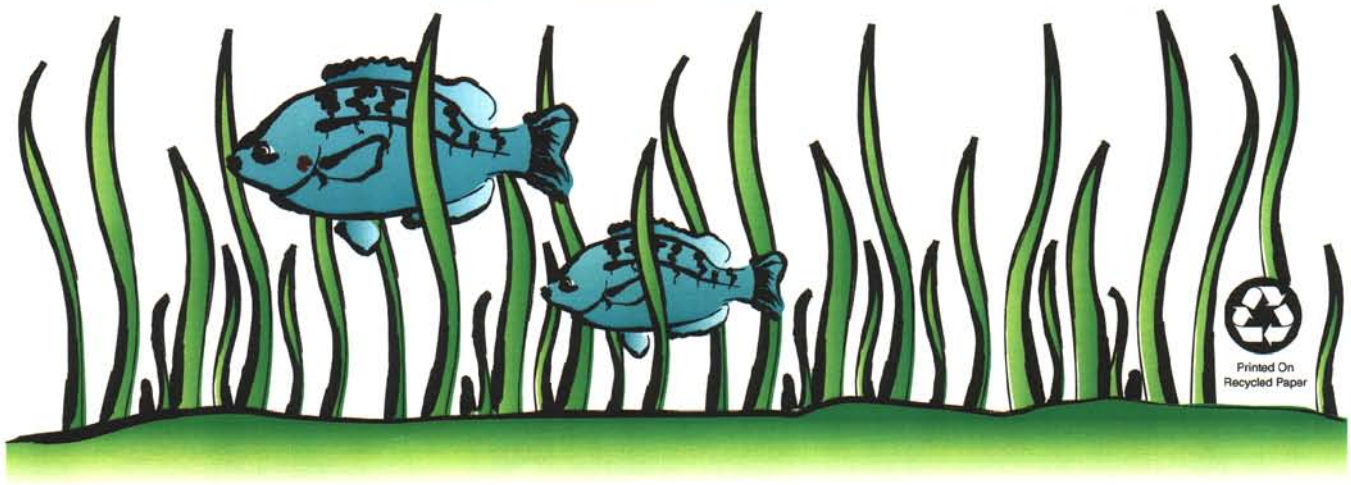
LAKE PANASOFFKEE

Surface Water Improvement and Management (S.W.I.M.) Plan

Southwest Florida
Water Management District



Southwest Florida Water Management District

April 2000

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Surface Water Improvement and Management (SWIM) Plan

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Southwest Florida Water Management District
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EXECUTIVE SUMMARY

Background

Freshwater fishing contributes more than $1.4 billion to the Florida economy, generating $37.4 million in taxes annually and 18,873 jobs. Lake Panasoffkee in Sumter County is an Outstanding Florida Water and the third largest (4,820 acres) of the approximately 1,800 lakes in west central Florida. Throughout the late 1800s and the first half of this century, the lake played an important role in the regional economy as a shipping port for timber, citrus and other regional goods. More recently, the lake serves as a vital recreational freshwater fishing resource, not only for the county but the entire region. With a national reputation, especially for its redear fishery, Lake Panasoffkee is a significant sport fishery resource and an important contributor to the local and regional economy. An estimate of angler expenditures on Lake Panasoffkee, conducted using 1998 creel survey data, yielded a value of about $2.0 million per year. Fifteen percent of the anglers on Lake Panasoffkee come from out of state, and the majority of Florida residents travel more than 25 miles to use the lake.

Although, fishing remains popular at Panasoffkee, the lake's future as a significant recreational resource is threatened. The fisheries there have declined considerably during the last 30 to 40 years. In the mid-1950s, when the lake's fishery was first being studied, no less than 15 fish camps operated there. Today, only three remain.

Unlike many threatened Florida lakes, water quality is good at Lake Panasoffkee, attributed mostly to substantial groundwater flows into the lake from the Floridan aquifer. The threat to Lake Panasoffkee is the loss of desirable habitats for fisheries. Since the 1940s, almost 800 acres, or 22 percent of the lake's area, has been lost. Low water conditions can make the lake unnavigable. Ironically, the groundwater inflow which keeps the lake's water quality high is also the major contributor to the sediment which is filling the lake. The groundwater carries large amounts of dissolved calcium carbonate. When the groundwater mixes with the lake water, the calcium carbonate solidifies, producing sediments which settle on the lake bottom, covering fish-spawning areas. These factors have combined to negatively impact the lake's fishery, promoting increased shoreline vegetation and tussock formations, which impact recreation and navigation.

