	$90,500	$90,500			

Agency or Local Government Partnering:
Pinellas County submitted this project for cooperative funding during the FY 2000 funding cycle. The project was approved for funding and an agreement between the District and County has been executed. Additional coordination will be required between the District, the County and Florida Power to develop a design that is consistent with Florida Power's management of the transmission line and access roads.

Project Title: Brooker Creek Habitat Restoration - Channel F (Pinellas County)
This project proposes to design and construct a restoration project to restore the historical hydrologic connection of Channel F of Brooker Creek on Pinellas County's Brooker Creek Preserve. An historic jeep trail and fire plow line have bisected the channel in two areas and redirected the flow. The project will result in habitat enhancement through rehydration of flood plain wetlands.

Annual Budget Estimates:

	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
Salaries		$2,500	$2,500		
Contracts		$160,000	$160,000		
Expenses		$500	$500		
Total		$163,000	$163,000		

Agency or Local Government Partnering:
Pinellas County submitted this project for cooperative funding during the FY 2001 funding cycle. The project has been approved for funding and an agreement between the District and County to implement the project has been executed.

Project Title: Brooker Creek Headwaters Restoration (Hillsborough County)
The project involves the design, permitting, and construction of a habitat restoration project on a 1,111 acre parcel located in Northwest Hillsborough County. The property, jointly purchased by the District and County in 1992, contains the headwaters of Brooker Creek. The objective of the project is to restore the property's historic surface water hydrology and wetland habitats through backfilling existing agricultural ditches and, if possible, creation of additional wetlands within disturbed areas. Restoring the historic water storage capacity of this site will provide water quality treatment by increasing residence time on site while enhancing existing wetland communities.

Annual Budget Estimates:

	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
Salaries		$2,500			
Contracts		$300,000			
Expenses		$500			
Total		$303,000			

Agency or Local Government Partnering:
Hillsborough County submitted this project for cooperative funding during the FY 2001 funding cycle. The project has been approved for funding and an agreement between the District and County has been approved. Budgeted funds will be used for project design, permitting, and construction.

Project Title: Public Education
This project involves the development and implementation of a comprehensive public involvement program for the Lake Tarpon watershed. The program would focus on informing the public about the various components of the DBMP (PBS&J 1998) and provide information on BMPs that could be implemented by people within the watershed. The information could be distributed in a variety of ways including newsletters, public access television, video etc.

Improved public understanding of the causes of lake management problems, and the role that individuals can play in managing and improving the quality of the lake and watershed will go a long way to furthering the goals of the Plan. In addition, increased public involvement as stakeholders in the ownership and implementation of the Plan should reduce unproductive public criticism of governmental agencies, and improve the overall lake and watershed management effort. The Florida Yards and Neighborhoods Program may be one means of implementing these strategies.

Annual Budget Estimates:

	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
Salaries	$2,000	$2,000	$2,000		
Contracts	$5,000	$5,000	$5,000		
Expenses	$500	$500	$500		
Total	$7,500	$7,500	$7,500		

Agency or Local Government Partnering:
Pinellas and Hillsborough Counties would be the lead agency in implementing these projects. Funding and technical assistance may be provided through the District.

Project Title: Refinement of Groundwater Nutrient Estimates
The most recent groundwater investigation related to Lake Tarpon was the *Lake Tarpon Ground-water Nutrient Study* prepared by Upchurch (1998). The objectives of this study were to: 1)estimate the flux of nutrients, especially nitrate, into Lake Tarpon via groundwater; 2) determine the origins of nutrient rich groundwater in the Lake Tarpon watershed; and 3) identify the potential for future flux of nutrients in the lake and Brooker Creek from groundwater. The *Lake Tarpon Ground-water Nutrient Study* (Upchurch 1998) provided a comprehensive and detailed investigation of the nutrient sources in the Lake Tarpon and Brooker Creek watersheds and the potential for these sources to lead to increased nutrient inflows to Lake Tarpon. However, Upchurch (1998) concluded that additional groundwater wells were needed to refine the estimates of nutrient flux to the lake. Without these wells and additional data, it is difficult to point to any single land use or waste disposal practice as the most significant source of nutrients to the lake.

Annual Budget Estimates:

	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004
Salaries		$5,000	$5,000		
Contracts		$50,000	$50,000		
Expenses		$2,000	$2,000		
Total		$57,000	$57,000		

Agency or Local Government Partnering:

There are opportunities for the District to partner with Pinellas County and possibly the City of Tarpon Springs through the cooperative funding process to fund this investigation.

APPENDIX A - ISSUE ANALYSIS AND TECHNICAL ASSESSMENTS

This section discusses issues leading to the need for restoration and conservation of the lake's resources and considers much of the technical work that has been done on Lake Tarpon. Subjects covered include water quality, fisheries and aquatic vegetation. Additional information is contained in the referenced technical reports.

The *Lake Tarpon Drainage Basin Management Plan* or DBMP (PBS&J 1998) and the *Lake Tarpon Ground-water Nutrient Study* (Upchurch 1998) represent the most recent comprehensive studies of Lake Tarpon. The DBMP (PBS&J 1998) identified the pollutant loading sources to the lake, the potential nutrient load reductions that were necessary to achieve the water quality goals of the LTMC and the estimated pollutant load reductions that could be achieved by implementation of various management strategies.

Much of the information contained in this appendix is taken verbatim from these reports and the 1994 Lake Tarpon SWIM Plan (SWFWMD 1994), and references to the original reports are included for the readers information.

WATER QUALITY ISSUES

Trophic State

Trophic state can loosely be defined as an indication of the nutritional status of a lake or other waterbody. The blue-green algae bloom of 1987 was seen as an indication that the trophic state of Lake Tarpon was increasing. Nuisance algae blooms such as the one in 1987 occur when nitrogen and phosphorus are present in the water column at excessive concentrations.

Increases in trophic state can result in ecological changes in the lake. Increased algae concentrations result in higher turbidity values which impede light penetration to the lake bottom preventing the growth of rooted aquatic plants. Decomposition rates in the lake increase resulting in depleted oxygen concentrations in the water column. Depleted oxygen levels and changes in the algae community may then cause a shift in the fish population structure from a predominance of sportfish to a predominance of rough fish. This increase in trophic state is known as eutrophication and may occur naturally at very slow rates or may occur at accelerated rates due to human activity in the watershed. The classical lake succession sequence is usually depicted as a unidirectional progression through the following series of trophic states:

- Oligotrophy - nutrient poor, biologically un-productive, low turbidity.
- Mesotrophy - intermediate nutrients and biological productivity, moderate turbidity.
- Eutrophy - nutrient-rich, high biological productivity, high turbidity
- Hypereutrophy - turbidity and color similar to pea soup

Although trophic state concepts have been in existence for some time, much controversy has existed over the terminology, the precise definition of various trophic state classes, and the

development of an ecologically meaningful and widely accepted quantitative procedure for determining trophic state. In general, the most widely accepted trophic state index for Florida lakes is that developed by Huber et al. (1983). This index is unique in that it was developed specifically for Florida lakes, and thus recognizes and assimilates various characteristics (e.g., well-mixed, nitrogen limiting conditions) generally not accommodated in trophic state indices developed for temperate lakes. The Florida lake index is calculated differently for nitrogen limited, phosphorus limited, and nutrient balanced lakes; and involves the calculation of separate sub-indices for total nitrogen, total phosphorus, chlorophyll-a, and Secchi depth. The overall trophic state index (TSI) for a lake is determined by combining the appropriate sub-indices to obtain an average for the physical, chemical, and biological features of the trophic state.

To determine the current trophic state of Lake Tarpon, the most recent monitoring data available from Pinellas County, covering the period January 1999 through December 1999, were used. The mean monthly concentrations of chlorophyll-a, TN, TP, and the mean monthly Secchi depth, for this time period are as follows:

- Chlorophyll-a (Chl-a) = 28.56 ug/l
- Total Nitrogen (TN) = 1.02 mg/l
- Total Phosphorus (TP) = 40.0 ug/l
- Secchi Depth (SD) = 0.87 m

As discussed by Huber et al. (1983), three classes of lakes can be described pursuant to the total nitrogen to total phosphorus ratio. They are as follows:

- Nitrogen-limited lakes = $TN/TP < 10$
- Nutrient-balanced lakes = $10 < TN/TP < 30$
- Phosphorus-limited lakes = $TN/TP > 30$

Using the mean values shown above, the TN:TP ratio in Lake Tarpon is 25.5, making it a nutrient-balanced lake, at least under current conditions. Therefore, the TSI for nutrient balanced lakes is appropriate, and is defined as:

$$TSI(AVE) = 1/3\ [TSI(Chl\text{-}a) + TSI(SD) + 0.5[TSI(TPB) + TSI(TNB)]]$$

Where TSI(Chl-a), TSI(SD), TSI(TPB), and TSI(TNB) are sub-indices for chlorophyll-a, Secchi depth, TN nutrient-balanced, and TP nutrient-balanced, respectively. These sub-indices are given and solved as follows:

- $TSI(Chl\text{-}a) = 16.8 + (14.4 \ln Chl\text{-}a) = 65.1$
- $TSI(SD) = 10\ [6.0 - (3.0 \ln SD)] = 64.2$
- $TSI(TNB) = 10\ [5.6 + (1.98 \ln TN)] = 56.4$
- $TSI(TPB) = 10\ [(1.86 \ln TP) - 1.84] = 50.2$

With the values of all sub-indices known, TSI(AVE) for Lake Tarpon can be solved as follows:

- $TSI(AVE) = 1/3\ [65.1 + 64.2 + 0.5\ (50.2 + 56.4) = 60.8$

Therefore, the calculated multi-parametric trophic state index for Lake Tarpon, for the period January 1999 through December 1999 is 60.8. A primary issue regarding the application of the TSI to the classification of Florida lakes for management purposes is the selection of a critical TSI value, or a value above which the lake is considered to have trophic related problems. Based upon a review of data from 573 Florida lakes, and the subsequent classification of each, Huber et al. (1983) determined the TSI value of 60 to be a generally applicable critical value defining eutrophy.

Previous studies on Lake Tarpon (Huber et al., 1983; KEA, 1992) have concluded that Lake Tarpon did not historically exhibit trophic related problems. Using the above described criteria, however, with a calculated current TSI of 60.8 Lake Tarpon is has reached the TSI value where trophic related problems can begin to occur. Nutrient load reduction is recommended to meet the target TSI value of 55.

Surface Water

Until the algae bloom of 1987, water quality in Lake Tarpon was considered good and indicative of at most, mesotrophic conditions. Of 41 lakes sampled by the USEPA in 1973, Lake Tarpon was ranked fifth in overall trophic quality based on an analysis of nutrients, Secchi disk transparency, chlorophyll-a and dissolved oxygen data. Of the 41 lakes monitored, Tarpon exhibited the greatest Secchi transparency, 38 lakes (92 percent) had higher TN concentrations and 33 (80 percent) had higher TP concentrations (USEPA 1977).

Bartos (1976a) classified Lake Tarpon as oligo-mesotrophic based on an analysis of water quality data collected from 1970-1975 and using criteria proposed for Florida Lakes by Shannon and Brezonik (1972). Mean TP and total organic nitrogen (0.08 and 0.57 mg/l, respectively) fell in the oligotrophic to oligo-mesotrophic ranges proposed for colored lakes (Shannon and Brezonik 1972). Chlorophyll-a concentrations were an order of magnitude lower than that given for the oligotrophic range. Secchi transparency was consistent with an oligo-mesotrophic ranking. Bartos (1976b) summarized Lake Tarpon as a "colored circumneutral lake with good overall water quality except for relatively high chloride concentrations." A decline in nutrient concentrations was reported following enclosure of the Tarpon Sink, which was noted as a major nutrient source due to its connection to Spring Bayou. Following closure of the Tarpon Sink, nutrient concentrations were primarily influenced by Brooker Creek and most of the nitrogen from this source was entering Lake Tarpon as either organic or ammonia nitrogen (Bartos 1976a).

The blue green algae bloom (*Anabaena circinalis*) that occurred in 1987 covered 80 percent of the lake. The bloom persisted for much of the summer and significantly impacted recreational and aesthetic use of the lake during a peak recreational season. Extremely low dissolved oxygen concentrations were noted in the residential canals and minor fish kills were reported (SWFWMD 1994). Since this algae bloom, Pinellas County has been monitoring water quality. Unfortunately, due to inconsistencies in field sampling and laboratory techniques, only chlorophyll-a and TN concentrations can be reliably used to examine multi-year temporal trends in trophic state.

The DBMP (PBS&J 1998) evaluated water quality data collected between 1988 and 1996. Mean annual chlorophyll-a concentrations in relation to mean annual TN concentrations and cumulative rainfall amounts are shown in Figure A-1. Figure A-2 shows mean annual chlorophyll-a concentrations in relation to mean annual pH and cumulative rainfall amounts. From these graphs PBS&J (1998) made the conclusions below.

- Chlorophyll-a concentrations were relatively low and stable in 1988 and 1989 following the algae bloom of 1987.

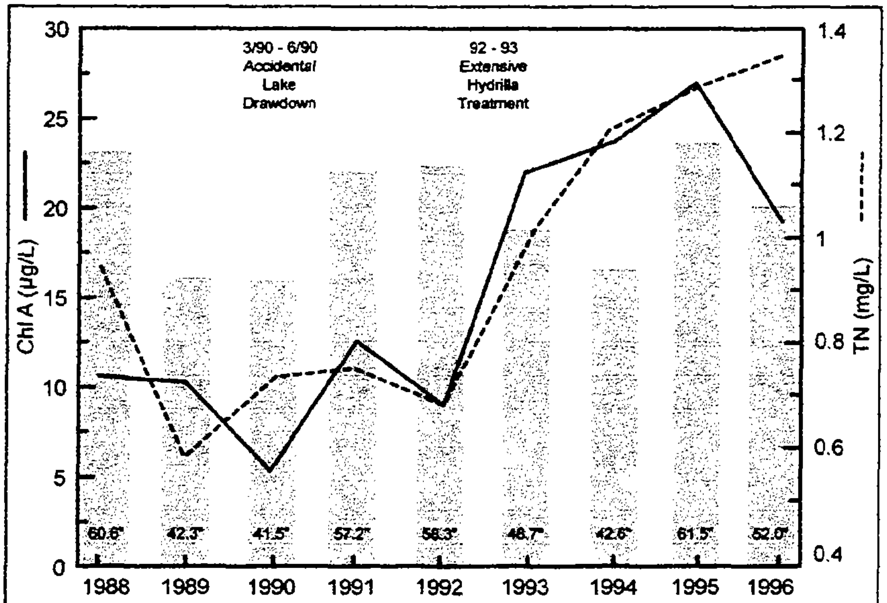


Figure A-1-Mean annual chlorophyll-a vs. mean annual TN concentration, with cumulative annual rainfall for the period 1988-1996 (PBS&J 1998)

- Chlorophyll-a concentrations decreased in 1990. It is hypothesized that this decrease was a lake response to the accidental release of water over the outfall structure in March 1990, which lowered the lake levels by approximately one foot. This release of water had the effect of flushing the lake of excess nutrients, and eventually diluting the lake volume with relatively nutrient-poor rainwater. In addition, it is hypothesized that groundwater seepage from the surficial aquifer also resulted in a reduction in the lake pH which may have in turn suppressed algae growth during the summer of 1990.

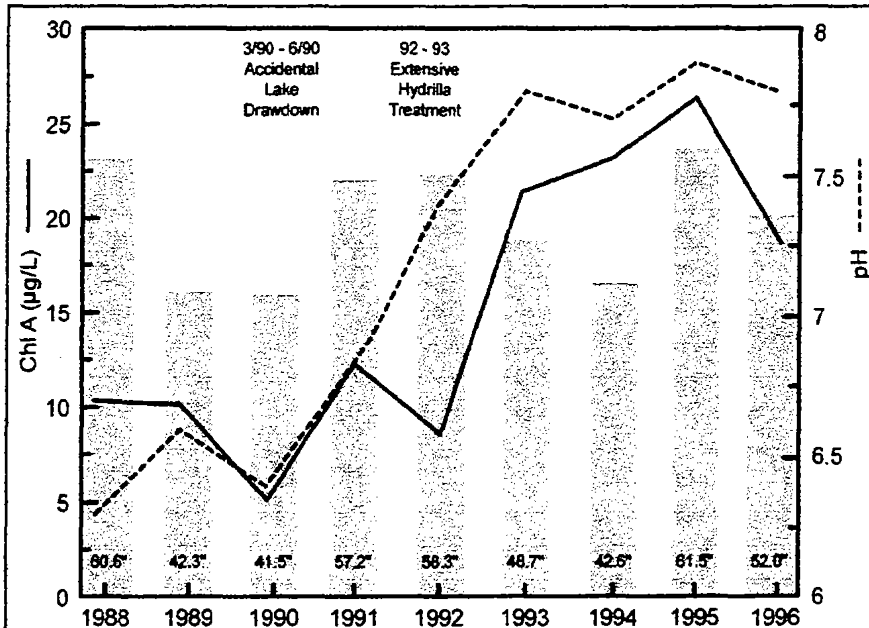


Figure A-2-Mean annual chlorophyll-a concentrations against mean annual pH values, with cumulative annual rainfall for the period 1988-1996 (PBS&J 1998)

- Chlorophyll-a concentrations increased to pre-drawdown levels in 1991. During the summer of 1991, pH levels in the lake returned to normal conditions.
- Chlorophyll-a concentrations increased substantially in 1993 and have remained relatively high since that time. It

should be noted that the observed chlorophyll-a increases during 1993 and 1994 occurred during a period of reduced rainfall. Therefore, increased non-point source loadings cannot be attributed to this trend. The most plausible explanation for this trend involves the large scale chemical treatment of hydrilla. During late 1992 and early 1993, over 500 acres of dense hydrilla were chemically treated resulting in a major die-off. As this dead plant biomass decomposed, the nutrients contained within the plant tissue were released into the water column, thus stimulating algae growth.

- Like chlorophyll-a, TN concentrations have also increased in the lake since 1993. The cause of this increase is not known, however, the relationship of this trend to the 1993 hydrilla die-off is intuitive. It is also consistent with what has been observed in other Florida lakes where large scale hydrilla treatment has been implemented (e.g., Lake Seminole). Although, development has continued at a steady pace since 1993, especially in the East Lake area, no substantial land use changes and associated nutrient loadings have occurred in the study area during this time period to account for the observed trends.

PBS&J (1998) asserts that "Although, development has continued at a steady pace since 1993, especially in the East Lake area, no substantial land use changes and associated nutrient loadings have occurred in the study area during this time period to account for the observed trends." Therefore, PBS&J (1998) attributes this dramatic increase in chlorophyll-a to the hydrilla treatment in 1993. However, based on a review of land use maps from1950 to 1990 for the Lake Tarpon and Brooker Creek watersheds a substantial change from natural areas to agricultural uses and ultimately urban land uses can be observed (Upchurch 1998). Upchurch (1998) further states that "Given the long travel times of groundwater in the Lake Tarpon Basin, all land uses that cause nutrients to be applied to the land surface or within the soil column, past and present, may have contributed to the nutrients found in the groundwater in the Lake Tarpon Basin." Therefore, it would be expected that decades of changes in the watershed have had a cumulative effect on the trophic state of Lake Tarpon.

Due to complex interactions between nutrients, algae and aquatic macrophytes it is difficult to ascribe the increased trophic state of Lake Tarpon to any single event. In the case of Lake Tarpon, calculation of the TSI has been complicated by the existence of hydrilla, an exotic nuisance aquatic plant. Canfield and Hoyer (1992) cite several studies that show that aquatic macrophytes can inhibit algal growth and thus suppress measured chlorophyll-a. Since the multi-parametric TSI uses chlorophyll-a, Secchi depth and in-lake nutrient concentrations, then TSI values calculated using these parameters will underestimate the true trophic state of the lake if substantial amounts of aquatic macrophytes are present. Removal of these macrophytes without removal of the original source of nutrients may lead to increases in chlorophyll-a concentrations through two mechanisms. If the macrophytes are "killed in place" and allowed to decompose, they will release nutrients bound up in the plant tissue. Secondly,any continued nutrient inputs will be available for algal uptake. In both cases, TSI value based on chlorophyll-a will also increase. Thus, the expansion of hydrilla may be more a symptom of increasing eutrophication, rather than as a cause.

As mentioned above by PBS&J (1998), there are two hypotheses to explain the observed decrease in algal productivity during the summer of 1990. In an attempt to determine the cause of the decrease, PBS&J (1998) plotted the relationship between mean annual

chlorophyll-a and TN and chlorophyll-a and pH. These plots are shown in Figures A-3 and A-4, respectively. Both plots show that there is a direct relationship between chlorophyll-A concentrations and pH and TN. Increased algal productivity can lead to increased pH due to the removal of carbon dioxide and the production of carbonate in the water column during active photosynthesis. Although the low pH values in Lake Tarpon during the summer of 1990 may have been a result of decreased algal productivity, they are more likely explained by the seepage of acidic groundwater from the surficial aquifer into the lake following the accidental drawdown that occurred in March 1990. This decreased pH may have stunted the algal productivity during this time, thus contributing to the observed reduction in chlorophyll-a (PBS&J 1998).

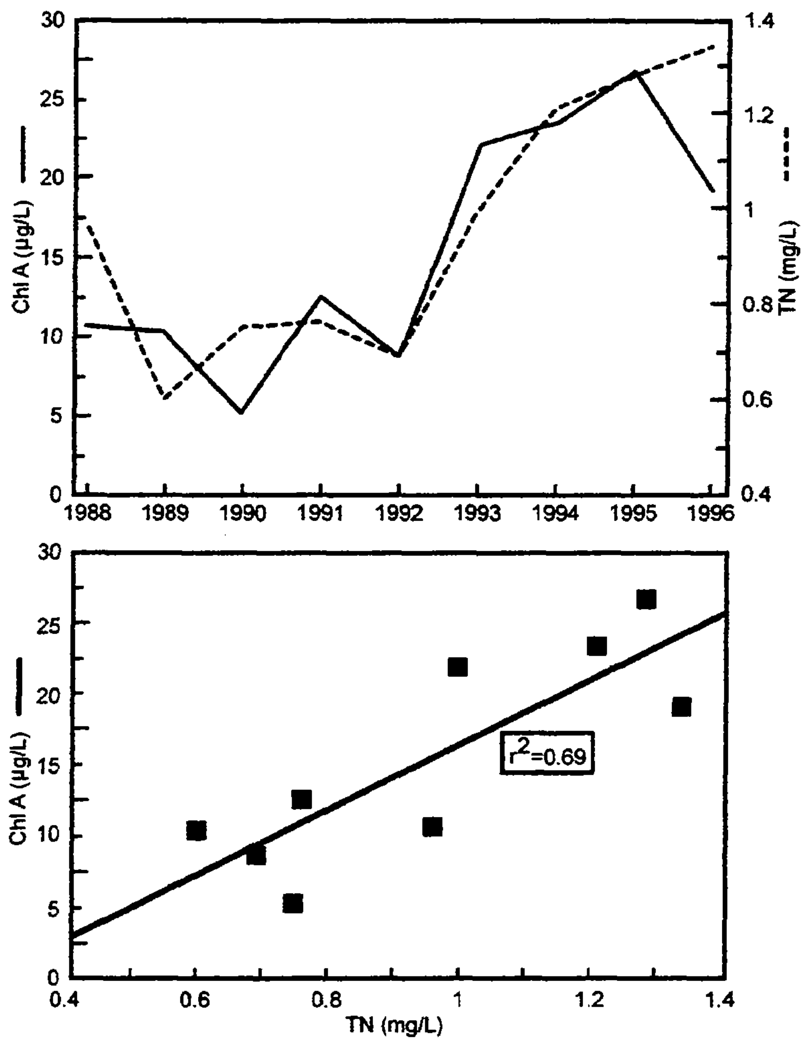


Figure A-3-Mean annual chlorophyll-a concentrations vs. mean annual total nitrogen concentrations for the period 1988-1966 (PBS&J 1998)

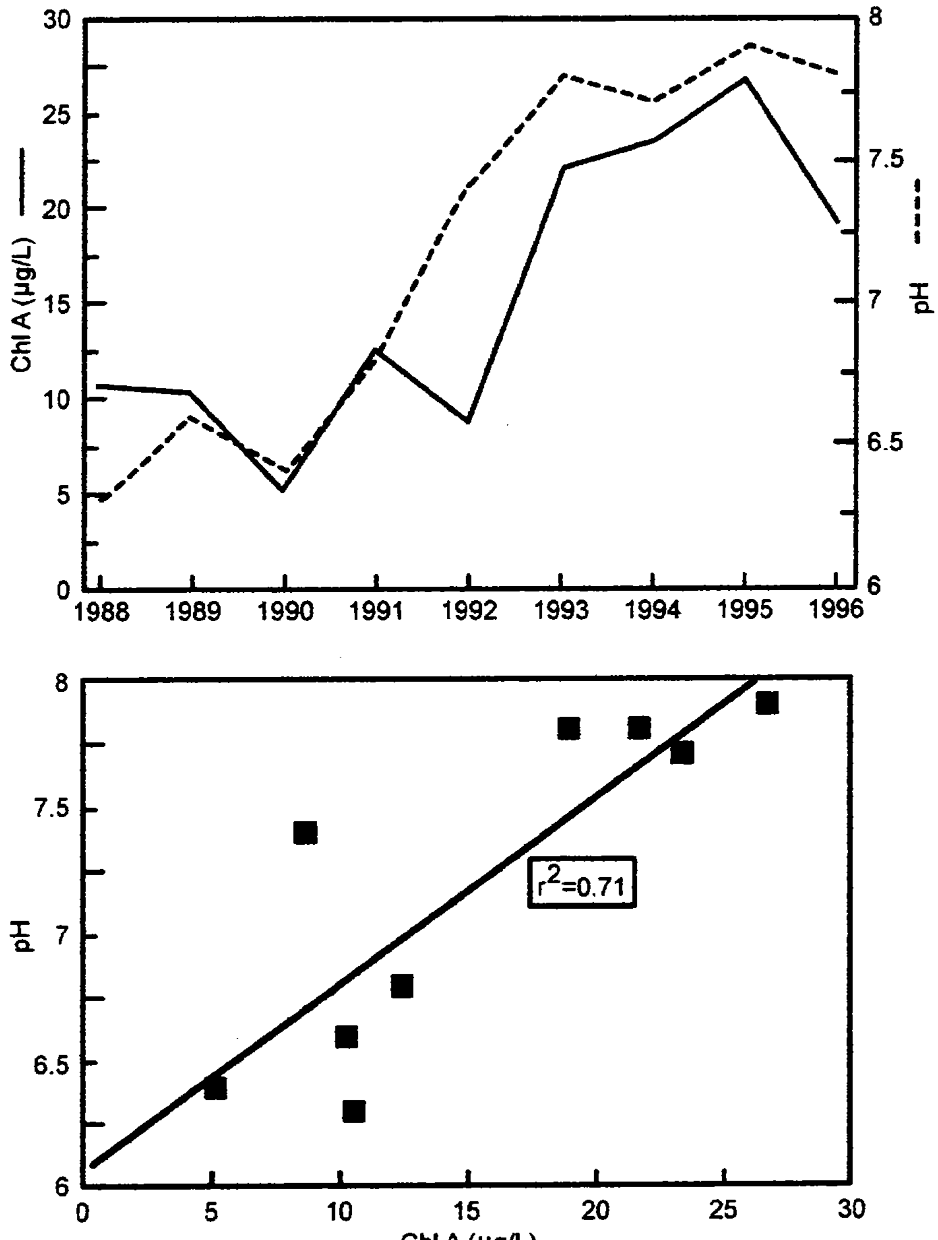


Figure A-4-Mean annual chlorophyll-a concentrations vs. mean annual pH values for the period 1988-1996 (PBS&J 1998)

The accidental drawdown in March 1990 occurred while the Lake Tarpon Outfall Structure was being operated in automatic mode. Strong winds from the north had pushed water into the southern end of the lake and in the Lake Tarpon Outfall Canal, in effect "piling it up" against the Outfall Structure. Sensors on the Outfall Structure read this increased water level elevation as a flood condition and opened the gates to release water. The actual release of water was from 3.1' mean sea level (msl) to about 2.4' msl (0.7' drop), at which time the malfunction was realized the gates were closed. From the time the gates were closed, the lake continued to drop for almost a two month period to a low elevation of 1.73' msl on May 22, 1990. Because the structure was closed, this continued decline in water levels can only be attributed to evapotranspiration and seepage. Figure A-5 shows a hydrograph of this event.