Lake Panasoffkee SWIM Process

The environmental and economic significance of Lake Panasoffkee lead the Southwest Florida Water Management District (District) to rank this lake as the fifth priority on its Surface Water Improvement and Management (SWIM) priority water body list in 1988. The original Lake Panasoffkee SWIM Plan, approved in 1989, was based on preservation and focused on diagnostic studies regarding water quality, sediment accumulation, vegetation, wildlife and fisheries. The Lake Panasoffkee Restoration Council (Council) used the results of these studies to develop management strategies for Lake Panasoffkee.

The Council was created by the Florida Legislature under Chapter 98-69, Laws of Florida. The Legislature charged the Council with identifying strategies to restore the lake. Specifically, the

Council was to look at sport fish population recovery strategies, shoreline restoration, sediment control and removal, exotic species management, floating tussock management and removal, navigation, water quality, and fisheries' habitat improvement. The law also requires that the Council "report to the Legislature before November 25 of each year on the progress of the Lake Panasoffkee restoration plan and any recommendations for the next fiscal year." The *Lake Panasoffkee Restoration Council, Report to the Legislature, November 25, 1998* represented the plan and recommendations of the Council. The Council's plan was the foundation for this revision of the Lake Panasoffkee SWIM Plan.

The Plan is organized into four sections in addition to the Executive Summary. The Introduction discusses the history of the Lake Panasoffkee SWIM process, the Management Issues and Goals, and explains the role of the Council. Management Strategies and the Priority projects to implement these strategies are discussed in the third and fourth sections of the Plan, respectively. Appendix A provides the technical assessments that lead to the formation of the Management Issues, Strategies and Goals. The regulatory jurisdictions within the watershed are discussed in Appendix B and Appendix C lists the identifies the permitted sources and water use permits.

Lake Panasoffkee Management Issues

The SWIM Plan, consistent with the conclusions of the Council, identifies the following management issues, in priority order:

- Fisheries habitat improvement,
- Shoreline restoration,
- Improved navigation, and
- Maintenance of overall good water quality.

Pursuant to Florida Department of Environmental Protection (FDEP) requirements, the SWIM Plan also includes a Pollutant Load Reduction Goal (PLRG).

Lake Panasoffkee SWIM Plan Goals

The goals of the Lake Panasoffkee SWIM Plan are consistent with the goals identified by the Council and the requirements of FDEP.

- Restore public access and navigation by completion of the Coleman Landing Pilot Project (Step 1) which will create a navigable channel from the boat ramp into the lake (approximately 24 acres).
- Restore fisheries habitat, historic shoreline conditions and navigation along the eastern and western shores (Steps 2 and 3, total approximately1,800 acres).

- Provide an opportunity for canal residents to contract independently with the dredge contractor responsible for implementing Step 2 and allow for dredged material to be disposed of on the site used for Step 2 at no cost to residents (Step 4, 37 canals, total approximately 34 acres).

- Restore fisheries habitat, historic shoreline conditions and navigation along the eastern shore of the lake by the removal of sediments and emergent woody/shrubby vegetation that has encroached into the lake bed (Step 5, total approximately 780 acres).

- Improve navigation and deepen the lake by removing sediment from the 34-foot contour shoreward (Step 6, total approximately 2,700 acres)

- Improve existing information available for fisheries' management to evaluate success of fisheries habitat and shoreline restoration projects.

- Based on paleolimnological evidence and existing water quality data, and considering the minimal hydrologic alteration in the watershed, the Pollutant Load Reduction Goal has been set at "zero" for nutrients.

- Maintain or improve existing water quality as measured by a trophic state index of 50 or less.

- Maintain 60 percent coverage of desirable submersed aquatic plants.

Lake Panasoffkee Management Strategies

Extensive buildups of inorganic sediments and the shallowing of the lake have destroyed fish-spawning areas, and promoted woody/shrubby vegetation that has encroached markedly along the east-southeast shoreline and substantial bands of emergent vegetation in the lake. This plan proposes six restoration steps to improve the fisheries habitat, restore the shoreline, and facilitate navigation. These steps and their associated budgets are shown in priority order in Table E-1.

Because the sediment accumulation is a result of in-lake processes, all of the restoration steps involve a substantial element of sediment removal. Complete implementation of these restoration steps will restore historic spawning areas, remove areas of dense emergent vegetation thus increasing submersed plant development and restoring the lake's shoreline, and create submersed and emergent vegetative zones in woody-shrubby areas. Total implementation of the plan will cost approximately $26 million.

In addition to the restoration steps, the SWIM Plan identifies several priority projects that are necessary to help manage the restoration projects in a cost-effective and environmentally sensitive manner and to evaluate the effects of the restoration projects on fisheries habitat. These include bottom contour/sediment (bathymetric) and vegetative mapping, a fish population study and fish food survey and water quality monitoring.

Without any action, the sedimentation, or "filling in", of Lake Panasoffkee will continue — the fisheries habitats will continue to be reduced, the lake will continue to get smaller, navigability problems will worsen, and the lake's environmental, aesthetic and economic benefits to the State and its residents will diminish. As the magnitude of the damage increases, so will the costs for restoring the lake.

Table E-1. Restoration steps in priority order showing acreages, sediment volumes, and associated costs.

RESTORATION STEPS	Area Acres	% Lake Area	Sediment Volume (Cu. Yds.)	Dredging Costs	Disposal Site Prep	Disposal Area Costs	Engineering Costs	Harvesting & Other Costs	Total Project Costs
Step 1 - Coleman Landing Pilot Project			140,000	$277,600	$50,000		$22,400		$350,000
Step Two - Dredging to Hard Bottom	1010	30%	4,888,889	$4,988,889	$833,383	$270,000	$150,000		$6,242,272
Step Three -East Side Emergent Removal	784	23%	3,229,166	$3,329,166	$548,835	$270,000	$150,000	$291,000	$4,589,001
Step Four - Canals	34	0.30%	162,000						$0
Step Five - Woody/Shrubby	781	22%	1,231,481	$1,331,481	$403,326	$202,500	$150,000	$7,810,000	$9,897,307
Step Six - Dredge to 34' Contour*	2716	78%	3,600,000	$3,700,000	$598,344	$270,000	$150,000		$4,718,344
Totals				$13,627,136	$2,433,888	$1,012,500	$622,400	$8,101,000	$25,796,924

* Although dredging from the 34' contour would involve removal of 11.5 million cubic yards of sediment, considerable amounts of sediment are removed in Steps Two and Three

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 Fish and Wildlife Conservation Commission (FWCC, formerly known as 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. Lake Panasoffkee was ranked as the fifth priority water body for the Southwest Florida Water Management District (District).

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 State SWIM funds can be spent on restoration, protection or management activities. The purpose of the Lake Panasoffkee SWIM Plan is to set forth a realistic course of action, identifying the projects and the effort needed to accomplish them, consistent with the levels and trends of SWIM funding. The law also requires that the plans must be updated at a minimum once every three years. The evolution of the SWIM Plans for Lake Panasoffkee is discussed in the following section.

Lake Panasoffkee Swim Plan Evolution

The original Lake Panasoffkee SWIM Plan, approved in 1989, was based on preservation strategies and focused on diagnostic studies regarding water quality, sediment accumulation, vegetation, wildlife and fisheries. However, during implementation of this Plan, a broader set of issues began drawing attention.

A revision scheduled for 1993 was deferred with the formation of the Withlacoochee River Work Group to allow time for the work group to study watershed issues, such as raising lake levels, improving fisheries and enhancing recreational and aesthetic uses of the lake. The Work Group final report was completed in 1994 and included options for raising lake levels. Additionally, in 1996, the FDEP initiated the Withlacoochee River Ecosystem Management Area to address watershed issues including lake levels.

During this time, SWIM diagnostic studies, delayed due to State funding limitations, were completed. The final diagnostic study (Water and Nutrient Budget Study) was completed in

1995. The diagnostic studies provided evidence that the aesthetic and recreational value of the lake has declined and that sediments and aquatic vegetation have resulted in a decline in fisheries.