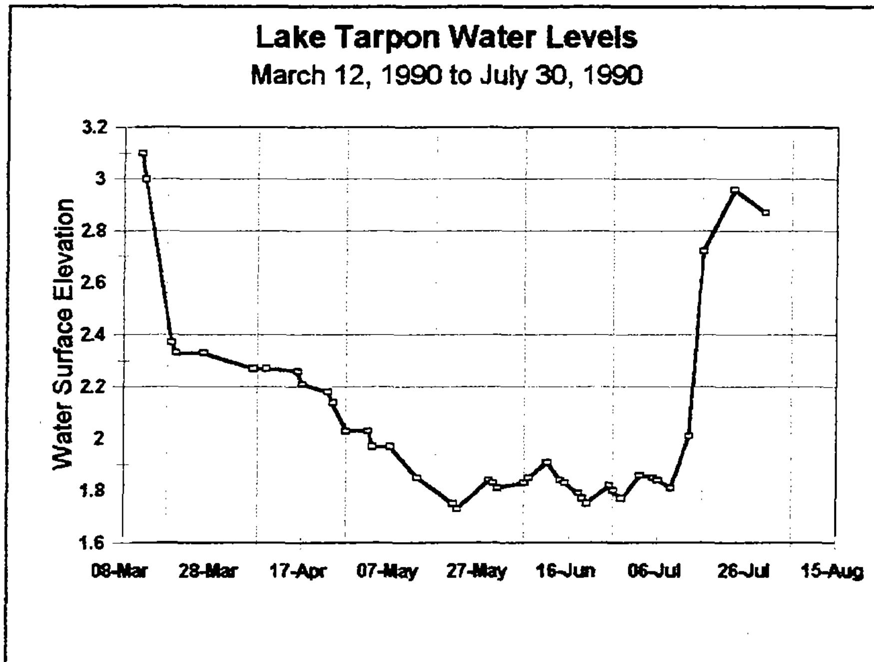


Figure A-5-Hydrograph of accidental drawdown March 1990

Due to the observed decrease in chlorophyll-a after the accidental release, PBS&J (1998) recommended that the Outfall Structure be operated in a similar manner to reduce in-lake retention time of nutrients and to dilute in-lake nutrient concentrations. Based on mean annual TN and TP concentrations from 1995 Lake Tarpon water quality data it is estimated that the discharge of 1.0' of water through the Outfall Structure would result in a nutrient mass discharge of 4.41 tons of TN and 0.25 tons of TP. Although lake retention time would be

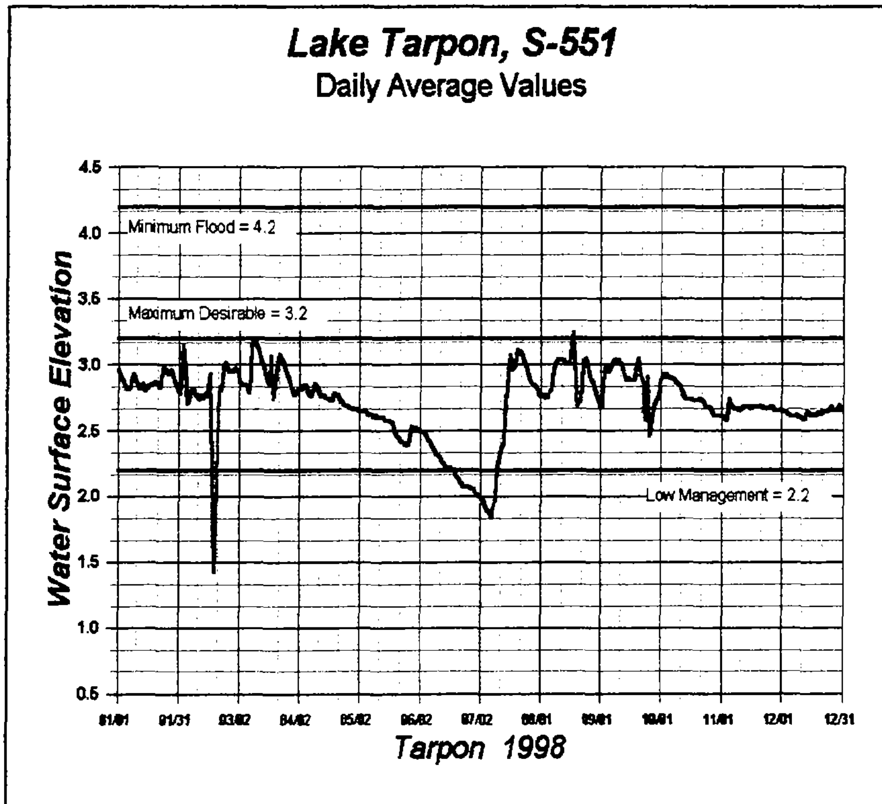


Figure A-6-Hydrograph showing accidental drawdown in February 1998 followed by natural lake level decline in July 1998

somewhat reduced, the discharged nutrient mass would be replaced by nutrients in the inflowing precipitation, runoff and groundwater. Therefore, dilution would occur only if the inflow waters had lower nutrient concentrations than in-lake concentrations.

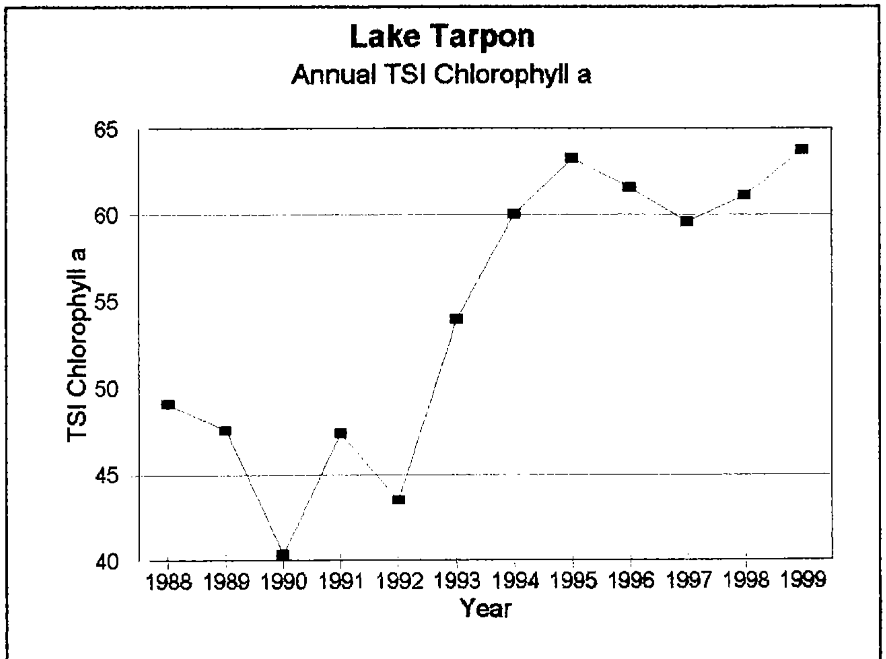


Figure A-7-Annual average TSI(Chl-a) values for the period 1988 -1999

Since the accidental release of 1990, another release of a similar magnitude occurred in 1998 (Personal Communication: Scott Stevens, District). In February 1998, an accidental release resulted in a 1.3' lowering of the lake elevation. This drawdown occurred during the El Nino event and heavy frequent rains raised the lake within 36 hours to pre-release levels. This release actually resulted in a larger volume of water being discharged over the structure than the March 1990 event, however, the lake did not continue to drop and therefore, rainfall not groundwater was the primary inflow to the lake. Figure A-6 shows a hydrograph covering this event. Although the lake was discharging, annual average chlorophyll-a values for 1998 appear to have slightly increased (Figure A-7).

The 1998 release did not result in a noticeable decline in chlorophyll-a concentrations, therefore this supports the hypothesis that the decrease in chlorophyll-a 1990 was likely the result of acidic groundwater seeping into the lake.

Groundwater

The most recent groundwater investigation related to Lake Tarpon was the *Lake Tarpon Ground-water Nutrient Study* (Upchurch 1998). This report provides a comprehensive review of the numerous groundwater studies that have been conducted in and around the Lake Tarpon watershed. These studies were grouped according to their objectives and included studies of regional groundwater quality, Lake Tarpon groundwater quality, potential nutrient sources, water and nutrient flux to Lake Tarpon, photolinear analysis and aquifer vulnerability mapping. The following discussion was excerpted from *Lake Tarpon Ground-water Nutrient Study* (Upchurch 1998).

Regional groundwater quality studies focused on defining conditions in the Floridan Aquifer, including chloride concentrations and potentiometric mapping (Cherry 1966; Hutchinson 1983; Corral 1983; Maddox *et al.* 1992; SWFWMD 1996). The study areas of the Lake Tarpon groundwater quality studies were centered around the lake and its connection to the Floridan

Aquifer and did not specifically look at potential nutrient sources (Hunn 1974; Spechler 1983).

Studies of potential nutrient sources to the aquifer were conducted by Fernandez and Hutchinson (1993) and Brown (1982). Fernandez and Hutchinson (1993) studied water quality in stormwater ponds in north-central Pinellas County. Although the ponds were not located in the Lake Tarpon watershed, this study did demonstrate the potential for stormwater to contribute nutrients to the surficial aquifer. Brown (1982) investigated the effects of spray irrigation of wastewater effluent just west of Lake Tarpon. These two studies are consistent with the findings of Jones and Upchurch (1993, 1994) and Jones *et al.* (1996, 1997) which point to many potential sources of nutrients to groundwater including fertilization of citrus, lawns and pasture, feed lots, stormwater and septic tanks. All of these potential sources either currently exist or have historically existed in the Lake Tarpon watershed (Upchurch 1998).

Several studies have been conducted to determine water and nutrient flux to Lake Tarpon (CCI 1990; N.S. Nettles & Associates, Inc. 1991; KEA 1992 and Robison 1994). The 1994 revision of the Lake Tarpon SWIM Plan (SWFWMD 1994) used the estimated groundwater flux prepared by KEA (1992) and the nutrient flux estimates prepared by Robison (1994). The *Lake Tarpon Ground-water Nutrient Study* (Upchurch 1998) provided updated groundwater nutrient flux estimates that were used in the DBMP (PBS&J 1998).

The objectives of the *Lake Tarpon Ground-water Nutrient Study* (1998) were to: 1)estimate the flux of nutrients, especially nitrate, into Lake Tarpon via groundwater; 2) determine the origins of nutrient rich groundwater in the Lake Tarpon watershed; and 3) identify the potential for future flux of nutrients in the lake and Brooker Creek from groundwater.

The *Lake Tarpon Ground-water Nutrient Study* (Upchurch 1998) concluded that water quality in the surficial aquifer reflects a combination of processes including 1) rapid recharge in the eastern half of the Lake Tarpon watershed and along the eastern side of Lake Tarpon; 2) mixing of rainfall-derived water with water from the Florida Aquifer by irrigation; and 3) mixing of somewhat saline Floridan Aquifer water as a result of up-coning or irrigation. Floridan Aquifer water in the eastern and middle thirds of the Lake Tarpon basin is dominated by water quality developed through interaction with the limestone aquifer. The western third of the basin, including the immediate vicinity of the lake, is characterized by the presence of the salt-water/fresh-water transition zone.

Potential sources for groundwater contamination have changed with changing land use in the last 50 years. Although, some land uses may no longer occur in the Lake Tarpon watershed, the nutrients they contributed to land surface and soils are likely still influencing groundwater quality. These are coupled with the more recent nutrient sources such as spray irrigation or wastewater effluent and lawn and golf-course fertilization.

The *Lake Tarpon Ground-water Nutrient Study* (Upchurch 1998) found ammonia to be widespread in low concentrations throughout the surficial aquifer in the basin. High ammonia concentrations were found at two locations in the Brooker Creek watershed. Both these reflect local wastewater sources (septic tanks or animals). Ammonia concentrations are high in the vicinity of the lake, which reflects application of fertilizers and wastewater. The

distribution of ammonia in the Floridan Aquifer is more uniform than in the surficial and concentrations are typically low.

Nitrate concentrations in the surficial aquifer are highly variable. High concentrations, which reflect septic tanks or animal wastes, were found in isolated plumes in the eastern half of the basin (Brooker Creek watershed). Areas of elevated nitrate were also found near the lake, where golf courses, wastewater reuse facilities and suburban development are predominant. Virtually no nitrate was detected in the Floridan Aquifer, probably owing to reducing conditions in the Floridan. Nitrogen compounds in the isolated plumes in the Lake Keystone area are a threat to surface waters, especially lakes. The surficial aquifer in this area can drain to the surface waters in this part of the Brooker Creek watershed and then be transported to the lake through the Brooker Creek system. Similar threats exist nearer to Lake Tarpon.

The *Lake Tarpon Ground-water Nutrient Study* (Upchurch 1998) provided a comprehensive and detailed investigation of the nutrient sources in the Lake Tarpon and Brooker Creek watersheds and the potential for these sources to lead to increased nutrient inflows to Lake Tarpon. However, Upchurch (1998) concluded that additional groundwater wells were needed to refine the estimates of nutrient flux to the lake. Without these wells and additional data, it is difficult to point to any one land use or waste disposal practice as the most significant source of nutrients to the lake. This is especially true in the northwest corner of the lake. This area of the lake is developed in residential land uses and is served by septic tanks. There is concern that these septic tanks are a significant source of nutrients to Lake Tarpon and that they should be abandoned and the residences connected to municipal wastewater treatment. However, the results of the *Lake Tarpon Ground-water Nutrient Study* (Upchurch 1998) were inconclusive as to the amount of nutrients from this source that actually entered the lake. Upchurch (1998) recommended that additional wells be installed in this area to evaluate the need for installing central sewer facilities in this area and to further refine the nutrient budget for the lake.

Pollutant Loading Sources: Water and Nutrient Budgets
As mentioned earlier, several investigators have prepared water and nutrient budgets for Lake Tarpon (CCI 1990; N.S. Nettles & Associates, Inc. 1991; KEA 1992 and Robison 1994). PBS&J (1998) re-evaluated the pollutant loading sources based on the most current data, including the groundwater nutrient flux developed by Upchurch (1998), and developed the revised water and nutrient budgets shown in Tables A-1, A-2, and A-3.

Table A-1. Lake Tarpon annual water budget.

INFLOWS	CUBIC FEET/SECOND	PERCENT OF TOTAL
Direct Runoff (modeled)	20.8	42.2
Precipitation	16.5	33.5
Brooker Creek (gaged)	9.1	18.5
Septic Tanks	0.1	0.2
Surficial Aquifer Seepage	1.9	3.8
Floridan Aquifer Seepage	0.9	1.8
TOTALS	49.3	100
OUTFLOWS	**CUBIC FEET/SECOND**	**PERCENT OF TOTAL**
Outfall Canal Discharge*	33.7	68.4
Evapotranspiration	15.6	31.6
TOTALS	49.3	100

* Revised as the difference between total inflow and the evapotranspiration outflow due to the unreliability of reported discharge volumes through the Lake Tarpon Outfall Structure.

Table A-2. Lake Tarpon annual total nitrogen budget.

INFLOWS	TONS/YEAR	PERCENT OF TOTAL
Direct Runoff (modeled)	27.45	48.6
Atmospheric Deposition	9.99	17.7
Brooker Creek (gaged)	10.45	18.5
Septic Tanks	6.49	11.5
Surficial Aquifer Seepage	1.78	3.1
Floridan Aquifer Seepage	0.35	0.6
TOTALS	56.51	100
OUTFLOWS	**TONS/YEAR**	**PERCENT OF TOTAL**
Outfall Canal Discharge	35.17	62.2
Fish Harvest	0.70	1.3
Sedimentation/Macrophyte Biomass*	20.64	36.5
TOTALS	56.51	100

* Calculated as the difference between total inflow and the sum of the outfall canal discharge and fish harvest outflows.

Table A-3. Lake Tarpon annual total phosphorus budget.

INFLOWS	TONS/YEAR	PERCENT OF TOTAL
Direct Runoff (modeled)	4.03	68.8
Atmospheric Deposition	0.20	3.4
Brooker Creek (gaged)	0.61	10.4
Septic Tanks	0.82	14.0
Surficial Aquifer Seepage	0.13	2.2
Floridan Aquifer Seepage	0.07	1.2
TOTALS	5.86	100
OUTFLOWS	**TONS/YEAR**	**PERCENT OF TOTAL**
Outfall Canal	1.39	23.7
Fish Harvest	0.24	4.1
Sedimentation/Macrophyte Biomass*	4.23	72.2
TOTALS	5.86	100

* Calculated as the difference between total inflow and the sum of the outfall canal discharge and fish harvest outflows.

Based on the work done to develop the water and nutrient budgets, PBS&J (1998) made the following observations and conclusions.

- The Lake Tarpon watershed consists of three major drainage basins including the Brooker Creek basin, the South Creek basin, and the Lake Tarpon basin. Direct runoff from the Lake Tarpon drainage basin (42.2 percent), and precipitation on the lake surface (33.5 percent), account for a total of 75.7 percent of the freshwater inflows to the lake. The gaged Brooker Creek flow (18.5 percent) is also a significant source of freshwater inflow. Hydrologic inflows from the surficial aquifer (3.8 percent), the Floridan aquifer (1.8 percent), and septic tanks (0.2 percent) are relatively insignificant.

- Hydrologic outflows from Lake Tarpon are limited to outfall canal discharges (68.4 percent) and evapotranspiration (31.6 percent).

- Compared to the South Creek basin and both the gaged and ungaged portions of the Brooker Creek basin, the Lake Tarpon basin is by far the most significant contributor to anthropogenic TN and TP loadings to the lake. Although the gaged Brooker Creek basin is a very significant source of hydrologic inflows to the lake, these findings strongly suggest that external pollutant load reduction strategies implemented in the Lake Tarpon basin, as opposed to the South Creek or Brooker Creek basins, will be most effective in trophic state management of Lake Tarpon.

- Of the six identified sources of nutrient inflows to Lake Tarpon, only direct runoff and septic tanks are considered to be manageable sources that could be reduced through the implementation of stormwater best management practices (BMPs) and construction of central sewer facilities, respectively.

- Approximately 48.6 percent of the TN load and 68.8 percent of the TP load to Lake Tarpon are contributed from direct stormwater runoff from the Lake Tarpon basin.

- Based upon the sub-basin ranking and prioritization procedure used in the pollutant loading analysis, four manageable hydrologic units (MHUs = combinations of hydrologically connected sub-basins), and two individual sub-basins, have been selected for the potential implementation of non-point source BMPs. These basins are shown in Figure A-8 and listed in order of decreasing priority below:

    - Group-B MHUs (contributing sub-basins 49, 51, 52, and 54);
    - Group-D MHUs (contributing sub-basins 5 and 6);
    - Group-A MHUs (contributing sub-basins 60, 62, 63, 65, and 66);
    - Group-C MHUs (contributing sub-basins 45, 46, and 47);
    - Individual sub-basin 23; and
    - Individual sub-basin 21.

  The cumulative nutrient load from the four priority MHUs and two individual sub-basins constitutes 6.32 and 0.73 tons of TN and TP per year, respectively. This represents 11.2 percent of the total annual TN load, and 12.5 percent of the total annual TP load, from external sources. In addition, this represents 23.0 percent of the annual TN, and 18.1 percent of the annual TP load, from direct runoff, respectively.

- Approximately 11.5 percent of the TN load and 14.0 percent of the TP load to Lake Tarpon are contributed from septic tank seepage in the Lake Tarpon basin.

- A total of 1,076 residences with septic tanks occur within the Lake Tarpon basin. Sub-basins 5, 6, 7, 9 and 13 generate the highest modeled septic nutrient loads. These sub-basins correspond to predominantly residential areas where no central sewer service, or only partial service, is available. Priority should be given to removal of septic systems and the extension of central sewer service in these sub-basins.

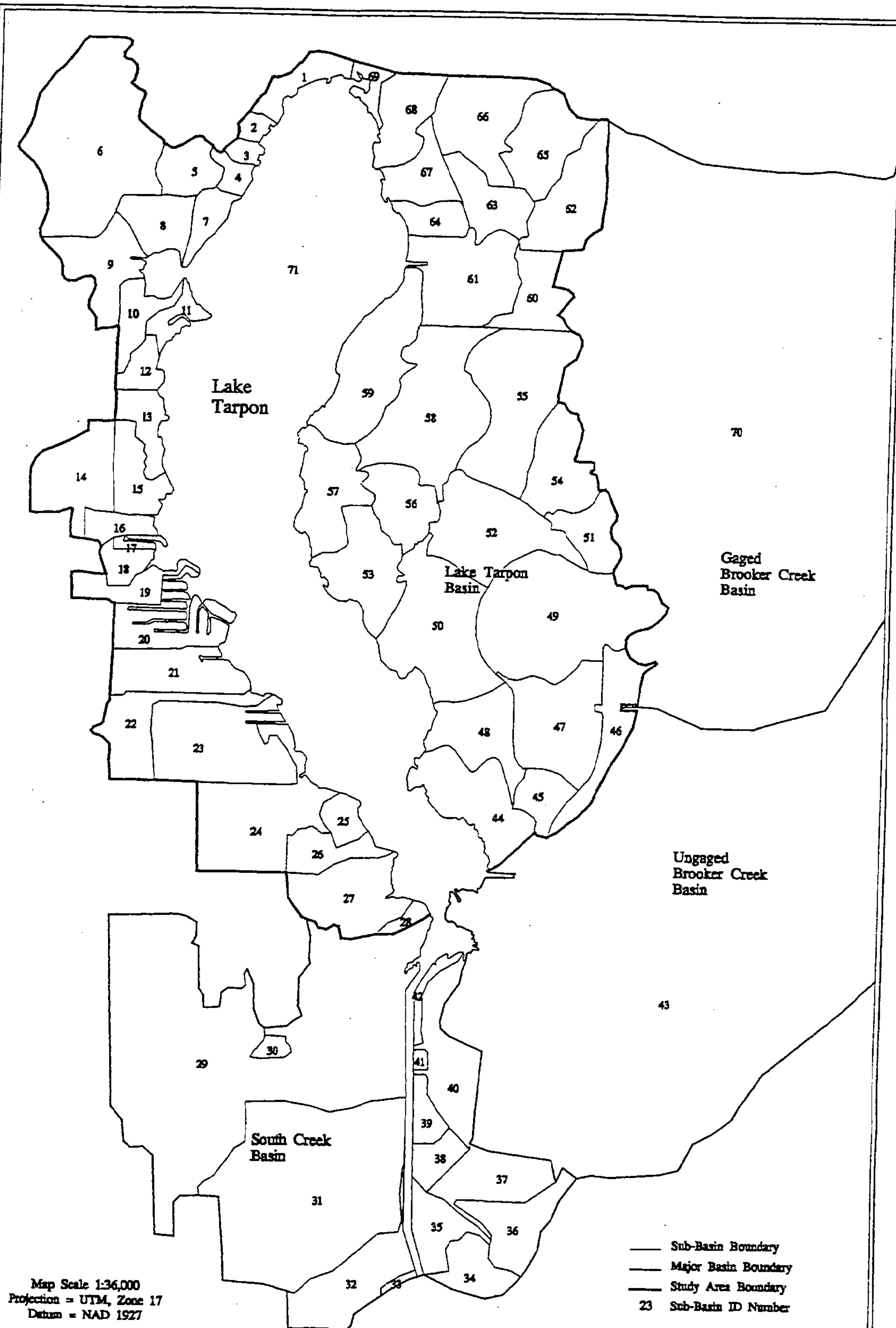
- Based on modeling results, the provision of central sewer to all residences with septic systems would result in an annual load reduction of 6.37 tons for TN and 0.78 tons for TP. This corresponds to 11.3 and 13.3 percent of the total annual TN and TP loads, respectively.

- Septic systems are regulated in an effort to minimize the potential for groundwater and surface water contamination. However, site specific conditions (such as high water table or improper soils) or lack of proper maintenance of the system may lead to the reduced effectiveness of treatment and eventual total failure of the septic systems which may contribute to locally significant groundwater and surface water pollutant loadings.

- The combined external load reduction strategies of providing enhanced stormwater treatment of runoff from the priority MHUs and sub-basins, and central sewer to all remaining residences with septic tanks, would result in a 14.3 and 20.8 percent reduction in total annual TN and TP loads, respectively.

- The Lake Tarpon basin is not homogeneous with regard to its physical and developmental characteristics. Anthropogenic loadings of TN from non-point sources, point sources (e.g., effluent reuse) and septic tanks are all higher from the west lake region than from the east lake region. With regard to TP, the sum of these three anthropogenic loading sources is also higher for the west lake region. The west lake region and the northeast quadrant of the lake generally represent the zones of highest pollutant loading.

- Seepage from the surficial aquifer accounts for approximately 3.1 and 2.2 percent of the total annual TN and TP loads to the lake, respectively. Nutrient concentrations in the surficial aquifer are affected by land application of fertilizers and spray irrigation of reclaimed water, as well as natural processes.



COASTAL

LAKE TARPON DRAINAGE BASIN MANAGEMENT PLAN

Figure A-8 Lake Tarpon sub-basin delineation

- Spray irrigation sites in Anderson Park (sub-basins 10, 11 and 12), Highland Lakes (sub-basin 24) and Lansbrook (sub-basin 53) account for virtually all of the modeled loads from effluent land application. Nutrient loads to the lake from effluent land application are potentially measurable with regard to TN loadings, primarily in the form of nitrate. Due to the different reactive processes and fate of phosphorus in the subsurface environment, TP loadings from effluent land application are calculated to be close to zero.

- With regard to management considerations, effective assimilation of nutrients from spray irrigation is extremely dependent upon effluent application rates and the concurrent antecedent conditions of the applicable soils. When applied to common areas (e.g., medians, public parks, etc.) under a managed rate control program, nutrient loadings to the lake from effluent land application can be effectively minimized. If, however, reclaimed water is made available to large residential areas in the Lake Tarpon basin, especially those on the west side of the lake where the soils are well-drained, the potential for over-application will likely increase. On a cumulative basis, unmanaged effluent land application in the Lake Tarpon basin has the potential to become a measurable component of the overall TN load to the lake.