Lake Panasoffkee Restoration Council - During the 1998 Florida Legislative Session, Chapter 98-69, Laws of Florida was passed creating the Lake Panasoffkee Restoration Council within the District. Representation on the Council was to include lakefront property owners, an environmental engineer, a biologist, an attorney, an engineer and a representative of the sport fishing industry. The Act also established an Advisory Group to the Council, to be staffed with one representative each from the District, FDEP, FWCC, the Florida Department of Transportation (FDOT) and the United States Army Corps of Engineers (USACOE).

The Council was specifically charged with the following responsibilities:

1. **Restoration Issues:** Review audits and all data specifically related to lake restoration techniques and sport fish population recovery strategies, including data strategies for shoreline restoration, sediment control and removal, exotic species management, floating tussock management or removal, navigation, water quality, and fisheries' habitat improvement, particularly as they may apply to Lake Panasoffkee;

2. **Evaluate Existing Studies:** Evaluate whether additional studies are needed;

3. **Funding:** Explore all possible sources of funding to conduct the restoration activities;

4. **Recommendations:** Advise the governing board of the District regarding the best approach to restoring Lake Panasoffkee, and make recommendations as to which techniques should be part of the restoration program (the Governing Board of the District shall respond in writing to the Council if any recommendations from the Council require re-evaluation. The response shall detail reasons for re-evaluation.); and

5. **Report to Legislature:** Report to the Legislature before November 25 of each year on the progress of the Lake Panasoffkee Restoration Plan and any recommendations for the next fiscal year.

LAKE PANASOFFKEE MANAGEMENT ISSUES

The Council considered the seven issues identified in the enacting legislation, 1) shoreline restoration, 2) sediment control and removal, 3) exotic species management, 4) tussock management and removal, 5) navigation, 6) water quality and 7) fisheries' habitat improvements. After consideration of these issues, the Council concluded that the primary issues in priority order are: 1) fisheries' habitat improvement; 2) shoreline restoration; and 3) navigation. Maintaining the overall good water quality within the lake and opportunities for cleaning up existing sources of pollution to the lake are high priorities of the Council and are a consideration in all recommendations. (Concerns have been raised regarding the pollution potential of untreated stormwater draining from approximately two miles of Interstate Highway 75 that crosses Shady Brook at the south end of the lake. This issue is addressed in this revision of the SWIM Plan.)

The Council determined that the remaining three issues, sediment control and removal, exotic species management and tussock control and removal were management strategies rather than issues. The Council concluded that the primary cause of the adverse impacts on the water resources of the lake was due to the accumulation of sediment causing a reduction in fisheries habitat, shoreline degradation and impediments to navigation.

In preparing the SWIM Plan, staff reviewed the *Lake Panasoffkee Restoration Council, Report to the Legislature, November 25, 1998*, and the diagnostic studies completed since the original SWIM Plan. Based on this review, the following management issues were selected as the main focus of the Lake Panasoffkee SWIM Plan:

Fisheries Habitat Improvement: Sport fishing is the primary recreational use of Lake Panasoffkee. It was recognized nationally as one of Florida's most productive fishing lakes for redear sunfish and it also supported a good blue gill and bass fishery. The FWCC has studied Lake Panasoffkee's fishery resource since the 1950s (Moody 1955, 1957), and the lake was designated a Florida Fish Management Area in 1963. This designation has ensured periodic creel census surveys by the FWCC. Declines in fish populations have been reported as early as the 1950s. Comparison of creel survey data from the 1974/1977 survey to the 1991/1992 survey showed a decline in the harvest estimates for largemouth bass, redear sunfish, and blue gill. Recently, the FWCC stated that an elimination of fish beds has occurred due to sediment accumulation and vegetative encroachment.

Shoreline Restoration: Accumulated sediment has silted in hard bottom areas which served as fish bedding areas, and in other areas emergent vegetation has become extremely dense as a result of shallowing. Additionally, the encroachment of vegetation has progressed to such an extent that almost 800 acres of historic lake bottom are now covered with a mix of woody/shrubby vegetation. This degradation of the lake shoreline is of concern due to the loss of open water and littoral habitats, both necessary for fish habitat, and the impediments it poses to navigation and access.

Navigation: Currently, the only no-fee public boat access directly on the lake is on the eastern shore at Coleman Landing. However, due to sediment accumulation and encroaching

submerged and emergent vegetation, the boat ramp and access channel are not navigable and it is not used by the public or agencies responsible for managing the lake. Tussocks, floating islands of marsh plants, are another impediment to navigation. Tussocks are formed when emergent rooted aquatic plants (such as cattails, pickerel weed and arrowhead) break free and form free floating islands. These plant islands can impede navigation and access to the shoreline if they accumulate along the shoreline due to wind and wave action.

Pollutant Load Reduction Goal (PLRG): The FDEP requires that a PLRG be developed for each SWIM water body. A "Pollutant Load Reduction Goal - 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, Florida Administrative Code)." To develop a PLRG it is first necessary to develop a goal for the waterbody. With respect to water quality, one method for setting a pollutant load reduction goal is referencing historic water quality and framing the goal in terms of returning water quality to a more pristine or undisturbed condition. A problem with this approach is that reliable pre-disturbance water quality data are often lacking. However, paleolimnological analyses may be used to reconstruct pre-disturbance water quality based on evaluation of the remains of microscopic flora and fauna (phytoplankton, zooplankton and benthic macroinvertebrates) found in sediment cores.

Paleolimnological analysis was performed based on diatom identifications and Trophic State Index (TSI) reconstruction techniques. Based on analysis of sediment cores, it was concluded that very few changes have taken place in and around the lake since 1855 (Belanger 1993). In fact, analysis suggests that the trophic state of the lake was once eutrophic during this period and had moved toward a more mesotrophic state since about 1970.

Trophic state, a measure of the degree of nutrient enrichment, is frequently used to classify lakes. A TSI can be calculated on the basis of chlorophyll a concentration, Secchi disk transparency, or limiting nutrient concentrations. Trophic state evaluations of Lake Panasoffkee indicate that the lake is nutrient balanced, meaning the lake will respond to increases in either nitrogen or phosphorus.

Water quality data collected by CH2MHill (1995) indicates that the TSI for the lake is 47, which places it in a mesotrophic category. This value is essentially the same as that calculated by Bays and Crisman (1981), 46, and from the USGS data taken from 1977 to 1990, 45.

Paleolimnological research, the fact that Lake Panasoffkee currently meets Class III Water Quality Standards and the apparently steady TSI value support a proposed PLRG of "zero" for nutrients. A PLRG of "zero" indicates no apparent need for corrective measures to decrease nutrient loading to the system. It should be noted that a PLRG is an overall system target and does not preclude the implementation of management strategies to maintain existing water quality. On the contrary, where opportunities exist to enhance or protect existing water quality they should be implemented.

LAKE PANASOFFKEE SWIM PLAN GOALS

The goals of the Lake Panasoffkee SWIM Plan focus on issues identified by the Council, including fisheries habitat improvement, shoreline restoration and navigation. In addition to these issues, the District has included the FDEP required pollutant load reduction goal.

- Restore public access and navigation by completion of the Coleman Landing Pilot Project (Step 1) which will create a navigable channel from the boat ramp into the lake (approximately 24 acres).

- Restore fisheries habitat, historic shoreline conditions and navigation along the eastern and western shores (Steps 2 and 3, total approximately 1,800 acres)

- Provide an opportunity for canal residents to contract independently with the dredge contractor responsible for implementing Step 2 and allow for dredged material to be disposed of on the site used for Step 2 at no cost to residents (Step 4, 37 canals, total approximately 34 acres).

- Restore fisheries habitat, historic shoreline conditions and navigation along the eastern shore of the lake by the removal of sediments and emergent woody/shrubby vegetation that has encroached into the lake bed (Step 5, total approximately 780 acres).

- Improve navigation and deepen the lake by removing sediment from the 34-foot contour shoreward (Step 6, total approximately 2,700 acres)

- Improve existing information available for fisheries' management to evaluate success of fisheries habitat and shoreline restoration projects.

- Based on paleolimnological evidence and existing water quality data, and considering the minimal hydrologic alteration in the watershed, the PLRG has been set at "zero" for nutrients.

- Maintain or improve existing water quality as measured by a TSI of 50 or less.

- Maintain 60 percent coverage of desirable submersed aquatic plants.