- Atmospheric deposition accounts for approximately 17.7 percent of the TN loadings, and 3.4 percent of the TP, loadings to Lake Tarpon. Because of the extremely diffuse nature of air pollutants, relatively little can be done in terms of specific management actions within a local watershed to reduce atmospheric deposition to a target waterbody.

- While discharges from the gaged Brooker Creek basin also constitute a significant source of TN loadings to the lake (18.5 percent of the total annual TN load), viable load reduction strategies probably don't exist given the relatively natural character of the Brooker Creek watershed and its status as a County preservation area.

- Given the large contributions of the relatively unmanageable sources of atmospheric deposition and Brooker Creek to the overall TN load, and the fact that the lake is close to being phosphorus limited based on the in-lake TN:TP ratio, external pollutant load reduction strategies for Lake Tarpon would likely be more effective if an emphasis was placed on phosphorus controls rather than nitrogen controls.

- The annual nutrient budgets for Lake Tarpon indicate that approximately 36.5 percent of the TN load, and 72.2 percent of the TP load, are retained within the lake via both deposition in lake sediments and assimilation in macrophytic plant tissue. Although it is difficult to accurately quantify the mass of nutrients annually released back into the water column in association with macrophyte senescence and decomposition, water quality trends indicate that this mass may be very substantial following large scale chemical treatment of hydrilla. These internal nutrient stores represent a potentially major source of nutrient loadings under certain conditions via internal recycling. Measures to reduce internal recycling should be pursued as a means of reducing the lake trophic state index.

Monitoring of the nutrient budget for Lake Tarpon is an important tool in determining the effectiveness of implemented management strategies and in monitoring changes in the lake trophic condition as a response to changes in the watershed and in-lake processes. Pinellas

County monitors water quality in Lake Tarpon monthly and they have collected water quality and quantity data for the inflows to the lake. To date, outflows to the lake have been estimated based on generally accepted practices. However, direct measurement of outflow through the Lake Tarpon Outfall Structure would aid in the refinement of the Lake Tarpon nutrient budget and in evaluating the success of the implemented management strategies. The District, Pinellas County and the United States Geological Survey began working together in 1999 to collect outflow data at the Lake Tarpon Outfall Structure.

Pollutant Load Reduction Strategies

Historical data for Lake Tarpon indicated that the annual average TSI was about 50 and during development of the 1994 SWIM Plan, Lake Tarpon had experienced annual average TSI values around 54. Given the inherent variability in the index, the TSI value may not have deviated substantially from the historic TSI. This, coupled with the need to allow Pinellas County to develop a plan to evaluate non-point source reductions on a cost/benefit basis, lead the District to set an interim PLRG of zero in the 1994 SWIM Plan.

Since completion of the 1994 Lake Tarpon SWIM Plan, the annual average TSI value for the lake has increased and for the period from May 1996 to April 1997 PBS&J (1998) calculated an annual average TSI of 59. This increasing productivity as measured by the amount of algae (chlorophyll-a) in the water results from an increase in nutrients entering the lake and from the recycling of these nutrients once they have entered the lake. Therefore, PBS&J (1998) evaluated various management strategies to control external and internal sources of nutrients to Lake Tarpon and the discussion below is based on their evaluation.

Control of External Nutrient Sources

As indicated in Tables A-2 and A-3, external nutrient loading sources to Lake Tarpon include atmospheric deposition, direct runoff (modeled), Brooker Creek, septic tanks, and seepage from the surficial and Floridan aquifers. The DBMP (PBS&J 1998) concluded that of these external sources, the only manageable sources (e.g., can feasibley be reduced through remediative measures) were direct runoff (48.6 percent of the total TN load and 68.8 percent of the total TP load) and leachate from septic tanks (11.5 percent of the total TN load and 14.0 percent of the total TP load). The other major external sources, including atmospheric deposition and groundwater inflows, are considered to be unmanageable from a practical standpoint. In addition, nutrient loadings from Brooker Creek were also considered to be essentially unmanageable given the relatively natural character of the basin. Furthermore, loadings from the Brooker Creek watershed in Pinellas County are not likely to be reduced through the construction of regional stormwater treatment facilities due to the fact that Pinellas County has already purchased the majority of the contributing land area as a preservation area, and such facilities would likely be inconsistent with the designated uses of the Preserve. (Since PBS&J was under contract to Pinellas County, they did not consider the Brooker Creek watershed in Hillsborough County. The District has begun working with Hillsborough County to investigate opportunities for water quality improvement and habitat and hydrologic restoration in the Brooker Creek watershed in Hillsborough County.)

With the exception of sediment removal, the most costly lake management options typically involve the rehabilitation of stormwater and wastewater discharges as a means of reducing

external nutrient loadings. Given the relative importance of external nutrient loads to the Lake Tarpon nutrient budget (compared to internal loads from nutrient recycling), and the potentially high cost of the various external load reduction strategies, only those management strategies aimed at external load reduction were subjected to cost-effectiveness analyses by PBS&J (1998). The results of those analyses are discussed in the following sections.

Stormwater Retrofit of Priority Sub-basins - During development of the nutrient budgets for Lake Tarpon, PBS&J (1998) delineated sub-basins within the Lake Tarpon watershed in Pinellas County (Figure A-8). Modeling techniques were used to estimate freshwater inflows and pollutant loadings to Lake Tarpon and to prioritize sub-basins for implementation of BMPs (Coastal 1995). Non-point source loadings for 67 sub-basins in the Lake Tarpon drainage basin were estimated using an empirical hydrologic model based on land use, soils, rainfall, and sub-basin boundaries. Hydrologically connected sub-basins were treated as a single manageable unit, and were termed "manageable hydrologic units" (MHUs). The MHUs and/or individual sub-basins with the highest TN, TP, and TSS loadings from direct runoff were identified and then ranked for priority based on pollutant load and other logistical factors. Table A-4 shows the area, modeled annual flows and TN and TP loads for the MHUs and individual sub-basins in priority order.

Table A-4. Summary of modeled loads from the priority MHUs and individual sub-basins.

Treatment Area	Area (acres)	Runoff (cfs)	TN (tons/year)	TP (tons/year)
Group B MHUs (sub-basins 49, 51, 52, 54)	713.3	1.29	1.63	0.22
Group D MHUs (sub-basins 5, 6)	436.2	1.03	1.61	0.15
Group A MHUs (sub-basins 60, 62, 63, 65, 66)	569.8	0.80	1.11	0.20
Group C MHUs (sub-basins 45, 46, 47)	337.2	0.68	0.85	0.08
Sub-basin 23	211.6	0.44	0.67	0.05
Sub-basin 21	114.6	0.24	0.45	0.03
Totals	**2,382.7**	**4.48**	**6.32**	**0.73**
% of direct runoff load	—	**21.5%**	**23.0%**	**18.1%**
% of total loads	—	**9.1%**	**11.2%**	**12.5%**

PBS&J (1998) evaluated cost effectiveness of retrofitting the four priority MHUs and the two priority individual sub-basins using wet detention stormwater ponds and alum injection stormwater treatment ponds. This analysis is summarized below.

Wet Detention Ponds - The amount of TN and TP load reduction that may be accomplished through the use of wet detention ponds was estimated by completing a conceptual design of ponds necessary to treat the regulatory runoff volume per District Management and Storage of Surface Waters (MSSW) standards. The following assumptions were made to estimate the amount of TN and TP load that would be available for treatment, and the load reduction that could be accomplished through use of wet detention ponds:

- 90 percent of all storms are of one inch rainfall or less.

- 75 percent of all those storms are temporally spaced to allow bleeddown of the ponds, so that the full storage volume is available for a new storm.

- *TN treatment efficiency* is 0.30, *and TP treatment efficiency* is 0.60.

Based on this analysis, the annual non-point source nutrient loads from the priority MHUs and individual sub-basins can feasiblely be reduced by 20.3 percent for TN, and 41.1 percent for TP, using wet detention ponds. Total costs, including land acquisition, construction, and operation and maintenance were estimated to be $2,309,622 for the 20-year life span of six (6) wet detention ponds, or approximately $384,937 per pond. The total TN reduction was estimated to be 1.28 tons or 2,560 lb/year (51,200 lb in 20 years) and the TP reduction was estimated to be 0.30 tons or 600 lb/year (12,000 lb in 20 years). Thus, the unit cost of treating direct runoff from the priority MHUs and individual sub-basins with wet detention ponds is ($2,309,622/51,200 lb TN), or $45/lb TN, and ($2,309,622/12,000 lb TP) or $192/lb TP.

Wet Detention Ponds Enhanced with Alum Injection - The amount of TN and TP load reduction that may be accomplished through the use of alum injection was estimated by completing a conceptual design of the systems necessary to treat runoff from the five priority MHUs. Design criteria were based on specifications for other local alum systems that have recently been designed and constructed (ERD, 1994). The assumptions made to estimate the amount of TN and TP load that would be available for treatment were the same as those made for wet detention ponds, with the exception of the load reduction. The load reductions associated with alum injection systems were:

- TN removal efficiency for injected alum is 0.40, and TP treatment efficiency is 0.90.

Based on this analysis, the annual non-point source nutrient loads from the priority MHUs and individual sub-basins can feasiblely be reduced by 27.0 percent for TN and 61.1 percent for TP using alum injection. The total cost of constructing, operating and maintaining six alum injection treatment facilities with sediment traps over the 20-year life of the project was estimated to be $4,136,188. The total TN reduction was estimated to be 1.71 tons or 3,420 lb/year (68,400 lb in 20 years) and the TP reduction was estimated to be 0.44 tons or 880 lb/year (17,600 lb in 20 years). Thus, the unit cost of treating direct runoff from the priority MHUs and individual sub-basins with wet detention ponds is ($4,136,188/68,400 lb TN), or $60/lb TN, and ($4,136,188/17,600 lb TP) or $235/lb TP.

Conversion of Septic Tanks to Central Sewer - The DBMP identified 1,076 septic tanks in the Lake Tarpon drainage basin and estimated that approximately 0.20 million gallons per day (mgd) of leachate was cumulatively discharged from these systems (PBS&J 1998). This resulted in estimated TN and TP loadings of approximately 6.49 tons/year of TN and 0.82 tons/year for TP or about 11.5 and 14.0 percent of the total external TN and TP loads to the lake, respectively. Converting septic tank service areas to sanitary sewer service areas could potentially reduce the TN load to Lake Tarpon by approximately 6.37 tons/year, or 12,740 lb/year (98 percent load reduction), and reduce the TP load to the lake by approximately 0.78 tons/year, or 1,560 lb/year (95 percent load reduction). This analysis did consider the change in nutrient loadings to the lake as a result of increased effluent disposal.

The total cost for replacing septic tank systems with sanitary sewer was estimated to be $9,264,400. The total TN reduction was estimated to be 12,740 lb/year (254,800 lb in 20 years) and the TP reduction was estimated to be 1,560 lb/year (31,200 lb in 20 years). Therefore, the unit cost of converting all septic tanks in the basin to sanitary sewer service is ($9,264,400/254,800 lb TN), or $35/lb TN, and ($9,264,400/31,200 lb TP), or $297/lb TP. (Note that this cost is amortized over 20-years.)

Cost Comparison of External Nutrient Removal Strategies

(The following discussion was adapted from PBS&J's *Lake Tarpon Drainage Basin Management Plan*, 1998.) Table A-5 summarizes the TN and TP reduction potentials for the three external nutrient load reduction strategies considered by PBS&J (1998). The unit costs of dollars per pound of TN and TP removed were based on the pollutant loading estimates from Coastal Environmental (1995) and total project costs for the three management alternatives as discussed in the preceding sections. All costs are based on a 20-year facility life for the equivalent comparison.

Table A-5. Summary of the TN and TP load reduction potential, unit costs and total costs of all external load reduction alternatives.

	Potential Load Reduction (lbs/year)		Percentage of Total Annual Load Reduction		Unit Cost of Load Reduction ($/lb)		Total Cost of Load Reduction* ($/year)	
BMP	TN	TP	TN	TP	TN	TP	TN	TP
Septic Tank Conversion	12,740	1,560	11.3	13.3	35	297	$445,900	$463,320
Wet Detention	2560	600	2.3	5.1	45	192	$115,200	$115,200
Alum Injection	3,420	880	3.0	7.5	60	235	$205,200	$206,800

* Annual costs amortized over 20-year facility life.

It should be noted that the accuracy of these costs depends on the validity and accuracy of the assumptions to make them. The non-point source (stormwater) loadings used for the wet detention pond and alum injection analyses were developed by Coastal Environmental (1995). Because the same values were used for both non-point source options, the unit cost differential arises from estimates of treatment efficiency and facility costs. Wet detention treatment efficiency was based on numerous literature references, as summarized by Coastal (1996). Alum injection treatment efficiency was based on bench tests and previous system operating results performed by ERD (1994): whereas costs were based on cost estimates for the Lake Maggiore alum injection system (ERD 1994).

Of the three external load reduction alternatives evaluated, the conversion of septic tanks to sanitary sewer service provides the most cost-effective solution for nitrogen removal at $35/lb TN. Wet detention ponds are second at $45/lb TN and alum injection is the most costly at $60/lb TN. Wet detention ponds are the most cost-effective for removing TP at $192/lb TP followed by alum injection at $235/lb TP and septic tank conversion at $297/lb TP. All three alternatives were relatively close in unit costs, varying by less than 40 percent. The average cost for TN and TP removal for the three alternatives was $47/lb TN and $241/lb TP.

Based on the assumptions and analyses presented above, septic tank conversion is clearly the most effective alternative in terms of total achievable load reduction, followed by alum injection and wet detention ponds. Septic tank conversion requires a substantial capital cost, but the ratio of O&M to capital costs is relatively low compared to the other alternatives. An additional benefit of converting septic tank systems to sanitary sewer service is the increased supply of reclaimed water that would be available to offset constraints on potable use water use. Wet detention ponds may be similarly used for stormwater reuse for irrigation but the alum injection systems would probably have minimum benefits in this manner.

With respect to achievable load reduction for stormwater runoff, especially for TP, alum injections is clearly a better choice than wet detention. Capital costs for wet detention and alum injection ponds are comparable; however, the alum injection requires substantially higher O&M costs. Wet detention ponds require minor periodic maintenance (mowing, fence repair, outfall cleaning, etc.) But alum injection systems require extensive maintenance for re-supplying chemicals, re-setting the instrumentation, periodic inspection of parts for wear and replacement and cleaning the system pumps, lines etc. Since the cost-effectiveness of the alternatives was evaluated over a 20-year facility life, the difference in annual O&M costs between wet detention and alum injection becomes significant.

Stormwater treatment enhanced with alum injection was recommended as the preferred alternative over wet detention for three reasons. The first was that there is limited land available in northern Pinellas County to provide adequately sized ponds to treat the stormwater. The second and most important reason was the need to maximize pollutant load reductions. As can be seen from the preceding tables, stormwater treatment enhanced with alum injection removes more nutrients than conventional stormwater treatment methods. (Personal Communication, Doug Robison, 2001). Finally, given the large unmanageable source of nitrogen from atmospheric deposition and that the lake is close to being P limited, load reduction strategies that decrease P may be more effective at decreasing the TSI for the lake.

Control of Internal Nutrient Sources

Internal nutrient sources identified by PBS&J (1998) include sediment resuspension, movement of nutrients from the sediment into the overlying water and decomposition of organic matter. Control of internal nutrient loadings include sediment removal or inactivation of sediment phosphorus by alum treatment, dilution or flushing of nutrient rich water and mechanical harvesting of nuisance aquatic plants. Due to potential toxic effects of alum in estuarine waters downstream of Lake Tarpon, the use of whole lake alum treatments was not considered. Sediment removal was not considered due to the fact that lake sediments are relatively low in organic content and the lake is relatively deep. Based on modeling results, sediments act as a sink for phosphorus and only provide a small flux of nitrogen (PBS&J 1998). For these reasons, only macrophyte harvesting and increased lake flushing and dilution through the implementation of an enhanced lake level fluctuation were considered by PBS&J (1998) as internal nutrient load reduction strategies.

Flushing and Dilution - Flushing and dilution are well-documented lake management techniques that involve increasing the rate at which the nutrient mass is flushed from the lake

combined with the use of higher quality dilution water to reduce in-lake concentrations of nutrients. Flushing and dilution serve to reduce the concentration of nutrients, and the period of time that algal cells are exposed to these nutrients. The reduced nutrient concentrations should lead to reduced algal growth and increased water column transparency due to lower algal cell concentrations and, to a lesser extent, the addition of highly transparent water to the lake volume. Increased transparency, in turn, should lead to the proliferation of more desirable rooted aquatic plants (NYSDEC, 1990).

Algal concentrations may be reduced by flushing alone (e.g., the discharge of lake water). If the flushing rate is greater than the algae growth rate, algal cells may be washed out of the lake system. Control can be achieved by a flushing rate of approximately 10-15 percent per day (NYSDEC, 1990). If flushing alone can be used to decrease algae concentration through washout, then lower quality water can be used, provided that the increases in algal growth rate resulting from the higher nutrient concentrations are not sufficient to exceed the increased flushing rate. Unfortunately, given the lack of an unlimited external supply of dilution water in the Lake Tarpon watershed, flushing rates approaching 10-15 percent per day are not considered achievable. In addition, dilution water with nutrient concentrations higher than those in the lake may exacerbate the existing water quality problems.

Using mean annual TN and TP concentrations from 1995 water quality data from Lake Tarpon, it is estimated that the discharge of 1.0 foot of water (e.g., from elevation 3.0 to 2.0 NGVD) associated with an enhanced lake level fluctuation schedule would result in a nutrient mass discharge of 4.41 tons of TN and 0.25 tons of TP. Although lake retention time would be slightly reduced, most of the discharged nutrient mass would be replaced by nutrients contained in the inflowing precipitation, runoff and groundwater. Effective dilution of the in-lake nutrient mass would occur only if the cumulative nutrient concentrations in the inflow waters were even slightly lower than in-lake concentrations, but measurements of the nutrient concentrations of inflowing waters indicate that only precipitation is less concentrated than lake water with respect to TN and TP. For this reason, it is imperative that a source of high quality dilution water be used in Lake Tarpon.

Macrophyte Harvesting - Mechanical harvesting is not only effective at controlling nuisance aquatic vegetation, but it can also be used as a means to improve water quality problems related to eutrophication. The growth of aquatic macrophytes requires the assimilation of both water column and sediment nutrients. Physical removal (i.e., harvesting) of the plant biomass is highly effective in preventing the return of the assimilated nutrients to the water column or sediments as the plants decompose.

Interest in the use of aquatic plants for eutrophication management has increased sharply in the past few years, accompanied by an emphasis on the use of naturally occurring rooted macrophytes for removing both water column and sediment nutrients. There have been several reports published on the successful application of mechanical harvesting of rooted aquatic plants to the mitigation of eutrophication (Souza, et. al., 1988; Frederiksen, 1987).

Mechanical harvesting can directly reduce the coverage of both submergent and emergent nuisance aquatic vegetation. In addition, it will contribute to the removal of nutrients from the lake ecosystem. Therefore, this management strategy could be used in conjunction with

chemical treatment of hydrilla to remove the chemically treated plant material before it decomposes and provides an internal nutrient source.

Summary of Expected Pollutant Load Reductions and Recommended PLRG

Based on the analysis conducted by PBS&J (1998), external load reductions for nitrogen and phosphorus were identified. These load reductions are summarized in Table A-7.

Table A-7. Summary of TN and TP potential external load reductions

BMP	Potential Load Reduction (tons/year) TN	TP
Septic Tank Conversion	6.37	0.78
Alum Injection	1.71	0.44
TOTALS (% total load reduction)	8.08 14.3%	1.22 20.8%

The Florida Administrative Code, Chapter 62-40.432(5)(c) and (d) discusses the intent of Pollutant Load Reduction Goals (PLRGs) which is to reduce pollutants from older stormwater management systems to restore or maintain beneficial uses of waters. Further, Chapter 62-40 requires that the numeric estimates of the level of pollutant load reduction goals anticipated to result from the planned corrective actions be included in the adopted SWIM Plan. Given the pollutant load reductions expected from implementation of the external nutrient load reduction strategies and the expected decrease in the TSI from these actions, the PLRG for Lake Tarpon is recommended to be 8.08 ton per year for total nitrogen and 1.22 tons per year for total phosphorus.

Based on modeling performed by PBS&J (1998) these two external nutrient load reduction strategies should result in about a 2.4 point decrease in the annual average TSI for Lake Tarpon. This decrease in TSI may fall short of the water quality goal for Lake Tarpon which is a TSI of 55. Therefore, additional management strategies will likely be necessary to achieve the water quality goals for Lake Tarpon. This SWIM Plan proposes additional monitoring projects that will provide the data necessary to refine pollutant loading estimates and additional management strategies that will be evaluated for their potential to help in meeting the water quality goals.

AQUATIC VEGETATION ISSUES

The primary nuisance aquatic plant species in Lake Tarpon are *Hydrilla verticillata* and *Typha latifolia*, commonly referred to as hydrilla and cattail, respectively. Hydrilla is a rooted submersed exotic species whereas cattail is a native emergent species. Hydrilla grows and expands very quickly and becomes a problem when it clogs drainage ways and canals, prevents boating access for water-dependent recreation, and crowds out beneficial native plants. Cattail is an emergent native species which also grows and expands quickly, often dominating the littoral zone as dense monotypic stands which preclude shoreline recreational uses, obscure waterfront vistas, and crowd out other beneficial native plants.

Submerged Aquatic Vegetation

Hydrilla was probably introduced into Lake Tarpon sometime during the 1970s and since then it has become an ongoing management concern. Historically the Bureau of Aquatic Plant Management (formerly under FDNR, now under FDEP) has had sufficient funding to effectively maintain submergent and floating nuisance aquatics in the lake and manmade canals at insignificant levels. However, since 1986, budgetary constraints have limited the control of hydrilla only within the natural lake, and within an arbitrarily determined management range of up to a 6 percent coverage, a level of coverage considered acceptable from the sport fishing and budgetary perspective. As a result, the control of hydrilla has been somewhat inconsistent in Lake Tarpon, characterized by fluctuations in the lake-wide coverage of this nuisance species. On the other hand, the spraying of floating nuisance aquatic vegetation, such as water hyacinth and water lettuce, has continued in both the lake and canals on a consistent basis, and has been generally very effective.

During the summer of 1992, hydrilla began spreading and establishing along the entire western shoreline covering more area than had previously been observed in Lake Tarpon. By the fall of 1992, it is estimated that approximately 500 acres of the lake surface area was covered by condensed hydrilla extending from the bottom to the surface, and that less dense hydrilla coverage extended across the majority of the lake bottom area (Personal Communication: John Rogers, FDEP). In recent years prior to this event, hydrilla coverage on Lake Tarpon had been effectively managed at a coverage of approximately 6-12 percent. Due to funding constraints during early 1992, the FDNR was unable to control the rapid growth of hydrilla in Lake Tarpon. As a result, no significant chemical treatments were made until October 1992.

To effectively treat the extensive hydrilla coverage it was necessary to implement several additional Sonar applications during March and May of 1993. These applications, which essentially resulted in a "whole lake" treatment, did not take effect until June and July 1993 when large floating mats of dead hydrilla were observed and persisted through the summer. No attempt was made to harvest these floating mats prior to their decomposition in the lake. These treatments were ultimately very successful in reducing hydrilla coverage back to a "maintenance" control level, as no follow up treatment was required in 1994, and only one treatment of 105 acres was required in 1995. PBS&J (1998) asserts that the resulting massive die off of macrophytic plant tissue, however, appears to have adversely impacted water quality and increased the trophic state of the lake.

Although a clear cause and effect relationship cannot be established, it is very likely that the rapid release of nutrients organically bound up in this large mass of macrophytic plant tissue into the water column contributed significantly to the sharp increases in total nitrogen and chlorophyll-a concentrations observed in the lake during subsequent years. Based on hydrilla nutrient content data from Lake Okeechobee (Gremillion et al., 1988), the chemical treatment of approximately 500 acres of hydrilla potentially released as much as 2.4 tons of TP and 20 tons of TN back into the water column to be subsequently taken up by phytoplankton. Figure A-9 shows this relationship as a plot of the cumulative annual treatment acreage of hydrilla versus mean annual chlorophyll-a concentrations.

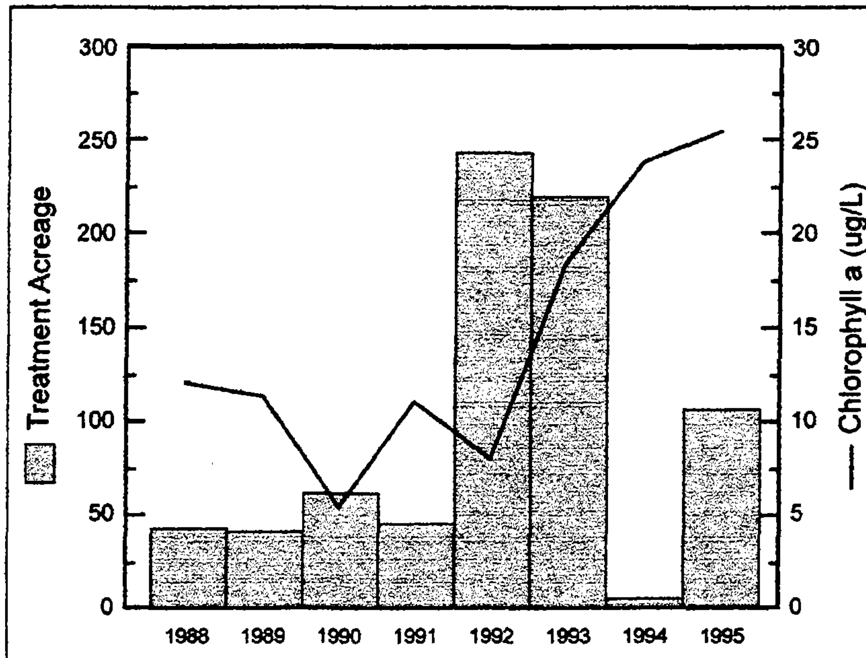


Figure A-9-Mean annual chlorophyll-a concentrations vs. cumulative total area of hydrilla chemical treatment for the period 1998-1996 (PBS&J 1998)

Trends in the coverage of desirable, native submerged aquatic vegetation, such as coontail (*Ceratophyllum spp.*) and eelgrass (*Vallisneria spp.*) have been difficult to assess due to the lack of a consistently applied quantitative monitoring program. An apparent reduction in eelgrass coverage occurred in the 1980s with the expansion of hydrilla in the lake (KEA, 1992); however, since the large scale eradication of hydrilla in 1993, coontail and eelgrass appear to be expanding their coverage in the lake (Personal Communication: John Rogers, FDEP).