MANAGEMENT STRATEGIES

The management strategies for restoring and protecting Lake Panasoffkee are based on the recommendations included in the *Lake Panasoffkee Restoration Council, Report to the Legislature, November 25, 1998.* Staff from the District, the FWCC and the FDEP, through their involvement on the Advisory Group played a significant role in developing the report. These agencies will continue to play a significant role in implementing the management strategies described herein.

Management for Fisheries Habitat, Shoreline Improvement and Navigation

The primary cause of declining fisheries habitat, degradation of the shoreline and impediments to navigation has been identified as sediment accumulation followed by encroachment of emergent vegetation. This sediment accumulation has not been caused by increased erosion and runoff in the watershed. Rather, in-lake processes have resulted in the build-up of mostly inorganic sediments. The lake receives large quantities of groundwater, which contributes to the overall good water quality. However, this groundwater carries large amounts of dissolved calcium carbonate. When the groundwater mixes with the lake water, the calcium carbonate solidifies, producing sediments which settle on the lake bottom.

Due to in-lake sediment accumulation being the primary cause of the resource issues for the lake, removal of sediments and emergent vegetation is the key management strategy for restoring the lake. A six-step dredging project has been identified as the priority project to implement this strategy. A summary of the steps for this project is provided in the table below, and each step is described in detail in the Priority Projects Section of this Plan.

The estimates in the table are based on existing data and studies that were not designed with the intention of estimating the information necessary to design a large scale dredging project. Therefore, one of the tasks to implement this strategy is the development of an accurate bathymetric map. It will be necessary to know the depth of sediment overlying hard bottom and to have this information collected at more frequent intervals than was previously collected. Other tasks to implement this strategy include design, acquisition and construction of spoil disposal and containment areas and the dredging or removal of sediments from the lake bottom.

Table 1. Restoration steps in priority order showing acreages, sediment volumes, and associated costs.

RESTORATION STEPS	Area Acres	% Lake Area	Sediment Volume (Cu. Yds.)	Dredging Costs	Disposal Site Prep	Disposal Area Costs	Engineering Costs	Harvesting & Other Costs	Total Project Costs
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Totals				$13,627,136	$2,433,888	$1,012,500	$622,400	$8,101,000	$25,796,924

* Although dredging from the 34' contour would involve removal of 11.5 million cubic yards of sediment, considerable amounts of sediment are removed in Steps Two and Three.

Management for Maintenance of Aquatic Plant Coverage

Lake Panasoffkee is a plant dominated lake, rather than a phytoplankton dominated lake. This coupled with groundwater as a major source of inflow to the lake gives Lake Panasoffkee its good water quality, especially in terms of clarity. Submersed vegetation in the lake has historically been dominated by eelgrass (*Vallisneria americana*), with smaller areas of coontail (*Ceratophyllum demersum),* southern naiad (*Najas guadalupensis*), parrot feather (*Myriophyllum aquaticum*) and pondweed (*Potamogeton illinoensis*).

Workers at the University of Florida have demonstrated that lakes with 50-60 percent coverages of aquatic plants tend to be clear lakes. Reducing aquatic plant coverage below this threshold may shift the lake to a phytoplankton dominated system. Therefore, especially during the dredging of the lake, it is imperative that vegetation maps are available to monitor plant coverages throughout the lake. This information can also be used to evaluate increases or decreases in areal coverage of undesirable aquatic plants such as hydrilla.

Management of Existing Water Quality

Water quality in Lake Panasoffkee is considered good due primarily to a large groundwater contribution, dense stands of aquatic plants and the predominantly rural character of the watershed. However, groundwater in the region is vulnerable to the transmission of contaminants due to the lack of confinement of the aquifer and surface water systems can collect and convey non-point source pollutants. Fortunately, the District's recent purchase of more than 9,000 acres on the eastern shore of Lake Panasoffkee protects 25 percent of the basin from development which will also protect water quality. To ensure that water quality is protected, routine monitoring should be implemented to provide an early warning of deteriorating water quality conditions.