It has been observed by numerous researchers that Florida lakes with severe algal bloom problems tend not to have rooted macrophyte problems (e.g., hydrilla), except perhaps for floating species like water hyacinth. Because increased algal abundance results in decreased water clarity, and thus reduces the euphotic zone, an inverse relationship should theoretically exist between macrophyte abundance (e.g., percent coverage) and algal abundance (e.g., chlorophyll-a concentration). This relationship underscores the importance of managing Lake Tarpon in such a manner that encourages the expansion of desirable, endemic submerged aquatic vegetation.

In summary, it is concluded that hydrilla can be, and has been, very effectively controlled in Lake Tarpon. Even though such control has been exercised inconsistently, resulting in ecological shocks to the system, it can be said that the FDEP Bureau of Aquatic Plant Management has essentially achieved its mandate of maintaining nuisance aquatics at their

lowest feasible levels in Lake Tarpon. Managing hydrilla coverage at some minimal maintenance level is probably a desirable goal for Lake Tarpon if: 1) chemical treatments are performed routinely on small areas such that the need for major whole lake treatments is avoided; and 2) the niche for rooted submerged aquatics is filled by other more desirable endemic species such as coontail (*Ceratophyllum demersum*) such that a minimum target lake-wide macrophyte coverage of 25 percent is achieved.

Emergent Aquatic Vegetation

As noted above, cattail may form essentially monocultures of densely growing plants along the lake shoreline. While cattail is a native species, problems occur when these plants proliferate unchecked. Cattails cause a litter buildup disproportionately high in comparison to most other aquatic plants, and reportedly become so dense that fish are restricted to the fringes rather than the interior of these stands. A more diverse assemblage of aquatic plant species is preferred since it provides a greater number of ecological niches. Increasing species diversity is equated with increasing environmental health.

Periodic and seasonal lake fluctuations, particularly on the high end of the scale, limit the expansion of cattail into deeper water. Lake level stabilization, therefore, tends to promote the expansion of cattail and allows dense, expansive stands to develop. While enhanced fluctuation would control cattail stand development, urban development in the watershed, and especially into the historic floodplain, has limited the vertical range over which Lake Tarpon can fluctuate. Historically, cattail was a relatively minor component of the emergent plant community in Lake Tarpon. Since the implementation of the water level fluctuation schedule in 1972, however, the coverage of cattail has expanded from less than 20-acres to approximately 120-acres (KEA, 1992). The cause of this expansion has been attributed primarily to the stabilized water levels in the lake which has allowed for the competitive dominance of cattail over other native species.

The effectiveness of increasing the upper range of water level fluctuation, even by a minor amount, as a means of controlling cattail stands has been recently observed in Lake Tarpon. During 1995 and 1996 cattail coverage decreased by approximately 15 percent due to increased rainfall amounts and the associated slightly higher lake levels.

Currently, cattails are essentially managed on a piecemeal basis for environmental, recreational and aesthetic reasons via the issuance of individual permits by FDEP for their removal along private waterfronts. Typically, applicants are required to replant their waterfronts with other desirable aquatic plants. No comprehensive program to improve the diversity of emergent aquatics in the littoral zone has yet been developed for Lake Tarpon. The removal and replacement of cattails with more desirable endemic species has occurred only on a limited piecemeal basis through the FDEP permitting program and other publicly funded habitat restoration. The largest such program was implemented by the District SWIM section where cattails were harvested from a total of 9.3 acres at five sites. The five sites were then revegetated with a more diverse mix of desirable native species. The success of these revegetation efforts, however, was generally poor due to the uprooting and erosion of the replanted areas by wave energy. Other smaller test revegetation projects have been successfully implemented by the FFWCC where bulrush was successfully established in areas previously dominated by cattail.

Cattail harvesting followed by revegetation with a more diverse assemblage of desirable emergent aquatics would likely provide significant ecological and aesthetic benefits. The benefits to the littoral plant community from this effort would, however, likely be supplemental to the greater lake-wide benefits derived from the increased lake level fluctuation range.

FISHERIES ISSUES

Lake Tarpon was formally designated as state Fish Management Areas by a special Resolution of the Pinellas County Board of County Commissioners in June, 1963. Section 39-20.005,Florida Statutes, sets forth the special regulations of state Fish Management Areas, and designates the Florida Fish and Wildlife Conservation Commission (FFWCC) as the state resource management agency with primary responsibility for sport fishery management.

The FFWCC has performed fisheries monitoring and management activities in Lake Tarpon on a periodic basis since the 1970s. Detailed fisheries investigations were conducted on Lake Tarpon from July 1987 to June 1991. During this time the FFWCC used a number of techniques to assess the fishery of the lake including aerial and boat surveys to estimate aquatic plant coverage, blocknetting and rotenone sampling in littoral sites, night electrofishing, and a creel survey. This combination of techniques allowed the FFWCC to assess fish population structure, the relationship between the fishery and macrophyte (aquatic plant) coverage, fishery utilization of differing habitats, and angler success and preferences.

For the most part, data presented by Champeau (1992) indicates an excellent sport fishery for Lake Tarpon. Being mesotrophic, Lake Tarpon has historically not supported the biomass of other more eutrophic (i.e., productive) Florida lakes, however, the population structure of the sport fishery has remained consistently within the preferred ranges. Sport fish are proportionately abundant with good percentages of harvestable and angler preferred sizes. Although most fishing effort in Lake Tarpon is focused on largemouth bass, the crappie population has expanded to early 1980 levels to provide an excellent secondary sport fishery. Data further indicate good reproductive success, recruitment (survival) and rapid growth. Champeau (1992) did, however, suggest that the fishery could be enhanced through habitat management. Ideally it should not be necessary to

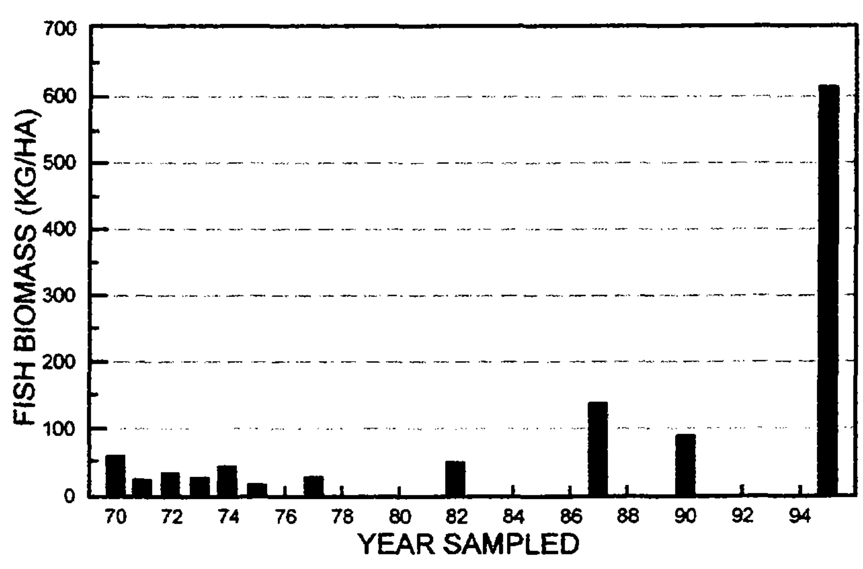


Figure A-10-Fish biomass from shoreline blocknets in Lake Tarpon, 1970-1995 (from PBS&J 1998)

manage habitat; however, two factors, lake level stabilization and the occurrence of exotic aquatic vegetation, necessitate an active management role with respect to aquatic vegetation.

The FFWCC again performed rotenone blocknetting and electrofishing in the summer of 1995 and spring of 1996 to assess densities and standing crops of all species present, and to determine the relative abundance and population structure of the largemouth bass population (Champeau, 1996). These results indicate that the electrofishing catch rates per unit effort, and the population age and size structure, for largemouth bass were comparable to data obtained during 1987 through 1992. In addition, the fish community balance is good with a forage biomass to carnivore biomass (f/c) ratio of 3.2. As shown in Figure A-10, however, the overall fish standing crop (biomass) in 1995 has increased by approximately 500 percent since last measured in 1990. This dramatic increase in fish biomass is due both to an increase in sport fish abundance as well as rough fish abundance.

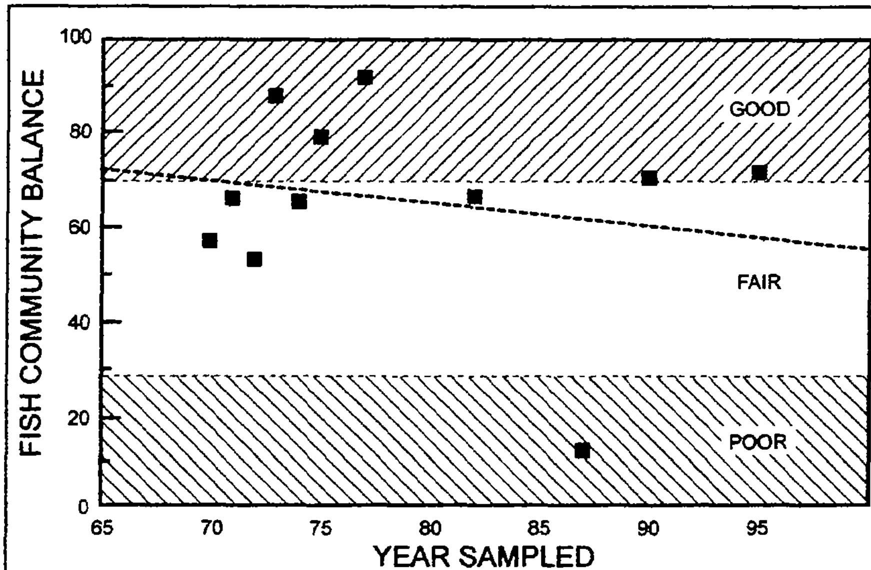


Figure A-11-Fish community balance in Lake Tarpon, 1970-1995 (from PBS&J 1998)

Using a proprietary index of fish community balance (Champeau, 1996), the sport fishery in Lake Tarpon appears to be stable, or on a slight decline, since the 1970s (Figure A-11). The observed increase in the fish biomass in Lake Tarpon, however, is considered by the FFWCC to be an indicator of increasing eutrophication that threatens the future integrity of sport fishing in the lake if not addressed. The FFWCC has concluded that cultural eutrophication seems to have benefitted the fisheries of Lake Tarpon to date due to increased productivity, as measured in fish standing crops, however, increased fertility beyond current trophic levels may have future negative consequences. As a result, the FFWCC has recommended that strategies to abate significant nutrient sources to Lake Tarpon be implemented at this time (Champeau, 1996).

HYDROLOGIC AND HABITAT RESTORATION ISSUES

During development of the DBMP, PBS&J (1998) conducted a field survey and assessment of all natural habitats remaining in the Lake Tarpon watershed. This assessment did not extend into the Brooker Creek watershed within Pinellas or Hillsborough Counties. The results of this inventory are summarized below.

As shown in Figure A-12, the majority of the western portion of the study area has been developed and urbanized. The U.S. Highway 19 corridor is the most intensely developed area in the basin, with transportation and commercial land uses predominating. The northwest quadrant of the basin, which occurs mostly within the limits of the City of Tarpon Springs, is also intensely developed with commercial land uses. On the other hand, the southwest portion of the basin occurs entirely within unincorporated Pinellas County, and is intensely developed with medium and high density residential land uses. The majority of the shoreline along the west side of the lake has been hardened or otherwise modified by residential and commercial development. Consequently, with the exception of Dolly Bay, Anderson Park, Salmons Bay, and Highland Park, there is relatively little littoral habitat on the western shoreline of the lake.

The eastern portion of the study area, although substantially developed, still retains many large contiguous remnants of the natural plant communities originally found within the basin. The most conspicuous habitat type in the east lake area is the large contiguous cypress and mixed hardwood forested wetland communities which run from southwest to northeast and form the Brooker Creek corridor. Although these wetland systems have been filled, ditched

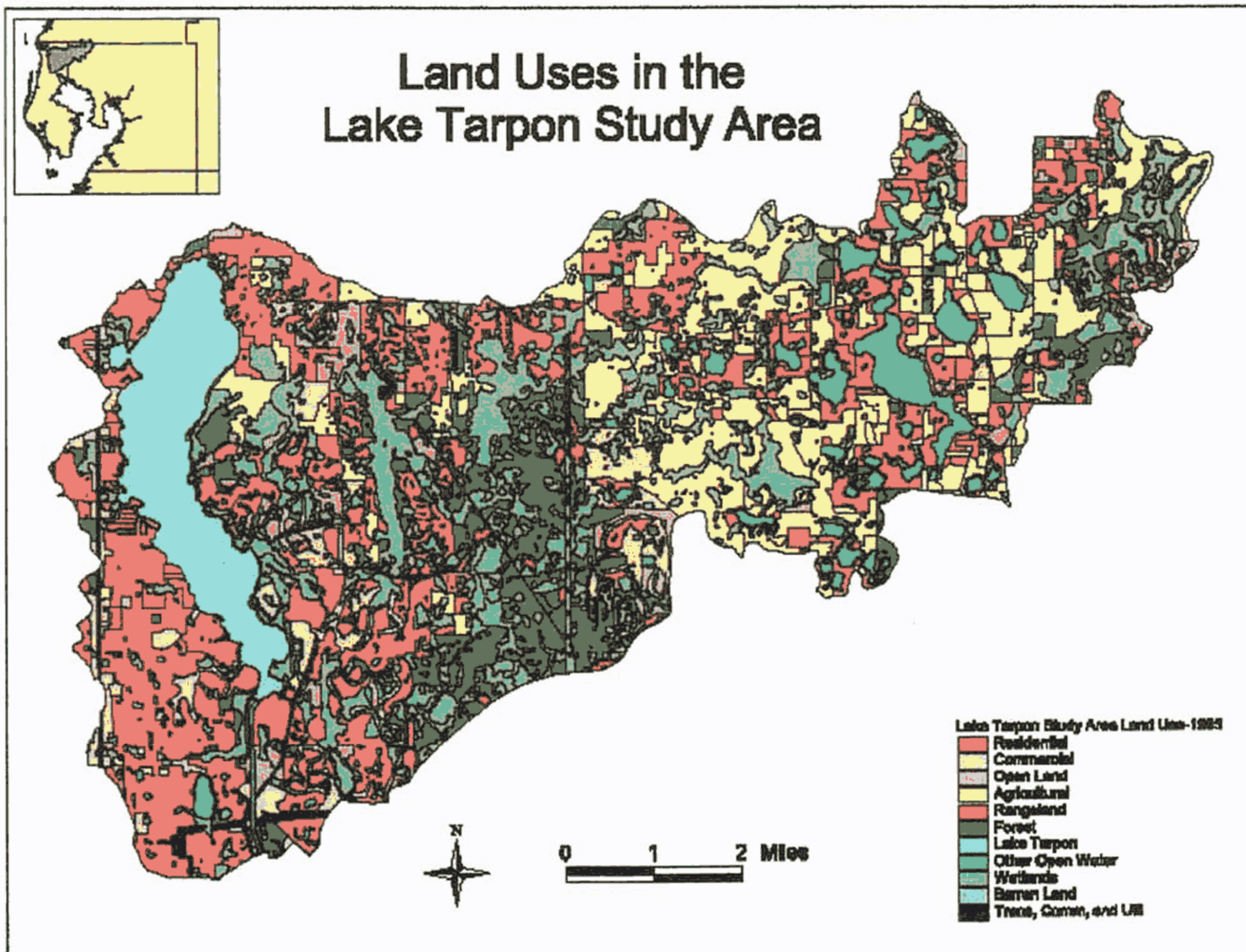


Figure A-12-1995 land use in Lake Tarpon and Brooker Creek watersheds

and impounded in many areas, some of the natural wildlife dispersal corridors and hydrologic flow ways still exist. Another conspicuous feature in the east lake area is the contiguous cypress and mixed hardwood forested wetland communities which occur along virtually the entire eastern shoreline of the lake. Waterward of this linear forested wetland system is a littoral fringe of herbaceous marsh vegetation. These marshes consist predominantly of cattails; however, some small areas of planted bulrush occur sporadically along this shoreline.

The majority of the relatively pristine habitat units remaining within the basin occur on the east side of the lake. Furthermore, the larger contiguous forested wetland systems, both those along the eastern shoreline of the lake, and those oriented southwest to northeast in the eastern basin, are clearly the most undisturbed natural systems remaining within the study area.

The majority of major wetland systems in the western portion of the basin have been hydrologically modified as a result of adjacent development. Two cypress systems, however, still show natural characteristics of both mature canopy and representative hydrophytic understory. The most notable example is the large mature cypress dome located west of U.S. 19 near the center of Lake Tarpon. This ±30-acre cypress swamp has, in the past, been a Southern bald eagle nesting site. Although no eagles have nested in this wetland for several years, it should continue to be preserved.

The remaining upland and wetland communities in the eastern portion of the basin are more representative of the historical habitat distribution and natural ecological characteristics of the watershed. Less intensive agricultural uses such as silviculture and cattle ranching preceded the current urbanization patterns in this area. This, in combination with more environmentally conscious development planning and regulation associated with the more recent development, has resulted in most of the historical wetland systems remaining intact. Unlike the west side of Lake Tarpon, over two-thirds of the eastern shoreline's natural wetland systems remain relatively undisturbed. Extensive cypress and mixed hydric forested systems also are distributed linearly throughout the adjacent upland areas of the basin to the east and represent historical and existing drainage patterns.

The habitat evaluation performed for the DBMP (PBS&J 1998) did not take into account the Brooker Creek watershed. Many of the relatively pristine wetlands identified on the east side of the lake coincide with channels of Brooker Creek (Figure A-13). The Brooker Creek Preserve is located in Pinellas County, east of the Lake Tarpon watershed and extends to the Hillsborough/Pinellas county line. The Preserve encompasses approximately 8,500 acres of land acquired by the County and the District. Additionally, Hillsborough County has acquired approximately 1,440 acres for conservation adjacent to the Preserve. Wetland impacts within the Brooker Creek Preserve and in the Brooker Creek watershed in Hillsborough County are not as extensive as on the western side of the lake, but they do exist. These impacts include transportation and utility corridors, drainage improvements, development and wellfields.

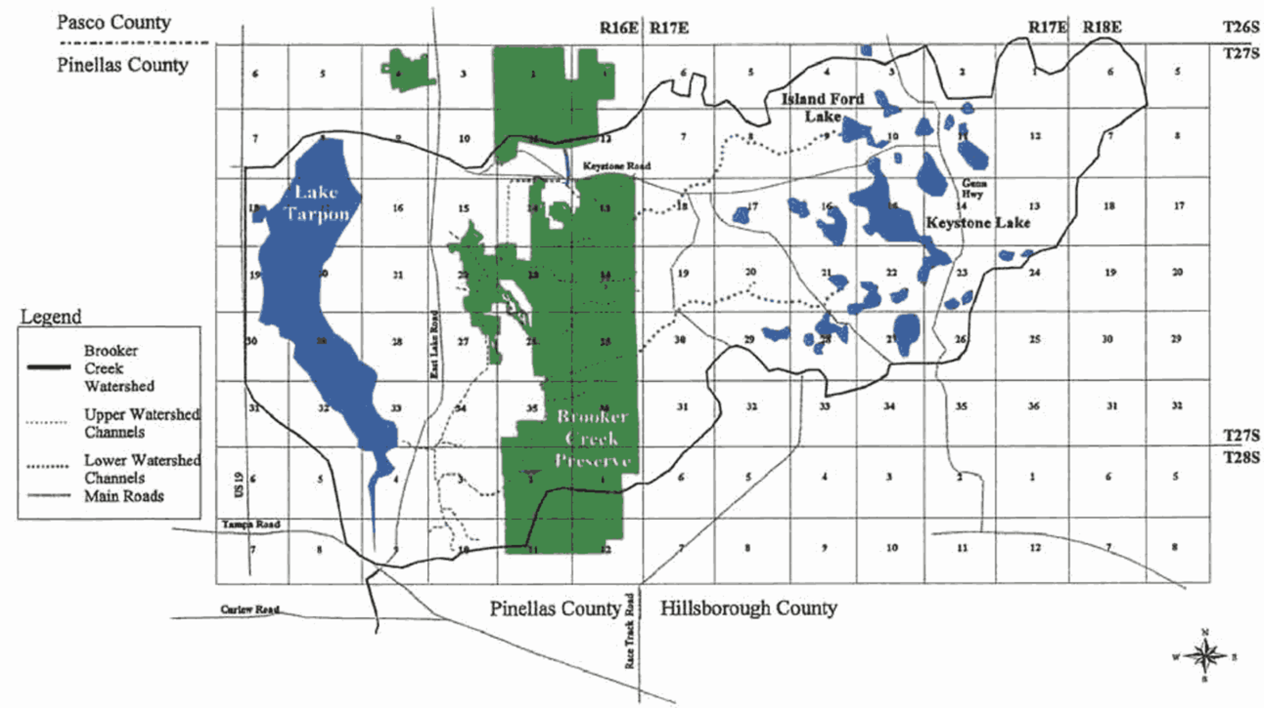


Figure A-13-Lake Tarpon and Brooker Creek watersheds showing headwaters of Brooker Creek

There appear to be more opportunities to enhance and restore wetlands east of the lake and in the Brooker Creek watershed due to the less impacted nature of the area and the land in public ownership. Therefore, the potential for hydrologic restoration may be greater on the eastern side of the lake within Pinellas and Hillsborough counties. However, hydrologic and habitat restoration projects should be pursued where opportunities exist to improve or enhance water quality, water quantity or wetland and aquatic habitat. Hydrologic restoration of impacted wetlands to restore historic surface water flow patterns (i.e., ditch blocks and rehydration) would provide multiple benefits. Initially, the restored wetlands would provide habitat for wetland dependant animals and plants. Hydrologic restoration could result in increased flows through the historic channels of Brooker Creek and other unnamed tributaries to Lake Tarpon. Ultimately, increased surface inflows to Lake Tarpon could lead to increased flushing and dilution of the lake, which could lead to improved water quality.

PUBLIC EDUCATION ISSUES

Currently, no formal community involvement or public outreach program exists to further the adopted Lake Tarpon management goals other than the establishment and continued existence of the Lake Tarpon Management Committee (LTMC).

The LTMC was first established in July 1987 by a special Resolution of the Pinellas County Board of County Commissioners. The intent of the Resolution was to create a multi-agency committee to formulate a Plan of Action whereby a long term lake management plan would be developed and implemented for Lake Tarpon. The plan was to specifically address the

causes and potential remediation measures for the 1987 algae bloom, however, long term effective lake management was stressed as the primary mission. The intended tenure of the LTMC was not defined by the Resolution. The original members of the LTMC included representatives of the following:

- Pinellas County Department of Environmental Management;
- Florida Department of Environmental Regulation;
- Florida Department of Natural Resources;
- Florida Game and Fresh Water Fish Commission;
- Southwest Florida Water Management District;
- City of Tarpon Springs;
- SOLID - Save Our Lake Invite Discussion;
- East Lake Homeowners Association;
- Highland Lake Homeowners Association; and
- The development community (represented by Lansbrook Development Corp.).

The LTMC has met on a more or less monthly basis since its creation, and has served as a very effective forum for the discussion of lake management issues. By virtue of its representation of key state environmental regulatory and management agencies, the committee has generally functioned efficiently as a vehicle for developing technical consensus on decisions related to research, funding, and resource management.

The primary role and responsibilities of the LTMC during its first decade of existence have included the:

- identification of priority lake management issues and problems;

- definition of appropriate diagnostic/feasibility studies and research programs to address the identified issues and problems;

- development of management recommendations and remediative programs; and

- provision of a general forum for the sharing of information and the discussion of ongoing and emerging lake management issues.

In addition, the LTMC, primarily through the coordination efforts of the PCDEM, has sponsored two public events with the objective of engendering public interest and involvement in lake management issues and activities. The events, entitled "Lake Tarpon Day," were conducted during the spring of 1993 and 1994, and were sponsored by the local chapter of the B.A.S.S. angler club. The events included the dissemination of public information, games, food, and a fishing contest. In general, the events were poorly attended by the public, and due to lack of sponsorship and interest, they were discontinued.

LIST OF STUDIES AND LITERATURE CITED

The literature cited for this report is noted with an asterisk. The remaining studies are those that have been prepared for Lake Tarpon.

*Bartos, L. 1976a. Lake Tarpon-Brooker Creek Runoff Study. Southwest Florida Water Management District. Environmental Section, Technical Report 1976-5. Brooksville, Florida.

*Bartos, L. 1976b Lake Tarpon Chloride Study. Southwest Florida Water Management District. Environmental Section, Technical Report 1976-6. Brooksville, Florida.

Bartos, L.F. and T.F. Rochow. 1976. Second Annual Progress report-1974: Monitoring of Lake Tarpon Fluctuation Schedule. Southwest Florida Water Management District. Environmental Section, Technical Report 1976-1. Brooksville, Florida.

Bartos, L.F., T.F. Rochow and W.D. Courser. 1977. Third Annual Progress Report-1977: Monitoring of Lake Tarpon Fluctuation Schedule. Southwest Florida Water Management District. Environmental Section, Technical Report 1977-3. Brooksville, Florida.

Biological Research Associates. 1976. Brooker Creek Riverine System between Lake Island Ford and Lake Tarpon. Prepared for Southwest Florida Water Management District. Tampa, Florida.

*Brown, D.P. 1982. Effects of Effluent Spray Irrigation on Ground Water at a Test Site Near Tarpon Springs, Florida. Tallahassee, U.S. Department of the Interior Geological Survey Open File Report 81-1197.

Casseaux, K.W. 1985. The Surficial Aquifer in Pinellas County, Florida. Tallahassee, U.S. Geological Survey, Water Resources Investigation Report. 84-4289.

*Canfield, D.E. Jr. and M.V. Hoyer. 1992. Aquatic Macrophytes and their Relation to the Limnology of Florida Lakes. University of Florida. Center for Aquatic Plants. Gainesville, Florida.

*Corral, M.A., Jr. 1983. Distribution of Selected Chemical Constituents in Water from the Floridan Aquifer, Southwest Florida Water Management District. Tallahassee, U.S. Geological Survey, Water Resources Investigation Report 83-4041.

Corral, M.A., Jr. and T.H. Thompson. 1988. Hydrology of the Citrus Park Quadrangle, Hillsborough County, Florida.

Chapman, P. 1974. Lake Tarpon Fish Management Area, Pinellas County. Review and Status Report. Florida Game and Freshwater Fish Commission.

*Champeau, T.R. 1996. Lake Tarpon Fisheries Investigations. Florida Game and Freshwater Fish Commission. Lakeland, FL.

Geo-Environmental Consultants, Inc. 1992. Sediment Distribution Patterns and Accumulation Rates for Two Sites in Lake Tarpon Florida. Prepared for King Environmental Associates, Inc.

*Gremillion, P.T., C.E. Mericas, and H.S. Greening. 1988. Lake Okeechobee aquatic weed harvesting demonstration project. Final report prepared for the South Florida Water Management District, West Palm, Beach, Florida.

Halley, M.C., M.A. Ross, and P.D. Tara. 1992. Lake Tarpon Water Quality Management Model. Center for Modeling Hydrologic and Aquatic Systems. University of South Florida. Tampa, Florida.

*Huber. W.C., P.L. Brezonik, J.P. Heaney, R.E. Dickinson, S.D. Preston, D.S. Dwornik, and M.A. DeMaio. 1983. A Classification of Florida Lakes. University of Florida Water Resources Research Center. Publication No. 72. Gainesville, Florida.

*Hunn, J.D., 1974. Hydrology of Lake Tarpon near Tarpon Springs, Florida. Tallahassee, Florida Bureau of Geology, Map Series No. 60.

*Hutchinson, C.B. 1983. Assessment of Interconnection between Tampa Bay and the Floridan Aquifer, Florida. Tallahassee, U.S. Geological Survey, Water Resources Investigations 80-81.

Johnson, M. 1972. Lake Tarpon Regulation Schedule. Southwest Florida Water Management District. Brooksville, Florida.

Joiner, N.D., K.D. Enge, J.A. Freitag, J.C. Godwin, G.E. Reynolds and D.E. Runds. 1992. Aquatic and Terrestrial Wildlife Surveys for the Lake Tarpon Watershed. Florida Game and Freshwater Fish Commission.

*Jones, G.W. and S.B. Upchurch. 1993. Origin of Nutrients in Groundwater Discharging from Lithia and Buckhorn Springs. Brooksville, Southwest Florida Water Management District.

*Jones, G.W. and S.B. Upchurch. 1994. Origin of Nutrients in Groundwater Discharging from Kings Bay Springs. Brooksville, Southwest Florida Water Management District.

*Jones, G.W., S.B. Upchurch and K.M. Champion. 1996. Origin of Nutrients in Groundwater Discharging from Rainbow Springs, Marion County, Florida. Brooksville, Southwest Florida Water Management District.

*Jones, G.W., S.B. Upchurch K.M. Champion and D.J. Dewitt. 1997. Water Quality and Hydrology of the Homossassa, Chassahowitzka, Weeki Wachee and Aripeka Spring Complexes, Citrus and Hernando Counties, Florida. Brooksville, Southwest Florida Water Management District.

*King Engineering Associates, Inc. 1992. Final Comprehensive Report: Lake Tarpon Diagnostic/Feasibility Studies. Prepared for the Pinellas County Department of Environmental Management and the Southwest Florida Water Management District.

*King Engineering Associates, Inc. 1992a. Draft Final Report: Lake Tarpon Pollutant Loading Sources. Prepared for the Pinellas County Department of Environmental Management.

King Engineering Associates, Inc. 1991. Characterization of Lake Tarpon Phytoplankton Populations. Clearwater, Florida.

King Engineering Associates, Inc. and Conservation Consultants, Inc. 1991. Review of Existing Lake Tarpon Groundwater Data. Unpublished Contract Report. Prepared for the Pinellas County Department of Environmental Management and the Southwest Florida Water Management District, Task 3.2.4B, Final Report.

Leasure, P.L., K.L. Garcia and T.R. Cuba. 1989. Lake Tarpon Status Report. Pinellas County Department of Environmental Management.

Leasure, P.L., D. Hicks, D. Moores, G. Quinn, and T.R. Cuba. 1992. Status Report of the 1989 Sampling Period. Pinellas County Department of Environmental Management.

Leasure, P.L., D. Hicks, D. Moores, G. Quinn, and T.R. Cuba. 1992. Conductivity and pH Responses to Lower Lake Levels Observed in Lake Tarpon During the Drought of 1990. Pinellas County Department of Environmental Management.

Leasure, P.L. 1995. Lake Tarpon Water Quality Monitoring Report, Data Years May 1988-April 1995. Pinellas County Department of Environmental Management, Report No. 95-001/WRM.

Lopez, M.A., and J.D. Fretwell. 1992. Relation of Change in Water Levels in Surficial and Upper Floridan Aquifers and Lake Stage to Climatic Conditions and Well-Field Pumpage in Northwest Hillsborough, Northeast Pinellas and South Pasco Counties, Florida. Tallahassee, U.S. Geological Survey Water Resources Investigations Report 91-4158.

*Maddox, G.L., J.M. Lloyd, T.M. Scott, S.B. Upchurch and R. Copeland (eds.) 1992. Florida Groundwater Quality Monitoring Program–Volume 2, Background Hydrogeochemistry, Tallahassee, Florida Geological Survey, Special Publication No. 364.

Mann, J.A. 1971. Hydrologic Aspects of Freshening Upper Old Tampa Bay. Florida: Florida Department of Natural Resources. Bureau of Geology information Circular 76.

McGinnis, H., F.W. Bell. in Aquatics Magazine Volume 22, No. 2. 2000. The Economic Value of Lake Tarpon, Florida and the Impact of Aquatic Weeds.

N.S. Nettles and Associates. 1991. Groundwater Loading Contribution to Lake Tarpon-Phase 1. Unpublished contract report submitted to King Engineering Associates, draft report.

*Champeau, T.R., K.W. Denson, P.W. Thomas and M.J. Mounce. 1992. Lake Tarpon Fisheries Investigation. Florida Game and Freshwater Fish Commission. Lakeland, Florida.

City of Clearwater. 1991. Brooker Creek Riverine System. Site nomination for acquisition under Hillsborough County's Environmental Lands Acquisition and Protection Program (ELAPP).

Coastal Environmental, Inc. 1995. Review of pollutant loading sources and the selection of priority drainage areas. Task 3.2.4 interim task report of the Lake Tarpon Drainage Basin Management Plan prepared for the Pinellas County Department of Environmental Management.

Conservation Consultants, Inc. (CCI) 1990. Lake Tarpon, Draft Report, Review of Existing Groundwater Data, Pinellas County Florida. Unpublished consulting report submitted to the Pinellas County Department of Environmental Management.

CCI. 1992. Final Report: Water Quality and Quantity Lake Tarpon, Pinellas County, Florida. Prepared for King Engineering Associates, Inc.

CCI. 1991. Draft Final Report: Analysis and Mapping of Sediments, Lake Tarpon, Pinellas County, Florida. Prepared for King Engineering Associates, Inc.

*Dames and Moore, Inc. 1992. Final Report: Lake Tarpon Aquatic Weed Harvesting and Revegetation Project. Prepared for the Southwest Florida Water Management District. Tallahassee, Florida.

Dorris, P.M. 1975. Evaluation of the Chloride Status of Lake Tarpon, Pinellas County. Memorandum. Southwest Florida Water Management District.

Dorris, P.M. and L.F. Bartos. 1980. Factors Affecting Salinity Reduction in Lake Tarpon, Pinellas County, Florida. Water Resources Bulletin 16(2):203.

*Environmental Research and Design (ERD). 1994. Lake Maggiore Restoration Stormwater Treatment Ponds/Alum Treatment Systems. Final report submitted to the City of St. Petersburg and the Southwest Florida Water Management District.

*Fernandez, M., Jr. and C.B. Hutchinson. 1983. Hydrogeology and Chemical Quality of Water and Bottom Sediments at Three Stormwater Detention Ponds, Pinellas County, Florida. Tallahassee, U.S. Geological Survey Water Resources Investigations Report 92-4139.

Florida Game and Freshwater Fish Commission. 1958, 1959, 1961, 1965a, 1965b, 1970, 1974, 1975, 1978, 1982. File Report on Fisheries and Water Quality of Lake Tarpon.

Gee and Jenson Consulting Engineers, Inc. 1960. Lake Tarpon Water Conservation Study and Report. West Palm Beach, Florida.

*PBS&J, Inc. 1998. The Lake Tarpon Drainage Basin Management Plan. Prepared for the Pinellas County Board of County Commissioners.

Paul, J.H., M.E. Frishcer, and C. Jiang. 1990. Algal Bioassay of Lake Tarpon. University of South Florida. St. Petersburg, Florida.

Parker, G.G. 1971, Lake Tarpon Hydrology. Memorandum, Southwest Florida Water Management District. Brooksville, Florida.

*Robison, D.E. Coastal Environmental, Inc. Personal Communication. Letter to M.H. Kelly dated October 17, 1994 regarding Lake Tarpon Revised Nutrient Budget.

SDI, Inc. 1998. Evaluation of Potential Hydrological Effects of Short-term Water Releases from Lake Tarpon. SDI Project No. PCF-110. Final Report Submitted to Pinellas County Department of Environmental Management.

*Shannon, E.E. and P.L. Brezonik. 1972. Eutrophication Analysis: A Multi-variate Approach. Proceedings of the American Society of Civil Engineers, Journal of Sanitary Engineering Division, 98(SA1):37-57.

*Souza, S.J., J.D. Koppen and R. Conner. 1988. Aquatic Weed Harvesting: A Cost Effective Means of Improving the Recreational, Aesthetic and Water Quality Conditions of Lake Hopatcong, Lake and Reservoir Management, Vol IV, North American Lake Management Society, Washington, D.C.

Southwest Florida Water Management District (SWFWMD). 1988 and 1994. Lake Tarpon Surface Water Improvement and Management (SWIM) Plan. Brooksville, Southwest Florida Water Management District.

Southwest Florida Water Management District (SWFWMD). 1996. Northen Tampa Bay Water Resources Assessment Project-Surface water/Groundwater Interrelationships. Brooksville, Southwest Florida Water Management District.

Spechler, R.R.. 1983. Chemical Characteristics of Water in the Upper Floridan Aquifer Near Tarpon Springs, Florida. Tampa, University of South Florida, Unpublished Master's Thesis.

Taylor, R.L. 1953 Hydrologic Characteristics of the Lake Tarpon Area, Florida: U.S. Geological Survey Open File Report.

U.S. Army Corps of Engineers (ACOE). 1987. Four River Basins Project: Regulation Manual for Lake Tarpon. U.S. Army Engineer District, Jacksonville, Florida.

U.S. Army Corps of Engineers (ACOE). 1961. Comprehensive Report of the Four River Basins Project. U.S. Army Engineer District, Jacksonville, Florida.

U.S. Environmental Protection Agency (EPA). 1977. National Eutrophication Survey, Working Paper Series: Report on Lake Tarpon, Pinellas County, Florida. EPA Region IV. Working Paper No. 275. Corvallis Environmental Research Laboratory, Corvallis, Oregon.

*Upchurch, S.B. 1998. Lake Tarpon Ground-Water Nutrient Study. Final report submitted to the Southwest Florida Water Management District. Prepared by ERM-South.

APPENDIX B - PHYSICAL CHARACTERISTICS

Definition of Management Boundaries

The Lake Tarpon watershed is 52.4 square miles (KEA, 1992) with approximately half the watershed located in Pinellas County and half in Hillsborough County (Figure B-1). A small portion of the watershed falls in Pasco County. The main tributary to the lake is Brooker Creek. Pinellas County has identified fourteen channels that eventually converge to form the main channel of Brooker Creek which discharges into Lake Tarpon on the southeastern shore. The headwaters of Brooker Creek begin in the lakes region of northwest Hillsborough County and account for the portion of the Lake Tarpon watershed that extends into Hillsborough County.

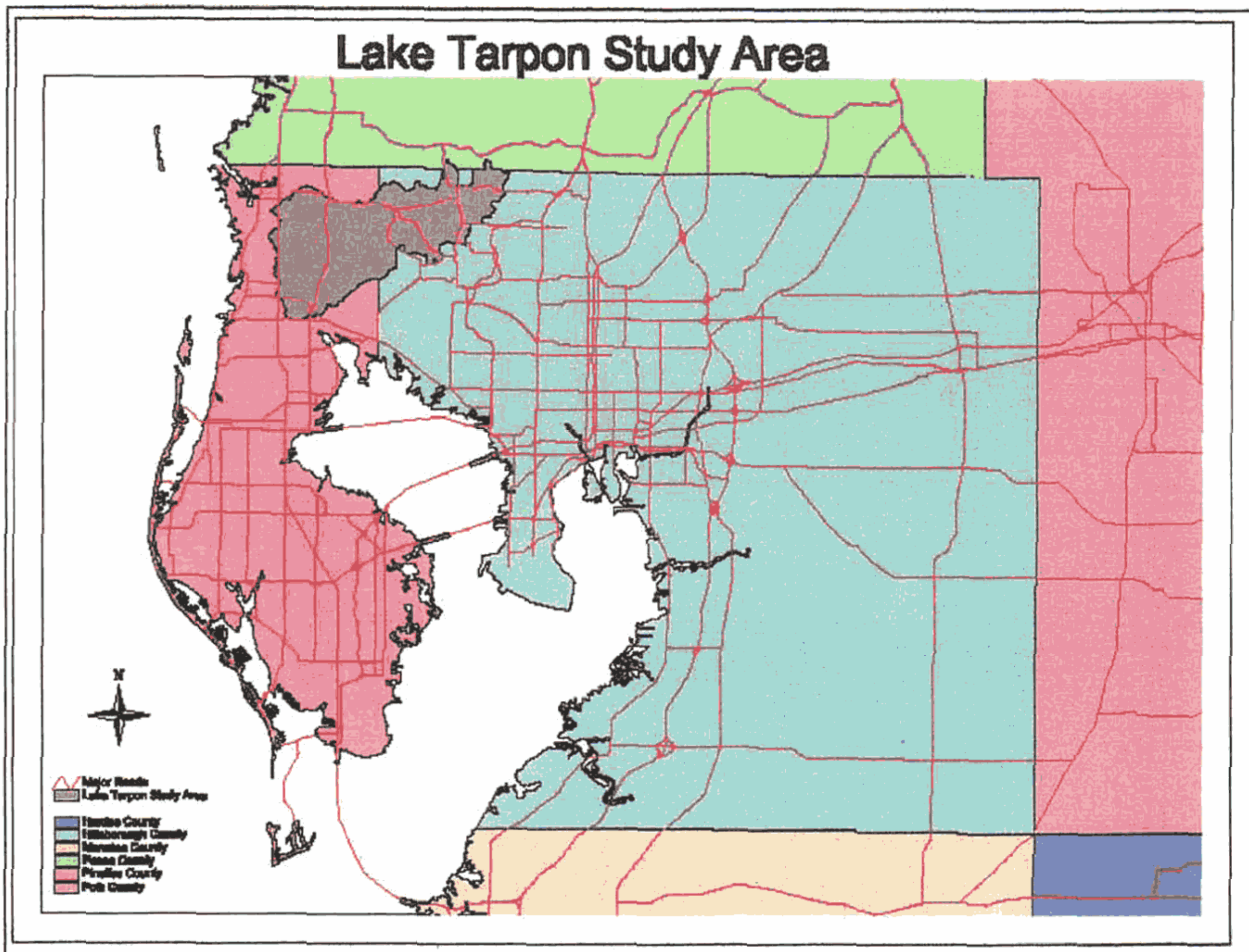


Figure B-1-Lake Tarpon and Brooker Creek watershed

Description of the Water Body and Its Watershed

Lake Tarpon is the largest lake in Pinellas County and has a surface area of approximately 4 square miles. The lake is approximately five miles long and 0.75 to 1 mile wide. KEA (1992) reported the average lake depth to be 7.3 feet with a maximum depth of 14 feet. The lake volume has been estimated to be about 1 billion cubic feet (Bartos and Rochow 1976) with a mean hydraulic retention time of 189 days (US EPA 1977).

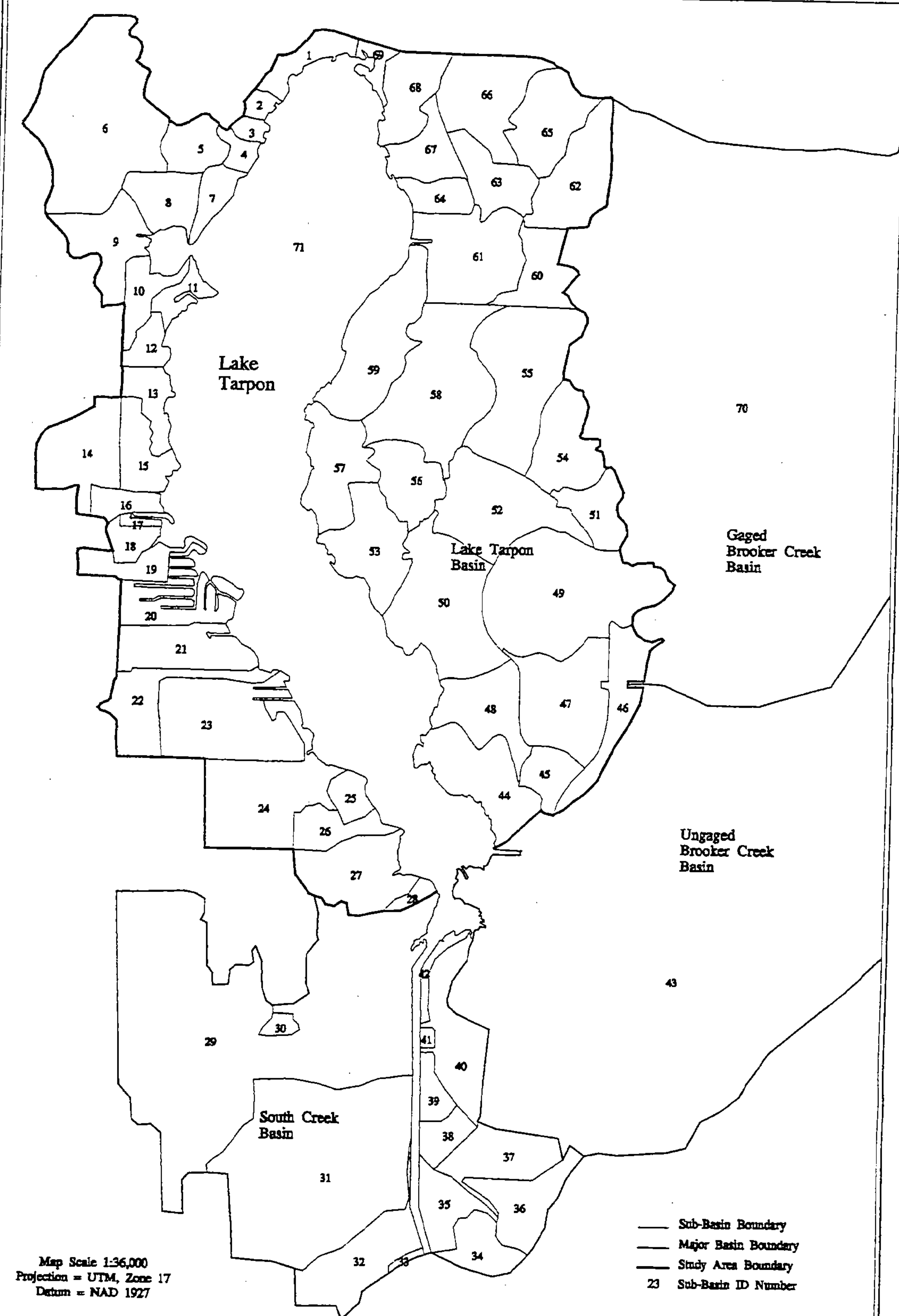
Lake Tarpon, formerly called Lake Butler, has historically been used for boating fishing and swimming. The lake was used for water supply for a four year period between March 1926 and May 1930. However, its use as a public water supply was abandoned due to the frequent inflow of saline water through the Lake Tarpon Sink. Lake Tarpon is still widely used for recreational activities.

The Lake Tarpon watershed has been divided into three macro-basins referred to as the Lake Tarpon basin, the South Creek basin and the Brooker Creek basin (KEA 1992). The Lake Tarpon Basin which includes the lake proper and its immediate shoreline, covers an area of approximately 9.1 square miles. The South Creek Basin, a 3.3 square mile basin, encompasses an area draining to the Lake Tarpon Outfall Canal and Lake St. George. Brooker Creek, the largest of the basins, covers an area of approximately 42 square miles and extends into Hillsborough County. Coastal (1995) further subdivided the Brooker Creek basin into the gaged and ungaged Brooker Creek basins (Figure B-2). The gaged Brooker Creek basin is that portion upstream of the USGS gage located at Ridgemoor Boulevard and the ungaged basin is that part located downstream of the USGS gage.

Topographically the lake's watershed ranges from an elevation of less than five feet above mean sea level (msl) to greater than 80 feet msl. The western and northern most portions of the watershed are characterized by steeper slopes and typically well drained soils, while the eastern area of the watershed is generally flat and consists of poorly drained soils (KEA 1992). These soil and slope characteristics have been an important factor in the development history of the watershed. Most of the commercial and high density development in the 1950s and 1960s was generally concentrated in the western portion of the watershed. This is important because this development pre-dated stormwater treatment and wetland protection regulations. During this time, much of the eastern shore of the lake and the Brooker Creek watershed was in rural and agricultural land uses. Urban development in this area began in the 1970s and 1980s when more rigorous stormwater treatment and wetland protection criteria were being adopted.

Of particular hydrologic significance is the Lake Tarpon Sink located on the northwest shoreline. This sink, which is 118 feet in depth, was hydrologically connected to Lake Tarpon. Dye studies conducted in 1946 and 1949 confirmed a hydrologic connection between the Lake Tarpon Sink and Spring Bayou in Tarpon Springs (Taylor 1953). The sink acted as both an outflow and inflow depending upon the tide and the water level in the lake. Inflows from the sink resulted in increased salinity concentrations in the lake. An earthen berm was constructed around the sink in May 1969 by the District to prevent the exchange of water between the sink and the lake. Until construction of the Lake Tarpon Outfall Canal, the sink was the only surface water outflow for the Lake. The Lake Tarpon Outfall Canal was

constructed as part of the Four River Basins Project by the US Army Corps of Engineers to provide flood control for Lake Tarpon. The Outfall Canal located at the southern most end of the lake was completed in 1967. The Outfall Canal which is approximately 3.5 miles long and about 12 feet deep connects the Lake to Upper Tampa Bay. At the time of construction an earthen dam was placed in the canal to prevent the backflow of salt water into the lake. In 1971, the earthen dam was replaced with an operable structure approximately 1.4 miles upstream of the Outfall Canal's confluence with Tampa Bay. The Lake Tarpon Outfall Structure (S-551) is operated by the District under the guidance of the US Army Corps of Engineers. The primary purpose of the Outfall Canal and S-551 is to provide flood control for Lake Tarpon. However, the Lake Tarpon Drainage Basin Management Plan (PBS&J 1998) has recommended that S-551 be operated to provide water quality habitat benefits while maintaining the District's flood control objective.



LAKE TARPON DRAINAGE BASIN MANAGEMENT PLAN

Figure B-2 Lake Tarpon sub-basin delineation

Brooker Creek Brooker Creek runs approximately 15 miles and drains approximately 42 square miles of northeast Pinellas County and northwest Hillsborough County (IES 1993) before entering Lake Tarpon at its lower southeastern corner, less than 3000 feet upstream of the Outfall Canal (SWFWMD 1989). The headwaters of Brooker Creek consist of fourteen channels that eventually converge and form the main channel which flows into Lake Tarpon. Five of these channels begin in the lakes region of northwest Hillsborough County (Figure B-3). Most of the channels of Brooker Creek are not well defined and can be characterized as broad riverine wetlands (IES 1993).

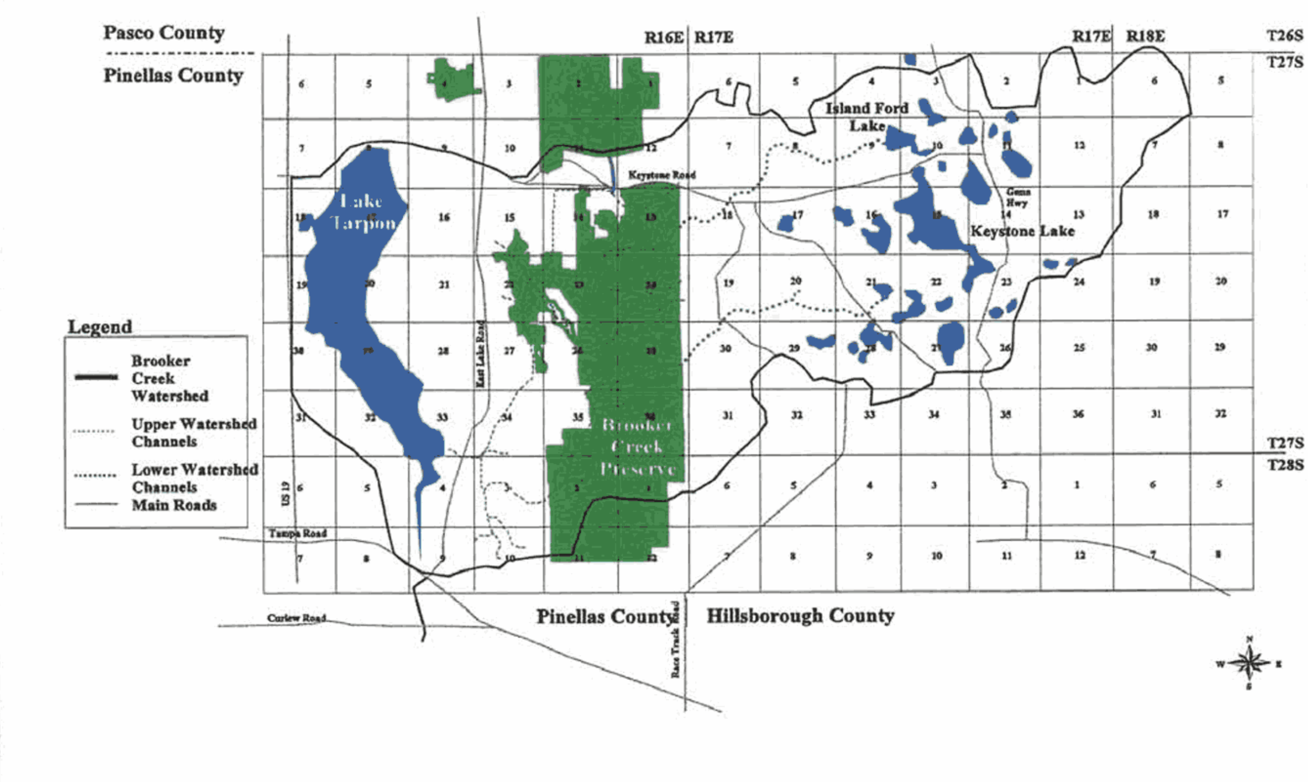


Figure B-3-Lake Tarpon and Brooker Creek watersheds showing headwaters of Brooker Creek

Anthropogenic activities have impacted the channels and wetlands of Brooker Creek. The uppermost reaches of Brooker Creek in Hillsborough County have been modified by ditches and water control structures that exist at Lake Keystone and Island Ford Lake (IES 1993). In addition to the typical impacts associated with urban development that exist in both Hillsborough and Pinellas Counties, such as stream channelization for flood control and filling of wetlands for development, there are there are several potable water supply wellfields in northwest Hillsborough County. These impacts and low rainfall have resulted in a decline in the average annual flow of the creek since 1961 (BWA 1978). Hydrogaphs for period of record data from the District's Resource Data Department are shown in Figures B-4 and B-5.

Many of the channels of Brooker Creek pass through the Brooker Creek Preserve in Pinellas County. The Brooker Creek Preserve consists of approximately 8,000 acres of undeveloped land in the northeast corner of Pinellas County adjacent to the Hillsborough/Pinellas County line. The land was acquired through a partnership between Pinellas County and the District. The Pinellas County Department of Environmental Management is responsible for management of the County's and the District's lands within the Preserve.