Management of Fisheries and Evaluation of Restoration on Fish Populations

Fish Food Survey: Macroinvertebrate Diversity, Abundance and Distribution - The Council's Advisory Group noted what appears to be a scarcity of macroinvertebrates (a group of animals without backbones that includes snails, clams and aquatic insects and worms) in lake sediments and on much of the submersed vegetation. It is possible that macroinvertebrate abundance should be low given the generally inorganic nature of the sediments and the fact that submersed vegetation is typically encrusted or covered with precipitated calcium carbonate. However, the lake is known or was known to produce a quality redear sunfish fishery. Redear sunfish are specially adapted to feeding on snails and mussels. It is also known that extensive deposits of unbroken snail shells can be found in certain areas of the lake and, in fact, serve as bedding areas for these sunfish. The occurrence of these snail shell deposits and the fact that these shells are unbroken are evidence that snail production was high in Lake Panasoffkee. Only cursory examinations have been made of the lake's macroinvertebrates; there is a need to quantify the abundance, diversity and distribution of macroinvertebrates in the lake since macroinvertebrates are a significant source of food for fish.

Fish Community Survey: Analysis of Fish Community Structure - Although creel censuses have been conducted on the lake a number of times, such data does not give complete insight into fish populations in the lake, especially non-game species. Electrofishing does provide additional information; however, other techniques could provide more complete information relative to fish abundance (such as number of fish per surface acre). Unfortunately techniques such as block netting are not often nor routinely applied due to the considerable man power and other resources required. Given that much of the restoration effort is directed at fish habitat improvement and given the economic resources requested, it will be incumbent upon the agencies involved to demonstrate the expected improvement in the lake's sport fishery and overall fish community structure that result from the proposed restoration activities. It is expected that such data would include not only standing crop estimates (e.g., pounds per acre), but data on the age structure.

Linkage to Other Water Resource Management Activities

In addition to the projects that are initiated by 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 Panasoffkee, one of the more prominent lakes within the District.

The SWFWMD's Water Management Plan - As required in Chapter 373, Florida Statutes, the District prepared its Water Management Plan (DWMP). 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 has policies that relate to the restoration, protection and management of Lake Panasoffkee

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. Wetlands 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 for impacts includes as a minimum, type-for-type mitigation at a one-to-one ratio. Other types of compensation may be required, 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 program (MFL). Maintaining minimum flows and levels is a significant statutory charge for Florida's water management districts. SWFWMD 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. Lake Panasoffkee is included in the 2002 to 2005 planning horizon for development of Minimum Levels.

Mitigation Banking - Mitigation banking allows developers to compensate for wetland losses in one place by preserving, restoring or creating wetlands in another to achieve a no net loss of wetlands. The rule allows mitigation banking in some instances, although it remains a controversial issue. The SWFWMD coordinates with the Florida Department of Transportation to take advantage of mitigation bank opportunities on District lands and within SWIM water body projects.

Land Acquisition - Land acquisition at the District is currently 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 will "sunset." Funds for land acquisition and management will be available through Save our Rivers 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 programs target 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 values endangered by development activities. The District owns more than 200,000 acres, the majority of which were purchased through the SOR and P2000 programs. Many recent purchases have been a joint acquisition between the District and a local government 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 might 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 Lake Panasoffkee's ecosystem that should be acquired for preservation or for restoration. The District has acquired 9,550 acres, known as the Lake Panasoffkee Property, which encompass the entire eastern shoreline of Lake Panasoffkee. The channels of the three primary surface water sources to the lake, Big Jones and Little Jones creeks and Shady Brook, are located wholly or largely within the Lake Panasoffkee property.

Implementation of the restoration plan for Lake Panasoffkee involves a substantial amount of sediment removal. Sediment disposal requires land for settling ponds and other activities. The District's SWIM Section will be coordinating with our Land Resources Department to obtain the lands necessary to accomplish the restoration project.

Basin Board Activities - The basin boards of the SWFWMD 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 level that intergovernmental water resource programs are implemented, monitored and evaluated for improvement. The basin boards provide a means of obtaining feedback from local governments and citizens. Basin boards also serve 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 decides to provide the impetus for a water management solution, with or without

a local partner. Many of the basin boards 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.

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, both in terms of statewide program development, and support for the Withlacoochee River Ecosystem Management Area Project. The project is one of six throughout the State intended to illustrate how this concept can provide for a comprehensive, holistic linking of environmental protection at many governmental (and private) levels. 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.

The 1999 FDOT Mitigation Plan developed for the SWFWMD proposes using a portion of the Lake Panasoffkee Restoration to mitigate impacts as a result of the FDOT's widening of the existing I-75 bridge that crosses along the southeastern portion of Lake Panasoffkee. Based on the approved mitigation plan, approximately two (2) acres of impacts have been identified. Although the impacted acreage may change during actually permitting of transportation project.