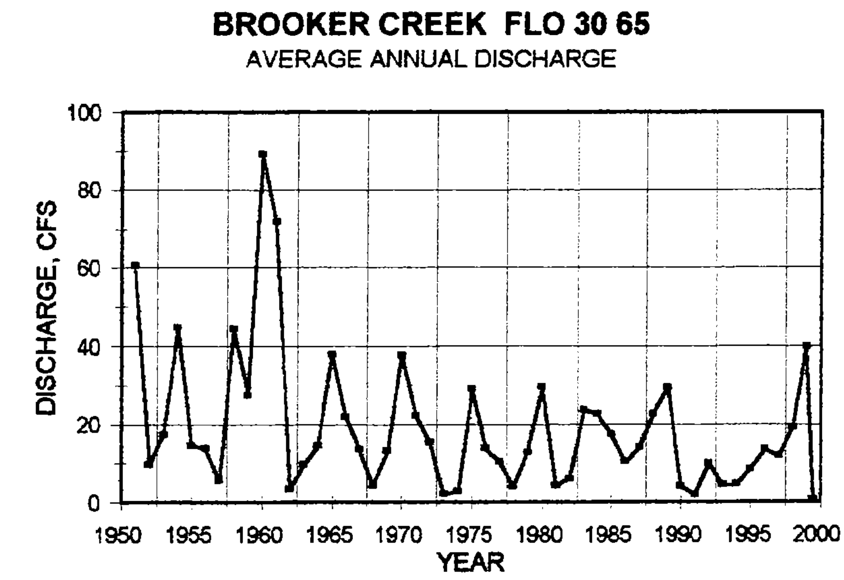


Figure B-4 Average annual discharge of Brooker Creek (District Resource Data Dept.)

One of the most obvious environmental impacts on the Brooker Creek Preserve is the existence of a large power line corridor. This main corridor, a smaller power line and access roads have bisected the channels of Brooker Creek as they cross the Preserve. These impacts include the filling of wetlands to construct the power line towers and roads. In some cases, areas excavated to provide fill have redirected flow away from the historic channels and wetland areas.

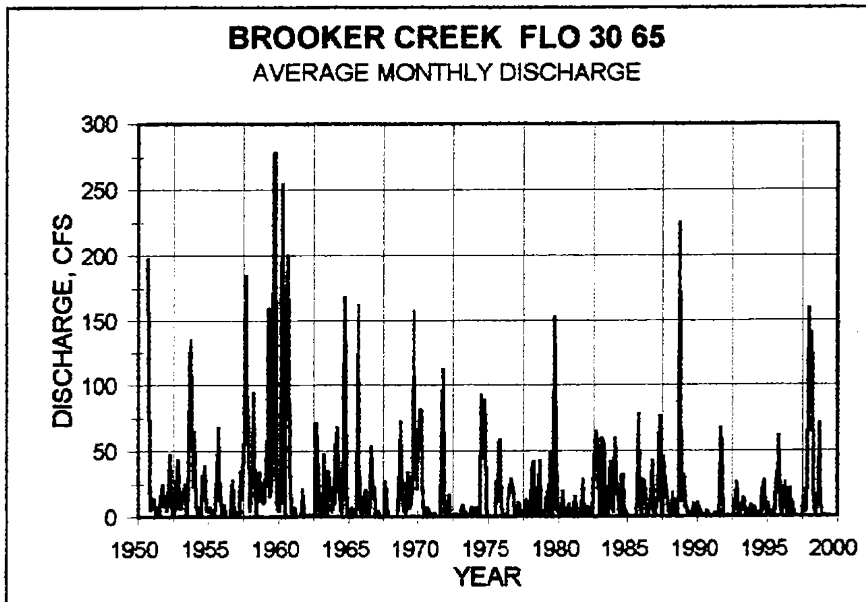


Figure B-5-Average monthly discharge of Brooker Creek (District Resource Data Dept.)

The land around the mouth of Brooker Creek is also owned by Pinellas County and managed as the John Chesnut, Sr. Park. The 251-acre park offers a mix of passive and active recreational activities. Conservation areas make up about 103 acres and open space and recreation areas about 148 acres.

Land Use

The Lake Tarpon watershed, inclusive of the lake, encompasses approximately 52 square miles, with roughly half in Pinellas County and half in Hillsborough County. The Brooker Creek watershed accounts for 42 square miles of the Lake Tarpon watershed and all of the Lake Tarpon watershed in Hillsborough County is in the Brooker Creek Drainage.

The *Lake Tarpon Ground-water Nutrient Study* (Upchurch 1998) researched land use changes over the past 50 years and, as can be expected, land uses within the entire Lake Tarpon watershed have changed dramatically in the last 50 years. In 1950, upland forests and wetlands were the most dominant land use. Urban land uses, served by septic tanks, were isolated to the Tarpon Springs area, to small subdivisions along U.S. 19 on the southwestern edge of the lake and around some of the lakes in northwest Hillsborough County. Citrus groves existed southwest of the lake and pasture and range land were prevalent east of the lake. From 1950 to 1970 urban areas had expanded somewhat. However, the most prominent increase was in the amount of land that had been planted in citrus. This land use was widespread along the ridges southwest of the lake and in the northwest Hillsborough area.
Between 1970 and 1990, urban growth replaced much of the pasture, range land and citrus. With the exception of a small area near the east central shore of the lake, the entire eastern margin of the lake had become urbanized and most of these areas were served by small local package wastewater treatment plants. Between 1990 and present, Pinellas County upgraded their wastewater treatment system and these small plants were hooked up to their regional wastewater treatment plant.

The most recent land use data available is from 1995 and a map is shown as Figure B-6 and the acreage breakdown is shown in Table B-1 below. From this breakdown, it is evident that residential development dominates the land use within the entire basin. This is followed by wetlands, agriculture and open water. Most of the wetlands and forest within Pinellas County occur east of the lake and coincide with the Brooker Creek Preserve. Future development in Pinellas County likely will slow due to the "built out" nature of the basin. However, opportunities for additional development still exist especially in Hillsborough County on the lands identified as agriculture.

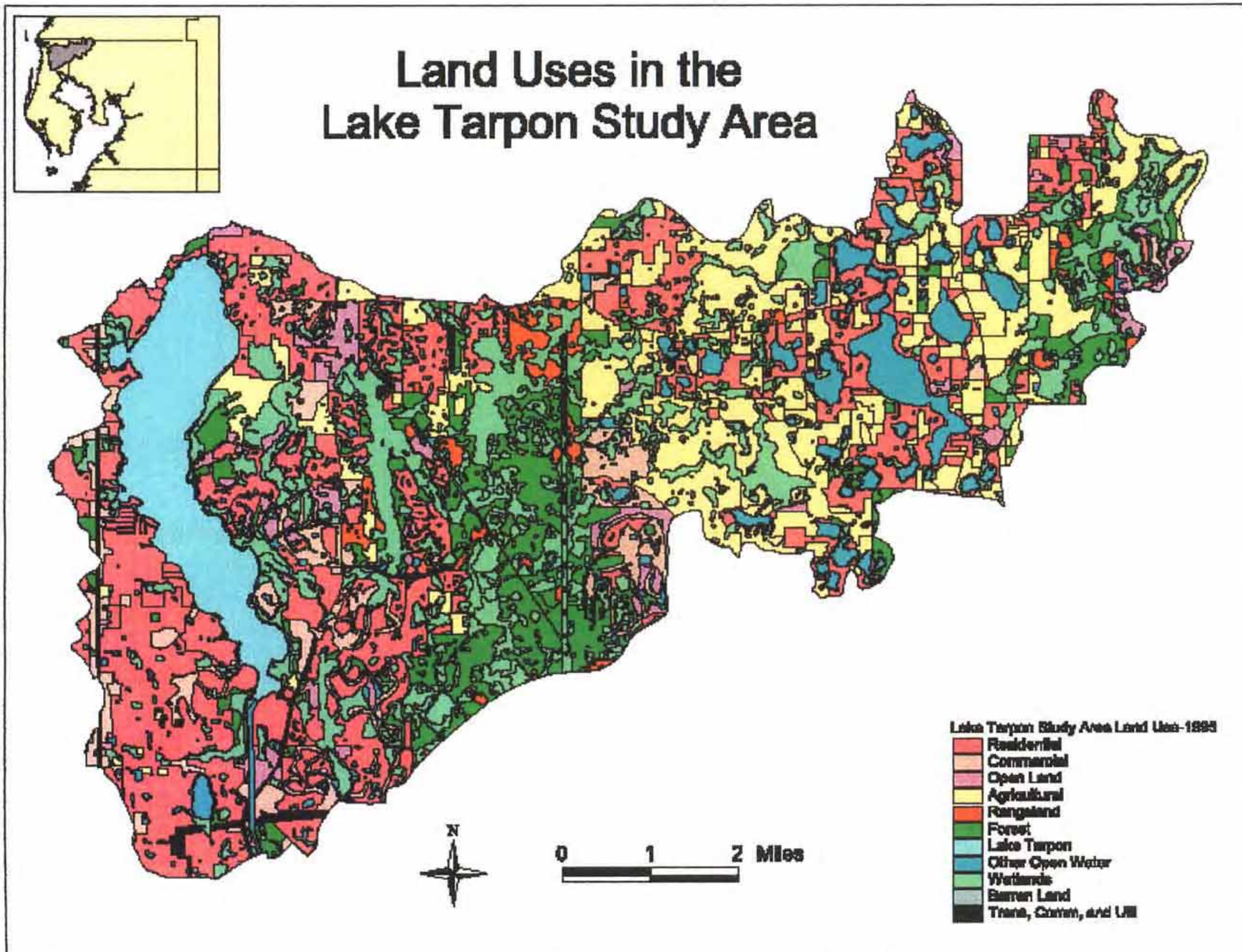


Figure B-6-1995 Land use in Lake Tarpon and Brooker Creek watersheds (SWFWMD Resource Data Department)

Table B-1. Land use acreage within the Lake Tarpon Study Area

Land use	Area (acres)	Percent cover
Agricultural	5966.4	16.2
Barren	.1	Less than 0.01
Commercial	2131.7	5.8
Forest	3764.7	10.2
Lake Tarpon	2472.4	6.8
Open	1089.47	3.0
Other Open Water	2472.8	6.8
Rangeland	709.5	1.9
Residential	9635.3	26.0
Trans, Comm, Utilities	404.8	1.1
Wetlands	8173.3	22.2
Total	**36820.4**	**100.0**

APPENDIX C - PERMITTED SOURCES AND WATER USE PERMITS

This appendix lists point sources and water use permits within the Lake Tarpon watershed. Point source permit information (wastewater and landfill permits and petroleum and RCRA sites) was obtained from the Southwest District office of the FDEP. Based on correspondence received from the FDEP Southwest District Office on September 22, 1999, no facilities were operating without a permit, with a temporary permit or violating effluent limits or standards, therefore, no timetable is provided to bring the facilities into compliance with FDEP Regulations. No facilities have a permitted surface water discharge. (Letter from Gerold Morrison, FDEP Southwest District Office, 9/22/99)

Table C-1 Wastewater Permits as of 6/29/99

Facility ID	Name	Facility ID	Facility Type	Design Capacity (MGD)
FLA012140	Silver Dollar Resort	FLA012140	DW	0.0350
FLA012167	Eagles WWTP	FLA012167	DW	0.3000
FLA012907	Tarponaire Mobile Resort	FLA012907	DW	0.0125
FLA012934	Ringhaver/Ring Rent Equipment Co.	FLA012934	IW	not provided by FDEP
FLA012908	Whispering Lakes	FLA012908	DW	0.0200

Table C-2 Petroleum Sites as of 6/29/99

Facility No.	Name
298732456	Texaco # 1321-24-203-1321
528624562	Texaco - NASRS
528624597	Athens Auto Service
528943769	Mobil # 02-A7D
528945428	Dimmitt Jeep Eagle
528624522	Days Inn - Tarpon 19 Innkeepers, Inc.
528732810	D&D Oil
529047545	FL Dept. of Transportation Right-of-Way
528630818	Stamas Yacht, Inc.
298625644	Ready Food Store # 66
529103285	Lansbrook Golf Club
528623647	7-Eleven Food Store # 20099
528520581	Pinellas County Park – John Chesnut Jr.
528837347	Highland Lake Golf Course
528838060	Circle K # 8530
528623466	Circle K E 7495
528733523	East Lake Woodland, Ltd.
528630802	Texaco # 203-1346
528515426	Mobil # 02-611
528735197	Texaco Food Mart # 282-08-24-203-1379
528515114	7-Eleven Food Store # 20596
529046196	Countryside Country Club

Table C-3 Dry Cleaners as of 6/29/99

Facility ID	Name
9601182	Capri Cleaners
9501294	Wood Lake Cleaners

Table C-4 MSSW PERMITS IN THE LAKE TARPON WATERSHED (as of 4/22/99)

PERMIT NUMBER	REVISION NUMBER	PROJECT SIZE (acres)	PROJECT NAME
000022	00	7	PARK AVENUE SHOPPING CENTER
000024	00	45	MANDARIN LAKES SUBDIVISION
000047	00	5	TARPON FINANCIAL CENTER
000068	00	112	KEYSTONE CROSSINGS SUBDIVISION
000068	01	105	KEYSTONE CROSSINGS SUBDIVISION
000068	02	105	KEYSTONE CROSSINGS SUBDIVISION
000077	00	4	ST. LUKE'S EYE CLINIC
000077	01	3	TRINITY INFORMATION CENTER
000077	02	2	ST. LUKE'S EYE CLINIC-PARKING LOT ADD.
000077	03	1	ST. LUKE'S EYE CLINIC-PARKING LOT EXP.
000161	00	12	LANDMARK PALMS
000171	01	15	INDIGO POND-PHASE II
000171	02	15	INDIGO POND-PHASE II
000171	03	15	INDIGO POND-PHASE II
000184	00	3	WASHINGTON SQUARE SHOPPING CTR.
000226	00	7	PALM HARBOR COLLECTION
000229	00	10	CURLEW LAKES COMMERCIAL TRACT
000229	01	10	CURLEW LAKES COMMERCIAL TRACT
000229	02	2	CURLEW LAKES COMMERCIAL TRACT
000229	03	2	CURLEW LAKES COMMERCIAL TRACT
000253	00	30	ASHLAND HEIGHTS
000274	00	72	FARMINGTON SUBDIVISION
000274	01	11	HILLS. CO.-FARMINGTON SUBDIVISION POND
000286	00	960	CYPRESS BEND
000292	00	12	DOT-SAFETY HARBOR BRIDGE
000337	00	20	OAKS AT COUNTRYSIDE, THE
000337	01	12	COUNTRYSIDE PALMS
000360	00	32	WOODLANDS PLAZA
000368	00	3	HEATH & COMPANY
000368	01	3	HEATH AND COMPANY AT CITY OF OLDSMAR
000397	00	26	ESTANCIA TOWNHOMES
000397	01	26	ESTANCIA TOWNHOMES
000397	02	20	ESTANCIA TOWN HOMES UNIT 2
000397	03	65	BROOKFIELD & BROOKFIELD VILLAS-PHASE 2
000397	04	2	BROOKFIELD VILLAS CLUB HOUSE/REC. AREA
000397	05	0	BROOKFIELD OUTFALL REPLACEMENT
000407	00	5	SABAL RIDGE, STRIP SHOPPING CTR.
000439	00	60	SALT LAKE ESTATES
000439	01	60	RIVERSIDE
000485	00	9	OLDE PALM HARBOR CENTER
000578	00	293	TAMPA BAY PARK OF COMMERCE
000578	01	11	TAMPA BAY PARK OF COMMERCE-PH.1
000578	03	79	TAMPA BAY PARK OF COMMERCE-PHASE 1
000578	04	11	TAMPA BAY PARK OF COMMERCE-PH.1

Table C-4 MSSW PERMITS IN THE LAKE TARPON WATERSHED (as of 4/22/99)

PERMIT NUMBER	REVISION NUMBER	PROJECT SIZE (acres)	PROJECT NAME
000578	05	2	TAMPA BAY PARK OF COMMERCE-PHASE 1
000578	06	8	TAMPA BAY PARK OF COMMERCE
000578	07	13	TAMPA BAY PARK OF COMMERCE-PHASE I
000578	08	7	MAXXIM MEDICAL INC BLDG EXP. (FKA)*
000588	00	6	TURTLE COVE
000588	01	4	OLDSMAR MUNICIPAL SERVICE BUILDING
000602	00	6	OLDSMAR FLEA MARKET
000622	00	5	TARPON PROFESSIONAL OFFICE CTR.
000631	00	26	SAIL HARBOR S/D PHASE I
000632	00	31	SAIL HARBOR S/D PHASE II
000634	00	7	HARBOR OFFICE CENTER
000638	00	54	NEWHAVEN WEST
000638	01	11	BRITTANY PARK-PHASE 3
000647	00	38	COBB'S LANDING BASIN "H"
000647	01	24	COBB'S LANDING BASIN "G"
000678	00	53	NEWHAVEN EAST
000678	01	61	NEW HAVEN EAST
000678	02	9	RIVERWATCH
000678	03	3	RIVERWATCH
000680	00	9	PALM HARBOR CATHOLIC CHURCH
000680	01	0	ST. LUKE'S CHURCH-AKA PALM HARBOR
000686	00	7	VILLAGES OF SOMERSET WOODS
000686	01	9	VILLAGE OF SOMERSET WOODS
000690	00	80	ARMISTEAD SUBDIVISION
000845	00	8	PARKVIEW PLACE
000847	00	1	IN THE NAME OF JESUS WORLD OUT.
000860	00	271	TAMPA BAY PARK OF COMMERCE
000860	01	15	TAMPA BAY PARK OF COMMERCE-E.RD.
000860	02	111	TAMPA BAY PARK OF COMMERCE-PHASE III
000860	04	108	TAMPA BAY PARK OF COMMERCE-PHASE III
000999	00	67	CORAL LAKES
000999	02	27	CORAL LANDINGS SHOPPING CTR-PH.I & II
000999	03	0	BOSTON CHICKEN-CORAL LANDINGS
000999	05	7	CORAL LAKES-SOUTH PARCEL
000999	06	1	WORLD SAVINGS & LOAN-CORAL LANDINGS
000999	07	7	CORAL LAKES-SOUTH PARCEL
000999	08	2	CORAL OAKS-ADDITION
000999	09	2	A.I.G OFFICE BUILDING
001090	00	33	PGA TOUR FAMILY CENTER
001090	01	127	RODRIGUEZ, CHI CHI, YOUTH FOUND.
001090	02	5	RODRIGUEZ, CHI-CHI-YOUTH FOUNDATION
001090	03	0	RODRIGUEZ, CHI CHI-GOLF COURSE KIWANIS
001113	00	17	KLOSTERMAN KORNER
001172	00	50	CUMBERLAND MANORS PHASE 1
001172	01	52	CUMBERLAND MANORS PHASE 2
001172	02	0	CUMBERLAND MANORS PHASE 2
001184	00	29	CORNERSTONE OFFICE PARK/CALIBRE
001184	01	4	EAST LAKE AMBULATORY SURGERY CENTER
001184	02	0	CORNERSTONE CANCER CENTER ADDITION
001217	00	15	CLEARWATER CONVALESCENT CENTER
001217	01	6	PALM GARDEN OF CLEARWATER-BLDG ADD.
001243	00	22	COUNTRY OAK ESTATES

Table C-4 MSSW PERMITS IN THE LAKE TARPON WATERSHED (as of 4/22/99)

PERMIT NUMBER	REVISION NUMBER	PROJECT SIZE (acres)	PROJECT NAME
001300	00	5	YOUR ATTIC MINI STORAGE
001307	00	4	CURLEW CROSSINGS
001307	01	4	CROSSINGS, THE
001307	02	4	CURLEW CROSSINGS
001345	00	30	RIVER OAKS SUBDIVISION
001382	00	4	REPUBLIC WEST LIMITED OFF. COMPL
001421	00	13	COSTCO WAREHOUSE
001421	01	13	COSTCO WAREHOUSE-ABR CENTER
001421	02	2	DOT-ABR CENTER
001421	03	0	ABR CENTER
001435	00	4	KNIGHTS INN MOTEL-PALM HARBOR
001437	00	39	BROOKFIELD
001447	00	12	SUTHERLAND ELEMENTARY SCHOOL "I"
001447	01	19	SUTHERLAND ELEMENTARY SCHOOL "I"
001448	00	7	HIGHLAND ACLF
001455	00	35	MEARS COMMERCE CENTER, INC.
001455	03	1	MEARS COMMERCE CENTER
001455	04	3	MEARS COMMERCE CENTER-PHASE 2B
001472	00	11	KLOSTERMAN OAKS
001501	00	210	WYNDHAM LAKES SUBDIVISION
001501	01	210	WYNDHAM LAKES SUBDIVISION
001501	02	210	WYNDHAM LAKES SUBDIVISION
001501	03	97	WYNDHAM LAKES SUBDIVISION-PH. I
001501	04	97	WYNDHAM LAKES MITIGATION PLANT.
001501	05	59	WYNDHAM LAKES PHASE II & III
001518	00	1	MCDONALD, LARRY & BETTY SITE
001519	00	37	CROSSINGS AT LAKE TARPON, THE
001536	00	8	MARKS FORD, KEN
001536	01	3	MARKS FORD, KEN-OLDSMAR REPAIR FAC
001551	00	57	CYPRESS LAKES ESTATES
001582	00	15	LANDMARK PALMS, ADD. & FOUNTAINS
001583	00	68	CHATEAUX DES LACS
001658	00	12	DIMMITT-PALM HARBOR
001658	01	17	DIMMITT-PALM HARBOR
001681	00	7	PASCO BUSINESS PARK
001682	00	56	WOODRIDGE LAKES
001704	00	438	VAN DYKE FARMS
001704	01	438	VAN DYKE FARMS
001741	00	10	HAMMOCK WOODS UNIT II SUBDIV.
001742	00	9	STATHOPOULOS, BILL COMMERCIAL
001774	01	176	SILVER DOLLAR RANCH
001774	02	0	SILVER DOLLAR RANCH WAREHOUSE ADD
001774	04	4	SILVER DOLLAR RANCH-MITIGATION AREA
001774	05	6	SILVER DOLLAR MOBILE HOME PARK ADD
001798	00	3	KEYSTONE PLAZA SHOPPING CENTER
001822	00	7	TURTLE CREEK
001834	00	5	COUNTRYSIDE WOODS TOWNHOUSES
001853	00	11	REGENTS PARK OF SAFETY HARBOR
001853	01	7	ARBORS OF SAFETY HARBOR, THE
001853	02	1	ARBORS OF SAFETY HARBOR, THE
001853	03	5	WESTCHESTER GARDENS
001885	00	5	PLITT THEATRE

Table C-4 MSSW PERMITS IN THE LAKE TARPON WATERSHED (as of 4/22/99)

PERMIT NUMBER	REVISION NUMBER	PROJECT SIZE (acres)	PROJECT NAME
001885	01	11	PLITT THEATRE SITE
001923	00	15	KEYSTONE TERRACE SUBDIVISION
001956	00	23	LAKE JULIA
001987	00	3	TECO-VAN DYKE FARM
001987	01	3	TECO-VAN DYKE FARM
002054	00	25	RIVIERE RIDGE PHASE I
002054	01	25	ST. LUKE'S CHURCH PARKING ADD.
002060	00	81	LAKES OF KEYSTONE SUBDIVISION
002068	00	5	OAK BAY CENTER
002094	00	20	ELEMENTARY SCHOOL "M"
002113	00	3	BRIAR CREEK OFFICE PARK
002113	01	3	BROOKSTONE/BRIAR CREEK OFFICE PARK
002119	00	198	BOOT RANCH
002119	01	22	BOOT RANCH-EAGLE RIDGE
002119	02	98	BOOT RANCH-EAGLE WATCH
002119	03	36	BOOT RANCH-EAGLE TRACE
002119	04	1	BOOT RANCH-FORCE MAIN
002119	07	375	BOOT RANCH MASTER INFRASTRUCTURE
002119	08	61	BOOT RANCH WEST-N. OF TAMPA ROAD
002119	09	14	LIFESTYLE APTS. AT BOOT RANCH W.
002119	10	61	BOOT RANCH WEST
002119	11	61	STRATFORD PLACE AT BOOT RANCH WEST
002119	12	98	BOOT RANCH-EAGLE WATCH
002119	13	10	BOOT RANCH-EAGLE WATCH
002119	14	0	PINELLAS CO.-SEWER SYS MAIN CROSSING
002119	15	12	EGRET'S LANDING AT BOOT RANCH
002119	16	30	VININGS CLUB, THE-BOOT RANCH
002119	17	11	HERON'S LANDING AT BOOT RANCH
002119	18	23	THE LANDINGS AT BOOT RANCH WEST
002126	00	202	WENTWORTH
002126	01	202	WENTWORTH
002126	02	202	WENTWORTH-GOLF COURSE #8 FAIRWAY
002126	03	202	WENTWORTH-GOLF COURSE
002178	00	10	OLDSMAR, CITY OF-DARTMOUTH AVE.
002198	00	513	PINELLAS CO.-MCMULLEN BOOTH
002198	02	74	PINELLAS CO.-MCMULLEN-BOOTH RD.
002198	03	98	PINELLAS CO.-MCMULLEN BOOTH RD-PH. III
002198	05	124	PINELLAS CO.-EAST LAKE ROAD- PH. I & II
002198	06	74	PINELLAS CO.-EAST LAKE ROAD/TAMPA ROAD
002198	07	13	PINELLAS CO.-TAMPA ROAD EAST (C.R. 752)
002198	08	45	PINELLAS CO.-E. LAKE RD/KEYSTONE RD
002198	09	124	PINELLAS CO.-EAST LAKE ROAD, PH. I & II
002198	11	124	PINELLAS CO.-EAST LAKE ROAD
002198	12	0	PINELLAS CO.-EAST LAKE RD./KEYSTONE RD.
002198	13	40	EAST LAKE ROAD
002198	14	98	PINELLAS CO.-MCMULLEN BOOTH RD-POND I
002198	15	0	PINELLAS CO.-WATERMAIN EXTPUBLIX
002198	16	11	PINELLAS CO.-EAST LAKE ROAD-PHASE I & II
002198	17	1	PINELLAS CO.-TAMPA ROAD EAST (C.R. 752)
002198	20	124	PINELLAS CO.-EAST LAKE ROAD-PH. I & II
002198	21	2	PINELLAS CO-E LAKE RD-KEYSTONE -PASCO
002198	22	1	PINELLAS CO.-E. LAKE RD/KEYSTONE RD

Table C-4 MSSW PERMITS IN THE LAKE TARPON WATERSHED (as of 4/22/99)

PERMIT NUMBER	REVISION NUMBER	PROJECT SIZE (acres)	PROJECT NAME
002198	23	124	PINELLAS CO-EAST LAKE ROAD-PHASES I & II
002198	24	3	PINELLAS CO-E LAKE RD TRAFFIC OPS MODS
002198	25	11	PINELLAS CO-EAST LAKE RD-CR 611-PH I&II
002326	00	2	ST. PETERSBURG, CITY OF-SLUDGE
002352	01	4	SUNSHINE VOLVO
002364	00	3685	TRINITY COMMUNITIES
002364	05	2775	TRINITY COMMUNITIES-EAST PASCO TRACT
002364	08	2775	TRINITY COMMUNITIES-EAST PASCO TRACT
002364	17	2775	TRINITY COMMUNITIES-EAST PASCO TRACT
002364	24	2775	TRINITY COMMUNITIES-EAST PASCO TRACT
002364	34	33	PINELLAS WOODS SUB AKA GREY OAKS
002378	00	1	HARVESTERS, INC.-CITRUS GROVE
002397	00	2	STAMAS PROPERTY
002511	00	39	GROVES AT COBB'S LANDING, THE
002513	04	12	MANATEE VILLAGE-MITIGATION PROJECT
002544	00	546	BRYAN TRACT, TRACT D
002544	01	396	CRESCENT OAKS COUNTRY CLUB
002544	03	396	CRESCENT OAKS COUNTRY CLUB
002544	04	2	CRESCENT OAKS COUNTRY CLUB-PH. I
002544	07	14	CRESCENT OAKS COUNTRY-PHASE 1 & 2
002544	08	3	CRESCENT OAKS COUNTRY CLUB-PHASE II
002583	00	0	RIVERBEND VILLAGE
002661	00	1166	CYPRESS LAKES
002661	01	5	TAMPA BAY SKATING ACADEMY
002661	02	43	CYPRESS LAKE-NORTH/SOUTH RD.
002661	03	8	OLDSMAR, CITY OF-WATER DEPT SITE
002661	04	33	NORTH-SOUTH ROAD & SITE ALTERATION
002661	05	57	CYPRESS LAKES-SOUTHWEST AREA
002661	06	21	LAKEVIEW DR EXTENSION-CYPRESS LAKES
002661	08	75	CYPRESS LAKES-EASTERN AREA
002661	09	25	FOUNTAINS AT CYPRESS LAKES, THE
002661	10	16	ELEMENTARY SCHOOL "Z"
002661	11	23	FOUNTAINS AT CYPRESS LAKES II-A, THE
002661	12	75	CYPRESS LAKES-EASTERN AREA
002661	13	11	CYPRESS LAKES-EASTERN AREA-PHASE II
002661	14	25	FOUNTAINS AT CYPRESS LAKES, THE
002661	15	75	CYPRESS LAKES-DRAINAGE PLAN
002661	16	312	CYPRESS LAKES-SOUTH
002661	17	23	FOUNTAINS AT CYPRESS LAKES II-A, THE
002661	18	3	CYP LAKES-DISCOUNT AUTO & WALTSON
002661	19	13	FOUNTAINS AT CYPRESS LAKES II-B, THE
002661	20	43	CYPRESS LAKES-MITIGATION DESIGN
002661	21	13	SUN KETCH TOWNHOMES AT CYPLAKES
002661	22	1	ECKERD'S STORE AT CYPRESS LAKES
002661	23	16	CYPRESS LAKES-EASTERN AREA, PHASE II
002661	24	26	CYPRESS LAKES-EASTERN AREA, PHASE I
002661	25	5	CYPRESS LAKES-SERVICE ROAD, PARCEL 1
002661	26	75	CYPRESS LAKES-INTERIM DRAINAGE PLAN
002661	27	2	CYPRESS LAKES (7-ELEVEN - SR 584)
002708	00	3	NORTH BAY COMMUNITY CHURCH, INC.
002708	01	3	NORTH BAY COMM. CHURCH-PARKING ADD.
002725	00	4	LESSER OFFICE CENTER

Table C-4 MSSW PERMITS IN THE LAKE TARPON WATERSHED (as of 4/22/99)

PERMIT NUMBER	REVISION NUMBER	PROJECT SIZE (acres)	PROJECT NAME
002786	00	49	GLENBROOK EAST AND WEST
002786	03	4	ST.PETE JUNIOR COLLEGE-TARPON SPRINGS
002786	04	4	GLENBROOK EAST
002817	00	6	ROCKY POND SUBDIVISION
002835	00	9	RIVIERE RIDGE PHASE 2
002888	00	32	RIDGEMOOR, TRACT 43
002979	00	25	BOOT RANCH RETAIL
002979	01	25	BOOT RANCH RETAIL
002979	02	1	AMOCO SERVICE STATION
002979	03	22	SHOPPES AT BOOT RANCH, THE
002979	04	1	BOOT RANCH-SOUTHTRUST BANK
002979	05	1	CHEVRON FACILITY-BOOT RANCH
002979	06	1	WENDY'S REST.-SHOPS @ BOOT RNCH
002979	07	1	CITIZEN'S BANK-SHOPPES AT BOOT RANCH
002979	08	1	RALLY STORE #125 AT BOOT RANCH RETAIL
003017	01	19	PALM HARBOR APARTMENTS
003017	02	19	STONEGATE APARTMENTS AT PALM HARBOR
003019	00	20	TARPON WOODS ESTATES I PARCEL 4
003080	00	1	OLDSMAR, CITY OF-R.E. OLDS PARK
003105	00	11	PINELLAS CO.-ALCOHOL TREATMENT
003158	00	5	HARBORSIDE CHRISTIAN CHURCH
003158	01	5	HARBORSIDE CHRISTIAN CHURCH-PHASE 2
003221	00	2	HIGHLAND LAKES TRACT 17-4
003221	01	3	HIGHLAND LAKES TRACT 17, PHASE 4
003328	00	70	BURTON, NELL C.-DRAINAGE DITCH
003536	00	30	PINELLAS CO.-MERIDEN AVE.
003536	01	30	PINELLAS CO.-MERIDEN AVE.
003539	00	1	PINELLAS CO.-CURLEW AVE. ST. IMP
003539	01	1	PINELLAS CO.-CURLEW AVE IMPROVEMENT
003558	00	13	CURLEW CENTRE
003558	01	13	CURLEW CENTRE MINI STORAGE
003630	00	38	LAKE PLACE
003642	00	13	EMERALD BAY
003807	00	40	PRESIDENT'S LANDING - PHASE 2
003807	02	43	PRESIDENT'S LANDING-PHASES 3 & 4
003807	03	44	PRESIDENT'S LANDING-PHASE 5
003855	00	150	ARBOR LAKES SUBDIVISION
003855	01	69	ARBOR LAKES SUBDIVISION-PHASE 1
003855	02	38	ARBOR LAKES SUBDIVISION-PHASE 2
003855	03	69	ARBOR LAKES-PHASE 1
003855	04	38	ARBOR LAKES SUBDIVISION-PHASE 2
003855	05	38	ARBOR LAKES SUBDIVISION-PHASE 2
003859	00	6	PINELLAS CO.-RES. FACILITY RD.
003859	01	6	PINELLAS CO.-RES. FACILITY RD.
003868	00	0	NATIONWIDE INSURANCE BLDG
003942	00	10	MEADOW RUN SUBDIVISION
003942	01	9	PALM HARBOR REC COMPLEX-C.R. 94
004026	00	1	FPC-TARPON SPRINGS
004039	00	3	CURLEW HEIGHTS SUBDIVISION
004039	01	3	VELVENTOS SUBDIVISION
004100	00	45	BEACON SINGLE FAMILY
004100	01	45	BEACON SINGLE FAMILY

Table C-4 MSSW PERMITS IN THE LAKE TARPON WATERSHED (as of 4/22/99)

PERMIT NUMBER	REVISION NUMBER	PROJECT SIZE (acres)	PROJECT NAME
004100	02	0	PINELLAS/ CURLEW GROVES DRAINAGE IMPR
004180	00	43	OAK TRAIL DEVELOPMENT
004228	00	2	JEHOVAH'S WITNESSES-CARVEL CT.
004341	00	2	OLDSMAR PERFORMANCE CENTER
004341	01	2	OLDSMAR PERFORMANCE CENTER
004401	00	28	EAGLE COVE
004401	01	28	EAGLE COVE SUBDIVISION
004404	00	10	PALM HARBOR CENTER-HIGHLAND LAKE
004446	00	15	PRESERVE, THE
004446	01	15	PRESERVE, THE
004447	00	11	PRETTY LAKE ESTATES
004491	00	6	FIRST CHRISTIAN CHURCH/TARPON SP
004491	01	11	FIRST CHRISTIAN CHURCH OF TARPON SP
004590	00	12	ST. JAMES SUBDIVISION
004601	00	10	CLEARING NORTH, THE
004601	01	10	PARKSIDE
004788	00	5	SADDLEWOOD
004788	01	5	LATTERDAY SAINTS CHURCH MTG HOUSE
004868	00	58	PINELLAS CO.-WHITEBRIDGE DRIVE
004872	00	2	BECKETT BAY PARK
004885	00	1	WEST LAKE MEDICAL CENTER
004973	00	1	FPC-BROOKER CREEK
004989	00	1	PINELLAS CO.-PINE ST./CURLEW RD.
004993	00	2	ACME SPONGE BUILDING
004993	01	2	ACME SPONGE BUILDING
005077	00	26	HUNTER'S CROSSING
005087	00	3	TANGLEWOOD OFFICES-TARPON WOODS
005139	00	10	MANOR CARE
005139	01	8	ARDEN COURTS OF PALM HARBOR
005158	00	9	ALL SAINTS CATHOLIC CHURCH
005162	00	67	CANTERBURY SUBDIVISION
005162	01	67	CANTERBURY SUBDIVISION
005162	02	47	CANTERBURY SUBDIVISION
005199	00	16	WARRINGTON GREEN SUBDIVISION
005226	00	2	BENTOS, RON-ACLF
005229	00	1	COLONIAL-19 AUTOMOTIVE CENTER
005372	00	23	CLEARWATER-NE POLLUTION CTRL FAC
005372	01	5	CLEARWATER, CITY OF-NE POLLUTION FAC.
005372	02	2	CLEARWATER, CITY OF-N.E. WWTP
005372	03	0	GTE MOBILNET-COUNTRYSIDE CELL SITE
005476	00	2	MAGNE LIFE
005478	00	22	LANSBROOK PARKWAY-PHASES 2 & 3
005478	01	22	LANSBROOK PARKWAY-PHASES 2 & 3
005523	00	0	GTE MOBILNET-OLDSMAR
005651	00	1	PINELLAS CO. PINE STREET
005651	01	1	PINELLAS CO.-PINE STREET
005659	00	0	OLDSMAR,CITY OF-PUBLIC LIBRARY
005662	00	151	FERN RIDGE
005662	01	95	FERN RIDGE SUBDIVISION
005662	02	94	FERN RIDGE
005690	00	0	INGRAHAM AGRICULTURAL BUILDING
005726	02	12	WHISPERING LAKES EAST

Table C-4 MSSW PERMITS IN THE LAKE TARPON WATERSHED (as of 4/22/99)

PERMIT NUMBER	REVISION NUMBER	PROJECT SIZE (acres)	PROJECT NAME
005739	00	13	OLDSMAR, CITY OF-WWTP
005739	01	0	OLDSMAR, CITY OF-WWTP
005785	00	8	RESERVE, THE
005794	00	2	HILLS. CO.-WATER TRANS. MAIN
005813	00	0	ST. PETE., CITY OF-CHLORINE FAC.
005813	01	0	ST. PETERSBURG, CITY OF-COSME CHLORINE
005813	02	1	ST. PETERSBURG, CITY OF-COSME WTP
005860	00	29	CROSS CREEK AT EAST LK WOODLANDS
005860	01	16	CROSS CREEK @ E. LAKE WOODLANDS-PH II
005868	03	43	DOT-S.R. 580/S.R 584 PROJECT #10150-3537
005868	05	43	DOT-S.R. 580/S.R 584 #10150-3537
005868	07	43	DOT-STATE ROAD 580/584-POND 2 REVISION
005868	08	43	DOT-S.R. 580/S.R. 584
005868	09	43	DOT-S.R. 580/S.R. 584 #15050-3527 & 3542
005868	10	43	DOT-S.R. 580/S.R. 584
005944	00	7	SILVERTHORNE
005982	00	0	SCARBOROUGH-VANGUARD JT. VENTURE
006009	01	1	ANCLOTE LANDINGS
006209	00	9	PINELLAS CO- OLDSMAR ELEMENTARY
006311	01	145	KEYSTONE BLUFFS SUBDIVISION
006311	02	75	KEYSTONE BLUFFS SUBDIVISION
006311	03	75	KEYSTONE BLUFFS
006311	04	17	ELEMENTARY SCHOOL "B"
006360	00	1	PINELLAS CO.-BAYVIEW DR./SR 580
006360	01	1	PINELLAS CO.-BAYVIEW DR./SR 580
006406	00	2	HOLY TRINITY EPISCOPAL CHURCH
006406	01	4	HOLY TRINITY EPISCOPAL CHURCH
006497	00	1	COMPREHENSIVE PSYCHOLOGICAL SERV
006511	01	10	HUNTERS GLEN SUBDIVISION
006511	02	10	HUNTERS GLEN SUBDIVISION
006512	00	4	PINELLAS CO.-FISHER RD/CYPRESS AVE. IMP.
006577	00	16	PINELLAS CO.-MCMULLEN-BOOTH RD.
006577	01	0	PINELLAS CO.-SEWER SYSTEM FORCE MAIN
006680	00	22	WAL-MART-U.S. 19, PALM HARBOR
006680	01	8	GIS HOUSING
006681	03	0	WOODLANDS ANIMAL HOSPITAL
006712	00	7	TARPON SPRINGS MAIN POST OFFICE
006801	00	7	FAMILY GOLF CENTRE
006809	00	3	WESTERN AUTO-U.S. HIGHWAY 19
006809	01	3	WESTERN AUTO-U.S. HIGHWAY 19
006896	00	2	TECO-KEYSTONE CIRCUIT 66051
006900	00	13	PINELLAS CO.-WESTLAKE VILL. PIPE
006970	00	1	PINELLAS CO.-ROLANDO AND CURLEW
006970	01	1	PINELLAS CO.-ROLANDO AND CURLEW
006970	02	2	PINELLAS CO.-CASA VISTA DRIVE
006970	03	2	PINELLAS CO.-CASA VISTA DR. ASSESS. PRJ.
006970	04	1	PINELLAS CO.-ROLANDO DR/CURLEW ROAD
007160	00	2	MATTER BROTHERS FURNITURE-US 19
007187	00	91	CARLYLE
007227	00	7	HIGHLAND LAKES TRACT 280
007231	00	0	HOFFMAN MINI STORAGE
007436	00	2	SUMMER HOUSE-PALM HARBOR

Table C-4 MSSW PERMITS IN THE LAKE TARPON WATERSHED (as of 4/22/99)

PERMIT NUMBER	REVISION NUMBER	PROJECT SIZE (acres)	PROJECT NAME
007466	00	11	OAKLAKE COMMERCIAL TRACT
007466	01	5	OAKLAKE NORTH PEOPLES BANK-PHASE A
007478	01	2	CLIMATE CONTROLLED SELF-STORAGE
007579	00	0	TARPON SPRINGS COMMUNITY CENTER
007864	00	800	NORTHWEST HILLSBOROUGH EXPRESSWAY
007864	05	130	NW HILLSBOROUGH EXPRESSWAY 6.1
007864	09	130	NW HILLSBOROUGH EXPRESSWAY 6.1
007864	11	130	VETERANS EXP. SECT. 6.1
007864	17	130	DOT SUGARWOOD/HUTCHINSON RD
007894	00	54	PINELLAS CO.- RECREATIONAL TRAIL
007894	01	1	DOT-PINELLAS RECREATIONAL TRAIL
007894	02	1	DOT-PINELLAS RECREATIONAL TRAIL
007894	03	1	PINELLAS CO.-PINELLAS REC TRAIL
007894	04	2	PINELLAS CO.-PINELLAS REC TRAIL
007894	10	5	PINELLAS CO.-PINELLAS TRAIL SPINE RETRO
007894	12	1	FDOT-PINELLAS PK ST OVERPASS
008040	00	0	KEYSTONE UNITED METHODIST CHURCH
008100	00	18	ELEMENTARY SCHOOL SITE "Q"
008102	00	3	PALM HARBOR LIBRARY ADDITION
008102	01	3	PALM HARBOR LIBRARY-ADDITION
008108	00	40	DEVONSHIRE SUBDIVISION
008247	00	21	CLEARWATER, CITY OF-FOREST RUN PARK
008302	00	3	OLDSMAR, CITY OF-BUCKINGHAM AVENUE
008473	00	0	WEXLER COMMERCIAL CENTER
008508	00	31	GLEN EAGLES-COURTYARD 1
008508	02	7	GLEN EAGLES-COURTYARDS 2
008508	03	7	ENCLAVE AT GLENEAGLES
008551	00	1	OLDSMAR, CITY OF-PARK BLVD. DRAIN. IMPR.
008665	00	0	PINELLAS CO.-MAGNOLIA RIDGE DITCH
008665	02	0	PINELLAS CO.-MAGNOLIA RIDGE DITCH
008678	00	34	DOT-S.R. 580/ST. CLAIR TO S.R. 584
008678	01	34	DOT-STATE ROAD 580/ST. CLAIR TO S.R. 584
008678	03	34	DOT-STATE ROAD 580/ST. CLAIR #15050-3522
008678	04	34	DOT-SR580-ST CLAIRE ST/SR 584 15050-3522
008986	01	13	RIDGECREST PROPERTIES SUBD. & COMM.
008986	02	21	RIDGECREST SUBDIVISION
008986	03	7	COBB'S RIDGE-PHASE I
008986	04	3	GIBRALTAR OFFICE CENTER
009046	00	2	PINELLAS CO.-OAK DRIVE AND LAKE DRIVE
009167	00	47	OLDSMAR, CITY OF-CANAL PARK-PHASE I
009167	01	0	ST. PETERSBURG JR COLLEGE-OLDSMAR
009167	02	3	ST. PETERSBURG JR. COLLEGE-N.E. CENTER
009167	03	1	OLDSMAR, CITY OF-CANAL PARK-PHASE II
009167	04	30	OLDSMAR, CITY OF-CANAL PARK-PHASE II
009167	05	0	OLDSMAR, CITY OF-CANAL PARK
009167	06	5	OLDSMAR, CITY OF-CANAL PK
009173	00	0	CYPRESS WOODS ELEMENTARY SCHOOL
009248	00	4	PINELLAS CO.-HIGHLANDS BOULEVARD IMPR.
009249	00	26	ST. PETE JR. COLLEGE-TARPON CAMPUS
009249	01	17	ST. PETE JR. COLLEGE-TARPON CENTER
009249	02	3	SP J C -TARPON SPRINGS CTR.
009385	00	26	PINELLAS CO.-TAMPA ROAD WEST (C.R. 752)

Table C-4 MSSW PERMITS IN THE LAKE TARPON WATERSHED (as of 4/22/99)

PERMIT NUMBER	REVISION NUMBER	PROJECT SIZE (acres)	PROJECT NAME
009385	01	26	PINELLAS CO.-TAMPA ROAD WEST (C.R. 752)
009539	01	51	PINELLAS KLOSTERMAN RD/US 19A-19 IMPV
009539	02	13	PINELLAS CO-KLOSTERMAN RD & US 19
009646	00	32	LAKE KIMBERLY
009764	00	12	PINELLAS CO.-CURLEW CITY DRAINAGE IMPR.
009771	00	5	LAKE ALICE SUBDIVISION
009771	01	0	LAKE ALICE SUBDIVISION
009773	00	70	PINELLAS CO.-BI-COUNTY THRUWAY
009773	01	10	PINELLAS CO.-BI-COUNTY THRUWAY
009774	00	13	BI-COUNTY THRUWAY
009837	00	91	DOT-S.R. 586/U.S. 19 TO CSX RAILROAD
009837	01	94	DOT-S.R. 586/U.S. 19 TO S.R. 584
009837	03	1	DOT-SR 586/FISHER RD/US 19 # 15150-3560
009837	05	94	DOT-SR 586/U.S. 19-S.R. 584/#15009-3540
009837	06	94	DOT-S.R.586/U.S. 19/S.R.584 #15009-3540
009837	07	94	DOT-SR 586/US 19 TO SR 584 TO CSX R/R
009861	00	27	LAKE ABRAY BORROW PIT
010060	01	1	HILLS. CO.-TURTLE CRK BLVD/ROCKY CREEK
010096	00	20	HUTCHINSON & OFFENHAUER MINOR SUBD.
010176	00	34	PINELLAS COUNTY MIDDLE SCHOOL 'A-A'
010294	00	18	ELLINWOOD SUB-LANSBROOK PARCEL 9
010311	00	6	PINELLAS CO.-TRANSMISSION MAIN
010324	00	86	FALLBROOK SUB-LANSBROOK PARCEL 8
010406	00	2	PINELLAS CO.-JOHN CHESNUT PARK RD
010453	00	22	RIDGEMOOR-TRACT 23
010453	01	11	RIDGEMOOR-TRACT 23
010530	00	5	DAVIS, AUSTIN-LIBRARY
010555	00	17	STONEBRIAR AT THE WOODLANDS
010555	01	0	STONEBRIAR AT THE WOODLANDS
010719	01	1	DOT-S.R. 580/S.R 584 PROJECT #10150-3537
010719	03	1	DOT-S.R. 580/S.R 584
010814	00	3	STATE FARM SERVICE CTR-COUNTRYSIDE
010844	00	0	CHI CHI RODRIGUEZ YOUTH FOUNDATION
010851	00	41	HIGHGATE SUBDIVISION
010864	00	28	IVY RIDGE SUBDIVISION-PHASE I
010864	01	5	IVY RIDGE SUBDIVISION-PHASE 2
010864	02	0	TRACT R-2 PARK SITE-RAW WATER PIPELINE
010870	01	10	BROOKER CREEK VILLAS
010902	00	0	PINELLAS CO.-SPAN PINES DRAINAGE IMPR
010907	00	51	LAKE KIMBERLY PROJECT
010907	01	39	LAKE KIMBERLY PROJECT
010907	02	39	LAKE KIMBERLY-LAKE 3
010974	00	0	PINELLAS CO.-LAKE TARPON CHANNEL 'U'
011001	00	0	PINELLAS CO.-TARPON LK BLVD. CROSSINGS
011099	03	9	TARPON SPRINGS, CITY -DODECANESE BLVD.
011099	04	9	TARPON SPRINGS, CITY -DODECANESE BLVD.
011099	05	2	TARPON SPRINGS, CITY OF-LIVE OAK STREET
011099	07	2	TARPON SPRINGS, CITY OF-LIVE OAK ST EXT
011100	00	13	EAST LAKE WOODLANDS GOLF COURSE
011159	00	2	ST. LUKES EYE CLINIC-PARKING LOT ADD.
011160	00	6	KEYSTONE PLANT FARM
011251	02	20	WCRWSA-CYPRESS CREEK TRAN. MAIN-PH. 1

Table C-4 MSSW PERMITS IN THE LAKE TARPON WATERSHED (as of 4/22/99)

PERMIT NUMBER	REVISION NUMBER	PROJECT SIZE (acres)	PROJECT NAME
011251	04	18	WCRWSA-KELLER CONNECTOR MAIN-PHASE I
011251	06	20	WCRWSA-CYPRESS CREEK TRAN. MAIN-PH. 1
011252	00	1	CLASSIC GLASS & MIRROR
011286	00	10	PUBLIX AT BROOKER CREEK
011286	01	4	PUBLIX AT BROOKER CREEK
011286	02	1	MADISON SAVINGS & LOAN @ LANSBROOK
011286	03	1	BARNETT BANK AT LANSBROOK
011365	00	0	INDIGO POND-PHASE II
011365	01	0	INDIGO POND-PHASE II
011507	00	101	COVENTRY VILLAGE AT RIDGEMOOR
011507	01	47	COVENTRY VILLAGE AT RIDGEMOOR-PHASE II
011507	02	101	COVENTRY VILLAGE AT RIDGEMOOR
011507	03	101	COVENTRY VILLAGE AT RIDGEMOOR
011534	00	13	WARWICK HILLS SUB
011535	00	2	ISLEWORTH SUB-FORMERLY PARCEL I
011590	00	57	SILVER DOLLAR TRAP CLUB
011590	01	16	SILVER DOLLAR TRAP CLUB
011618	00	0	PINELLAS CO.-BELCHER ROAD-PHASES I & II
011625	00	0	OLDSMAR, CITY- MARLBOROUGH ST. CUL
011635	00	2	OLDSMAR, CITY -MARLBOROUGH/PINE IMPR.
011672	02	35	PINELLAS CO.-BELCHER ROAD-PHASE I
011672	03	35	PINELLAS CO.-BELCHER ROAD-PHASE I
011672	04	35	PINELLAS CO-BELCHER ROAD, PHASE I
011672	05	1	BELCHER RD-PHASE II-PUTNAM PK DRN IMP
011672	06	35	BELCHER CURLEW-ALDERMAN RD-PH I & II
011903	00	18	JUNIPER BAY SUBDIVISION-PHASE 1
011903	01	41	JUNIPER BAY SUBDIVISION-PHASES 2
011903	02	3	JUNIPER BAY SUBDIVISION-PHASE 3
011904	00	0	WESTFIELD PLANNED COMM.-CYP LAKES
011911	00	65	AYLESFORD SUBDIVISION
012091	01	7	PINELLAS CO. WATER SYSTEM-TRANS. MAIN
012091	03	7	PINELLAS CO. WATER SYSTEM-TRANS. MAIN
012096	00	1	PINELLAS CO.-E. LAKE PACKAGE PLANT-PH. 3
012103	00	5	PINELLAS CO.-ROHE STREET PIPE REPL.
012174	00	27	GOLFSIDE SUBDIVISION
012174	01	8	PRESERVE AT LANSBROOK, THE
012247	00	0	KELLER WELL FIELD
012269	00	0	BROOKERS LANDING
012270	00	0	HILLS. -FITZGERALD ROAD DRAINAGE IMPR
012273	00	0	HILLS. CO.-FITZGERALD RD/ROCKY CRK IMPR
012316	00	0	PINELLAS CO.-EAST LAKE ROAD/PINE. TRAIL
012345	00	83	WCRWSA-COSME TRANSMISSION MAIN
012345	01	83	WCRWSA-COSME TRANSMISSION MAIN
012345	02	21	COSME TRANSMISSION MAIN
012346	00	4	WCRWSA-COSME TRANSMISSION MAIN
012346	01	2	WCRWSA-COSME TRANSMISSION MAIN
012393	00	11	KEYSTONE BLUFFS
012393	01	1	KEYSTONE BLUFFS
012413	00	1	CHICKEN CAFE'
012440	00	10	KINGS MILL SUBDIVISION
012440	01	10	KINGSMILL SUBDIVISION
012559	00	1	CYPRESS LAKES

Table C-4 MSSW PERMITS IN THE LAKE TARPON WATERSHED (as of 4/22/99)

PERMIT NUMBER	REVISION NUMBER	PROJECT SIZE (acres)	PROJECT NAME
012559	01	0	CYPRESS LAKES
012624	00	0	OLDSMAR, CITY OF-HARBOR PALMS-CULVERT
012624	01	0	OLDSMAR, CITY-HARBOR PALMS PARK-PIER
012624	02	0	OLDSMAR, CITY OF-HARBOR PALMS PARK
012627	00	0	OLDSMAR, CITY-HARBOR PALMS NAT PRK
012627	01	0	OLDSMAR, CITY-HARBOR PALMS NAT PRK
012637	00	57	KYLEMONT SUBDIVISION
012823	00	7	LANSBROOK COMMONS
012901	00	38	TR.B-INFRASTRUCTURE ROADWAYS & UTIL.
012901	01	26	LANSBROOK-PARCEL 24A
012901	02	16	BROOKER CREEK PLAZA-PHASES 1 & 2
012988	00	52	PINELLAS CO.-WATER TRANS. MAIN REPL.
012988	02	2	PINELLAS CO.-WATER TRANS. MAIN REPL.
013104	00	22	OAKMONT SUB-LANSBROOK PARCEL 12
013157	00	0	TAMPA BAY PRK COMMERCE-DITCH RELOC.
013237	00	2	FERN RIDGE SUBDIVISION
013248	00	4	HILLS. CO.-FERN RIDGE SUBDIVISION
013375	00	17	WOODSONG SUBDIVISION
013375	01	0	WOODSONG-POND "B"
013394	00	0	TARPON SPRINGS, CITY OF-LIVE OAK BLVD.
013394	02	2	TARPON SPRINGS, CITY OF-LIVE OAK STREET
013466	00	28	COUNCIL CREST SUBDIVISION
013467	00	30	CUMBERLAND ESTATES
013491	00	19	MIDDLE SCHOOL "BB"
013491	01	0	MIDDLE SCHOOL "BB" WALKER MIDDLE
013525	00	30	EASTLAKE OAKS-PHASE 3
013525	01	44	EASTLAKE OAKS-PHASE 1
013525	02	27	EASTLAKE OAKS-PHASE 2
013525	03	32	EASTLAKE OAKS-PHASE 4
013525	04	34	EASTLAKE OAKS-PHASE 3
013525	05	44	EASTLAKE OAKS-PHASE 1
013525	06	25	EASTLAKE OAKS-PHASE 2
013525	07	38	EASTLAKE OAKS-CONSERVATION EASEMENT
013525	08	0	EASTLAKE OAKS-PHASE 4, AGER OUTPARCEL
013525	09	44	EASTLAKE OAKS-MITIGATION PLANTING
013525	10	27	EASTLAKE OAKS SUBDIVISION-PHASE 2
013530	00	5	EASTLAKE OAKS
013530	01	5	EASTLAKE OAKS
013530	02	0	EASTLAKE OAKS SUBDIVISION-PHASE 2
013708	00	1	MIDDLE SCHOOL "BB"-OFF SITE FORCE MAIN
013744	00	39	DOT-US HWY 19/LIVE OAK #15150-3706
013916	00	52	LYNNWOOD-PHASE 1
013916	01	23	LYNNWOOD-PHASE 2
013918	00	80	MYRTLE POINT-PHASE 1 & 2
013924	00	9	BROOKER CREEK WORK CENTER
014076	00	67	OLDSMAR SUB/ARBOR WOODS-PHASE I
014076	01	65	ARBOR WOODS SUBDIVISION
014076	02	35	ARBOR WOODS PHASE 2
014076	03	67	ARBOR WOODS A.K.A-OLDSMAR SUBDIVISION
014076	04	49	ARBOR WOODS-PH. 1A- BAY ARBOR PH 1A
014076	05	35	ARBOR WOODS PHASE 2
014127	00	17	WOODLANDS POINTE

Table C-4 MSSW PERMITS IN THE LAKE TARPON WATERSHED (as of 4/22/99)

PERMIT NUMBER	REVISION NUMBER	PROJECT SIZE (acres)	PROJECT NAME
014287	00	2	GLEN EAGLES MEDICAL CENTER
014298	00	2	STONE BUICK
014307	00	1	SUN LAWNMOWERS
014376	00	1	ALPINE PLUMBING
014485	00	0	LAKE TARPON CELL SITE
014488	00	2	WEE-CARE DAY CARE PRE-SCHOOL
014490	00	1	OLSMAC AUTOMOTIVE
014518	00	37	CYPRESS LAKES ESTATES PHASE II
014534	00	2	PALM LAKE PET HOSPITAL
014535	00	1	HIGHLAND LAKES PRO SHOP
014542	00	11	SUTTON'S RIDGE SUBDIVISION
014546	00	1	VAUGHN'S DEPOT
014553	00	6	LUTHERAN CHCH OF RESURRECTION ADD
014557	00	4	OLDSMAR CITY HALL BUILDING
014557	01	4	OLDSMAR CITY HALL BLDG *LETTER MODIF
014587	00	2	10 BED ACLF ADD CURLEW COUNTRY HOME
014623	00	21	MEASE HEALTH CARE-COUNTRYSIDE EXP
014623	01	1	MEASE HEALTH CARE-COUNTRYSIDE PARK
014625	00	5	COUNTRYSIDE AMBULATORY SURGERY CNTR
014642	00	8	STONE BUICK-COUNTRYSIDE **FORMAL MOD
014654	00	23	FLORIDA POWER CORPORATION - LK TARPON
014664	00	17	BAY'S END
014717	00	6	HIGHLAND NATURE PARK
014723	00	2	SAFETY HARBOR FIRE HOUSE #. 2 PARKING
014723	01	2	SAFETY HARBOR FIRE HOUSE #2 PARKING
014727	00	1	GTE KEYSTONE RSU
014731	01	2	KINGDOM HALL OF JEHOVAH'S WITNESSES
014753	00	1	OAKTREE WAREHOUSES
014764	00	0	MACHINE SHOP ADD - #906 VERONA PLACE
014764	01	0	MACHINE SHOP ADD- 906 VERONA PLACE
014773	00	1	PROEFKE WAREHOUSE SITE (PARKING EXP)
014780	00	1	PARKING LOT ADDITION(UPPER)-ALL STAINTS
014794	00	52	MOSS BRANCH ACRES, AKA: LA ROSA FARMS
014796	00	2	SOMERSET DOWNS *TWICE AMENDED*
014801	00	2	EASTLAKE FIRE STATION #58
014805	00	1	MCDONALD'S REBUILD- 40278 U.S. HWY 19 TA
014853	00	1	EAST LAKE BAPTIST CHURCH
014863	00	1	SCARBOROUGH CONST HEAVY EQUIP.
014911	00	1	DUNKIN' DONUTS
014911	01	1	DUNKIN' DONUTS
014931	00	75	STATE ST OUTFALL PROJECT *AMENDED*
014931	01	75	STATE ST OUTFALL PROJECT (FORMAL MOD
014931	02	75	STATE ST OUTFALL PROJECT *LETTER MOD
014931	03	0	OLDSMAR-CONNECT LEE ST PARKING
015003	00	2	O'CHARLEY'S RESTAURANT - PALM HARBOR
015005	00	2	CHILI'S - TARPON SPRINGS
015014	00	2	HOME DEPOT EXP @ CURLEW CROSSING
015014	01	1	K. ROGERS ROASTERS/HOME DEPOT *MOD*
015022	00	1	DSC SALES, INC.
015081	00	9	98 BED ADULT CONGREGATE LIVING FACILITY
015099	00	33	GULL AIRE VILLAGE PHASE TWO
015099	01	1	GULL AIRE VILLAGE PHASE TWO * MODIFICATI

Table C-4 MSSW PERMITS IN THE LAKE TARPON WATERSHED (as of 4/22/99)

PERMIT NUMBER	REVISION NUMBER	PROJECT SIZE (acres)	PROJECT NAME
015114	01	7	QUEEN ANNE GATE RESIDENTIAL SUB
015126	00	2	HERTZ EQPT.RENTAL, A NEW FACILITY
015133	02	37	BROOKERS LANDING *2ND AMENDMENT*
015174	01	19	PEBBLE CREEK TOWNHOMES
015183	00	2	FOREST LAKE PROJECT
015187	01	15	HARBOR HILLS SUBD
015196	00	1	EXCEL LEARNING CENTER INC.
015196	01	1	EXCEL LEARNING CENTER INC
015196	02	2	EXCEL LEARNING CENTER-ADDITION
015197	00	2	FITZGERALDS USED CAR MALL
015224	00	1	CURLEW ROAD/FISHER ROAD CENTER
015243	00	3	CHRIST WESLEYAN CHURCH
015246	00	1	TECO CUSTOMER SERVICE BUILDING
015246	01	1	OLDSMAR MEDICAL CTR(AKA: TECO CUST)
015264	00	1	EAST TARPON RECREATION CENTER
015277	00	1	TACO BELL 1989 - TARPON MALL
015280	00	1	PAYLESS SHOE SOURCE
015281	00	1	ARBY'S TARPON MALL
015284	00	15	SERENITY SUBDIVISION
015284	01	0	CYPRESS WOODS AKA SERENITY
015343	00	1	SUNBELT RENTALS
015343	01	1	SUNBELT RENTALS
015343	02	1	SUNBELT RENTALS **FORMAL MOD**
015356	00	1	PICK KWIK- EAST LAKE
015356	01	1	PELICAN AUTO CENTER AT EAST LAKE
015360	00	2	MINI STORAGE BOX
015384	01	1	DRIS OFFICE SITE
015401	01	9	SAVANNAH OAKS
015401	02	9	SAVANNAH OAKS
015407	00	0	STAR ENTERPRISE TEXACO/PINELLAS CNTY
015424	00	11	SAVANNAH POINTE
015453	00	1	AUTO OASIS CAR WASH & LUBE, INC.
015499	00	14	PALM HARBOR PLAZA
015499	01	1	HESS STATION #09023
015511	00	6	NORTH PINELLAS YMCA
015534	00	1	FRANK'S TRAINS AND HOBBIES, BLDG. ADD.
015562	00	0	RETRA SERVICES CENTER
015638	00	0	CARTER FAMILY DOCK
015667	00	2	SHELL OIL/BURGER KING-TARPON SPR
015679	00	1	FLAMMER FORD, KARL-DISPLAY EXPANSION
015707	00	0	BRENZO & TAYLOR'S AIR COND/REFRI
015770	00	3	OUR LORD'S ACADEMY
015830	00	2	MOBIL OIL-TARPON SPRINGS
015830	01	2	MOBIL OIL #02-A7D, TARPON AVE, T.SPRINGS
015923	00	1	R'CLUB CREATIVITY IN CHILDCARE, INC.
015974	00	1	OAKCREST PRE-SCHOOL
015981	00	5	KNIGHT DENTAL LABORATORY
015981	01	6	KNIGHT DENTAL LABORATORY
015989	00	0	FIRST FLORIDA INTERNATIONAL REALTY, INC.
016074	00	3	KCD ASSOCIATES
016191	00	11	SERENITY RESIDENTIAL DEVELOPMENT
016230	00	1	HARTZOG OFFICES

Table C-4 MSSW PERMITS IN THE LAKE TARPON WATERSHED (as of 4/22/99)

PERMIT NUMBER	REVISION NUMBER	PROJECT SIZE (acres)	PROJECT NAME
016230	01	1	HARTZOG PROP. PROPOSED RESTAURANT
016360	00	0	ABC PACKAGING CORPORATION
016363	00	0	HIGHLANDS LKS BLUE COURSE DRAINAGE
016363	01	0	HIGHLANDS LKS BLUE COURSE DRAINAGE
016363	02	0	HIGHLANDS LKS BLUE COURSE DRAIN-IMP-4
016370	00	3	LOKEN SUBDIVISION
016378	00	0	PALM HARBOR FIRE STATION #67-ADDITION
016469	00	3	CONKEL'S TROPICALS, DON
016469	01	9	DON CONKEL'S TROPICALS
016518	00	0	MURPHY ENTERPRISES INC-CARWASH
016588	00	1	MEASE COUNTRYSIDE HOSPITAL-AREA PARK
016704	00	0	SPECIALTY GLASS INC
016704	01	0	SPECIALTY GLASS INC
016771	01	8	PALM HARBOR COMMONS PH-II
016928	00	25	PINELLAS-MCMULLEN BOOTH RD/CURLEW RD
016928	01	25	PINELLAS-MCMULLEN BOOTH RD/CURLEW RD
016928	02	25	PINELLAS CO-REGIONAL ENV MIT SITE
016931	00	19	CYPRESS LAKES ESTATES III SUBDIVISION
017002	00	2	BIBLE BAPTIST CHURCH OF PALM HARBOR
017003	00	2	TEEN CHALLENGE
017056	00	39	NORTH LAKE SUB A/K/A HAFTEL GROV
017056	01	28	NORTH LAKE SUBDIV PH I-HAFTEL GROVES
017117	00	0	PINELLAS CO.-PUMP STATION 302 RELOC
017221	00	10	MISTY WOODS
017223	00	2	FLOWERS RETAIL & STORAGE CNTR
017289	00	1	EAST LAKE FIRE STATION #59
017301	00	0	ANDREWS PROJECT
017347	00	38	BROOKSHIRE HOME OWNER ASSOC
017360	00	34	QUAIL LAKE SUBDIVISION
017373	00	8	CAMELOT
017408	00	1	ECKERD AT CURLEW
017408	01	2	ECKERD AT CURLEW & US 19
017409	00	54	ROBINWOOD SUBDIVISION
017421	00	1	MCDONALD'S AT CITY OF OLDSMAR
017438	00	0	SAFETY HARBOR, -BRIAR CREEK BANK
017450	00	2	CHAMPION HILLS COMMERCIAL CENTER
017572	00	2	UPARC DAYCARE CENTER
017591	00	13	CHANCELLOR PARK
017634	00	1	HESS GAS STATION STORE NO 09422
017784	00	0	CTT FRAMING
017813	00	6	NATIVE WOODS SUBDIVISION
017824	00	1	AMSOUTH BANK-TARPON SPRINGS
017882	00	13	MOUND LAKE
017882	01	0	MOUND LAKE-COMMUNITY CENTER
018053	00	0	HILLSBOROUGH CO-HALF MOON LK OUTFALL
018161	00	1	RED ROOF INN(FKA -TRAVELODGE)
018210	00	2	FLORIN,ROEBIG,WALKER,HUDDLESTUN,ROG
018255	00	10	PINELLAS CO-SK KELLER WTP H_2S
018262	00	0	P&M AUTO REPAIR
018296	00	1	LUXOR AUTO SALES
018370	00	7	HILLS CO-GUNN HWY/RACETRK RD IMPV
018403	00	2	HILLS CO-N MOBLEY RD @ WALKER SCH

Table C-4 MSSW PERMITS IN THE LAKE TARPON WATERSHED (as of 4/22/99)

PERMIT NUMBER	REVISION NUMBER	PROJECT SIZE (acres)	PROJECT NAME
018451	00	1	DELI FRESH CATERING INC-PARKING ADD
018469	00	3	COMMERCIAL TIRE CENTER
018522	00	7	HOSPICE
018641	00	37	PARK CREST AT INNISBROOK
018687	00	16	AUBURNDALE BORROW PIT-PHASE II
018737	00	1	DISCOUNT AUTO PARTS STORE 611
018958	00	0	STONE BUICK
018975	00	3	NEUROSURGICAL SPINE CENTER-PHASE I
019029	00	3	OFFICE DEPOT-TARPON SPRINGS
019212	00	0	CRYSTAL COVE COM. CHURCH INC

Table C-5 Water Use Permits in the Lake Tarpon Watershed (as of 4/22/99)

PERMIT NUMBER	PERMITTED QUANTITY (avg annual gpd)	OWNER NAME
00004502	77,900	BAKER COARSEY ENTERPRISES, INC.
00019303	18,000	PINELLAS COUNTY PARKS DEPARTMENT
00024302	64,500	ECHO LAKE GROVE CORPORATION
00026604	2,600,000	PASCO COUNTY UTILITIES
00028805	435,000	COUNTRYSIDE COUNTRY CLUB, INC.
00035403	200,000	PINELLAS COUNTY UTILITIES
00041102	305,000	KAY D. O'ROURKE
00041202	1,000	KAY D. O'ROURKE
00046203	5,700	VIRGINIA HALBROOK LITTLE
00062003	440,000	THE EAGLES GOLF COURSE LIMITED
00064001	57,300	U S HOME CORPORATION
00074206	1,380,000	CITY OF TARPON SPRINGS
00084202	48,900	MARY E. SNELL-TRUSTEE, A.H.
00115503	323,000	GOLF HOST RESORTS, INC.
00133302	68,900	EDWARD W. NETSCHER
00137302	25,300	DAVID R. ELLINOR
00154402	147,000	FRED S. JOHNSTON, JR.
00184802	25,300	JOHN A. & JANET E. ECKEL
00202101	60,000	LYKES BROS., INC.
00229802	30,900	CLAUDE A. MIRANDA
00230102	33,800	CEE BEE'S GROVE INC
00230402	13,000	GLADYS VINSON
00230802	54,200	EMMA HATCHER
00231102	34,400	EQUITY INVESTT ENTERPRISES CORP
00231403	105,000	MCMULLEN WHOLESALE NURSERY, INC.
00252503	41,400	JOAN HUMPHRIES
00253202	40,000	TAYLOR DEVELOPMENT GROUP INC
00273303	39,400	NELL C. BURTON
00274902	92,000	EMOGENE B. RIEK
00275402	12,200	NELL T. MILAM
00315801	2,000	LAKE VALENCIA HOMEOWNERS
00315901	1,300	DIMMITT REAL ESTATE
00320003	16,900	HUBBARD INVESTMENTS, INC.
00337102	8,700	ANASTASIA ARTZIBUSHEV
00454801	29,800	MIKE CONE
00455502	234,000	PINELLAS COUNTY PARKS DEPARTMENT
00494702	90,000	STELLA MICHAELS
00585401	14,600	PAUL & EMMA HATCHER
00645502	19,900	FRANK A. GREGORIO
00665202	40,400	HAMMOCK PINE PROPERTY OWNERS
00670102	333,100	CYPRESS RUN GOLF CLUB
00693901	13,600	CHARLES E TUCKER
00696003	454,000	WILLIAM L JACOBSEN
00716301	376,000	OAKLEY GROVES INC
00743702	1,000,000	EAST LAKE WOODLANDS LIMITED
00798001	57,700	PINELLAS COUNTY SCHOOL BOARD
00799402	67,500	HILL GROVES, INC.
00817502	34,000	FRED MCNAIRY
00850901	60,000	MIKE STANG & DONALD L CONKEL II
00861400	900	CITY OF CLEARWATER DIVISION OF
00867902	87,000	ARNOLD PAU
00895901	124,000	HIGHLAND LAKES HOMEOWNERS

Table C-5 Water Use Permits in the Lake Tarpon Watershed (as of 4/22/99)

PERMIT NUMBER	PERMITTED QUANTITY (avg annual gpd)	OWNER NAME
00897101	14,200	WILLIAM C KLEIN
00906503	292,000	LANSBROOK DEVELOPMENT CORP. &
00942400	4,500	TARPONAIRE MOBILE RESORT
00955101	169,000	WENTWORTH GOLF CLUB INC
00967003	422,000	JIM COLBERT GOLF INC
00985900	27,800	B.C.D. INVESTMENTS
00995507	83,000	JOHN MILLS
01035001	200,000	UTILITIES, INC. OF FLORIDA
01037500	38,000	PINELLAS COUNTY SCHOOL BOARD
01064600	101,000	SAFETY HARBOR SPA & FITNESS
01072500	24,900	PALM HARBOR COMMUNITY SERVICES
01073200	347,000	LANSBROOK GOLF CLUB CORPORATION
01096500	25,500	WANDA DIAZ
01100000	19,700	CONGRECARE CORAL OAKS PARTNERS
01112101	6,900	DENNIS R & DIANE TENCZA
01121800	1	CITY OF OLDSMAR
01139600	164	SKINNER DEVELOPMENT COMPANY, INC
01143300	498,000	CYPRESS LAKES INDUSTRIAL PARK
01150200	27,000	SEAGULL DRIVE JOINT VENTURE
01155001	35,600	CEE BEE'S GROVE INC
01183000	154,900	TAMPA BAY DOWNS INC
Consolidated Permit	37,500,000	TAMPA BAY WATER (ELDRIDGE WILDE, COSME-ODESSA)

Total permitted quantity = 49,835,665 average annual gallons per day

APPENDIX D - REGULATORY JURISDICTIONS IN THE LAKE TARPON WATERSHED

Federal

Federal jurisdiction in the Lake Tarpon watershed involves regulatory responsibilities of the U.S. Army Corps of Engineers (ACOE), the U.S. Environmental Protection Agency (EPA), the U.S. Coast Guard, the U.S. Department of the Interior (which includes the U.S. Fish and Wildlife Service or FWS and the U.S. Geological Survey or USGS). The main regulatory functions of these agencies include overseeing dredge and fill activities, maintaining navigability of waters of the United States, overseeing clean-ups following pollution spills, protecting endangered species and protecting overall environmental quality. The U.S. Geological Survey participates in special studies in the Lake Tarpon watershed and contributes to the collection of technical data.

U.S. Army Corps of Engineers

The ACOE is concerned with all activities which affect navigable waters of the United States, particularly those involving construction of structures and dredging and filling in navigable waters. The ACOE is also involved in permitting the placement of dredge and fill material into navigable waters and adjacent wetlands and in partial funding of aquatic plant control in navigable and public waters. A revision of the Rivers and Harbors Act of 1968 allows the ACOE to consider fish and wildlife, conservation, pollution, aesthetics, ecology and other relevant factors of a project.

U.S. Environmental Protection Agency

The EPA is the primary federal agency responsible for water quality protection. The agency oversees hazardous waste cleanups, protection of public drinking water systems, all point source discharges in waters of the United States (through the National Pollutant Discharge Elimination System permit program), and the protection and restoration of surface and groundwater. The agency also reviews ACOE permit activities, sets minimum quality standards and sets guidelines for state environmental programs. The EPA also funds sewage system improvements through the Florida Department of Environmental Protection.

U.S. Coast Guard

The Coast Guard's mission includes hazardous materials cleanups, search and rescue, buoys placement, vessel safety inspection and right-of-way clearance on navigable waterways. Since Lake Tarpon is a navigable water it is monitored by the Coast Guard.

U.S. Department of the Interior

Within the U.S. Department of the Interior the FWS and the USGS perform the primary functions of this agency as they relate to Lake Tarpon. The FWS reviews proposed activities which may impact threatened or endangered species and reviews ACOE permit applications for potential effects on fish and wildlife. The USGS conducts investigations concerning hydrology, hydrogeology, water use and groundwater and surface water quality.

State

Many state agencies are involved in environmental regulation and resource management in the Lake Tarpon watershed. They include the Florida Department of Environmental Protection (FDEP), the Florida Department of Community Affairs (DCA), the Florida Fish and Wildlife Conservation Commission (FFWCC, formerly the Florida Game and Freshwater Fish Commission), the Florida Department of Agriculture and Consumer Services DACS), and the Florida Department of Health and Rehabilitative Services (HRS).

Florida Department of Environmental Protection
The FDEP, formed when the Departments of Environmental Regulation and Natural Resources were combined into a single agency (July 1993) has all the responsibilities of the previous departments. It receives its authority partly from state law and partly from programs delegated by the EPA. The FDEP is the lead agency involved in water quality, pollution control, and resource recovery programs. The FDEP sets state water quality standards and has permit jurisdiction over point and non-point source discharges, certain dredge and fill activities, drinking water systems, power plant siting, and many construction activities conducted in waters of the State. The FDEP also interacts closely with other federal and state agencies on water related matters, and the FDEP and the District share responsibilities in non-point source and wetland permitting.

The FDEP is the primary reviewing agency for SWIM plans and is responsible for the disbursement of monies from the SWIM Trust Fund to the water management districts.

Florida Department of Community Affairs
The DCA is responsible for reviewing local comprehensive plans and has jurisdiction over developments of regional impact (DRI's). DRI investigations are concerned with proposed developments which have the potential to affect the health, safety or welfare of morethan one county.

The comprehensive plans for both the City of Tarpon Springs and Pinellas County have been reviewed by the DCA and they are currently in compliance with the Local Government Comprehensive Planning Act.

Fish and Wildlife Conservation Commission
It is the mission of the FFWCC to manage freshwater aquatic life and wild animal life and their habitats to perpetuate a diversity of species with densities and distributions that provide sustained ecological, recreational, scientific, educational, aesthetic and economic benefits. Its efforts within the SWIM plan area primarily involve freshwater sport and commercial fishing, fisheries research wildlife monitoring, enforcement of fisheries/wildlife regulations, listed species protection, wildlife research, development review and regional planning.

With regard to Lake Tarpon, the FFWCC is directed to review the SWIM plan to determine if the plan has adverse effects on wild animal life and freshwater aquatic life. Additionally, the FFWCC participates in law enforcement on the lake and coordinates with all agencies concerning all matters affecting the lake.

Florida Department of Agriculture and Consumer Services
The DACS, through its Division of Agriculture and Environmental Services regulates the registration and use of pesticides, including the purchase of restricted pesticides, maintains registration and quality control of fertilizers, regulates and licenses pest control operations and herbicide applicators, mosquito control and evaluates and manages environmental impacts associated with agrichemicals.

Florida Department of Health and Rehabilitative Services
The HRS is responsible for permitting of septic systems and other on-site disposal systems through its county health departments. It also coordinates mosquito control programs.

Regional

There are numerous programs and regional agencies whose jurisdictions lie within the Lake Tarpon Watershed. Of these, three are likely to be involved in or concerned with implementation of the revised Lake Tarpon SWIM Plan. They are the Tampa Bay Regional Planning Council, the Tampa Bay Estuary Program and the Southwest Florida Water Management District (District)

The Tampa Bay Regional Planning Council is the Regional Planning Agency designated in Section 186.505 of the Florida Statutes. It performs the responsibilities described in that section and the Regional Planning Agency roles assigned in Section 380.05, F.S. which includes resource planning committees, DRI reviews and Chapter 163 local plan reviews.

The Tampa Bay Estuary Program (TBEP) is responsible for administering the Comprehensive Conservation and Management Plan for Tampa Bay. Since Lake Tarpon discharges to Tampa Bay via the Lake Tarpon Outfall Canal, the TBEP will be included in the review process for the revised Lake Tarpon SWIM plan, as well as any projects that may impact nutrient loadings or water flows to Tampa Bay.

The District is responsible for performing the duties assigned under Chapter 373, F.S. as well as duties delegated through the FDEP for Chapters 253 and 403, F.S., and for local plan review under Chapter 163, F.S. The District performs those duties for the entire Lake Tarpon watershed.

Local Governments

There are three local governments with jurisdictions within the Lake Tarpon watershed, the City of Tarpon Springs, Pinellas County and Hillsborough County. Both the City of Tarpon Springs and Pinellas County play an important role in management of the lake through daily management of their communities, by the way of planning, zoning, and other land use decisions and the implementation and enforcement of local codes. Since the original SWIM Plan in 1989, Pinellas County, through their Department of Environmental Management has been a very active partner with the District in the management and monitoring of Lake Tarpon. A consultant for Pinellas County has recently completed the Lake Tarpon Watershed Management Plan which forms a basis for this revision of the Lake Tarpon SWIM Plan. The upper Brooker Creek watershed comprises the portion of the Lake Tarpon watershed which

falls in Hillsborough County. Hillsborough County is becoming more active in management of the Brooker Creek watershed through the County's environmentally sensitive lands acquisition program (ELAPP). They have also begun working with Pinellas County's Brooker Creek Preserve staff to coordinate management if adjoining environmentally sensitive lands are acquired.