Local Government Coordination and Partnering - The District has prepared county level Integrated Plans for the local governments within its jurisdiction as part of the District's Water Management Plan. 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 also 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 resources of the District. The development of Integrated Plans is a cooperative effort of the District, local governments and citizens and is best viewed as a process. The process is intended to promote continuing relations and mutual planning in the best interest of the resource. It is hoped that the action strategies identified will be added to the local government plan where local and District energies and funding can be directed toward them.

The current version of the Sumter County Comprehensive Plan acknowledges the Outstanding Florida Water status of Lake Panasoffkee and identifies general policies related to coordination to protect and enhance the resource. The County is currently working on amendments to the plan as a result of the Evaluation and Appraisal Report. These amendments contain more specific policies related to the restoration of Lake Panasoffkee and are consistent with the restoration goals of the Lake Panasoffkee SWIM Plan and the Lake Panasoffkee Restoration Council, Report to the Legislature, November 25, 1998. For more information, the reader is referred to the Sumter County Planning Department.

PRIORITY PROJECTS

The priority projects for Lake Panasoffkee focus on preservation of existing water quality, fisheries habitat and shoreline restoration and improvements to navigation. The following project summaries identify the current status of active and proposed restoration projects, describe the additional studies and data needs required to manage the lake, and provide project timelines and estimated budgets for implementation.

Project Title: Step One - Coleman Landing Pilot Project

Summary:

By the mid 1970s boater use of the boat ramp at Coleman Landing had dwindled to zero. Low water levels, sedimentation and tussock growth made boat launching and passage impossible. Prior to the establishment of the Council, the FWCC submitted to FDEP, by transmittal letter dated July 9, 1998, a *Joint Application for a Dredge and Fill Project at Coleman Landing.* The goal of the Coleman Landing Boater Access Improvement Project will be to provide boaters and anglers public access.

This effort will also serve as a pilot project to provide answers for questions likely to be raised if more extensive dredging activities are to be permitted. The project will provide valuable information regarding recolonization of dredged areas by desirable submersed vegetation (e.g., eelgrass) and use of such areas by fish and macroinvertebrates. This information will be necessary to offer "reasonable assurances" regarding the likelihood of natural revegetation when dredging in currently vegetated zones. Issues regarding handling, compaction and dewatering of dredged material could be addressed by the project, and questions regarding water quality changes likely to occur in dredged areas and sloughing of dredged material could be answered.

Annual Budget Estimates:

	FY 1999	FY 2000	FY 2001	FY 2002
Salaries	$5,000	$5,000		
Contracts	$175,000	$175,000		
Expenses	$2,000	$2,000		
Total	$182,000	$182,000		

Agency or Local Government Partnering:

Through the formation of the Lake Panasoffkee Restoration Council within the District, the District has been assisting the FWCC with implementation of this project. It is expected that this cooperation will continue through the completion of this project.

Project Title: Step Two - Dredge to Hard Bottom from the 35-foot Contour

Summary:

The prime historic fish bedding areas in Lake Panasoffkee are known to have existed in areas around Grassy Point and Shell Point located on the lakes northeast side (Figure 1). Extensive deposits of snail shells occur throughout this area, and sport fish, particularly redear ("shell cracker") and other sunfish ("bream") are known to have spawned there. Hard bottom can be reached with the least sediment removal in the Grassy/Shell Point areas and in a narrow band bordering much of the western shoreline. It is documented that in areas where accumulated sediment deposits are five feet or less, the lakeward most edge of the area could be fairly well defined by the 35-foot contour. For this reason, it is proposed that many historical bedding areas could be restored by dredging in two areas from the 35-foot contour towards shore while removing sufficient material to expose the hard bottom (e.g., shell deposits, sand, etc.). It was also recognized that there are substantial sediment deposits (i.e., greater than 20 feet deep) in the north end of the lake, that two major inflows, Little Jones and Big Jones creeks, enter the lake in this area, and that it is highly likely that sediments in this area would be carried into the two cleared spawning zones if not lowered to the 35-foot contour as well. For this reason, it is recommended that sediments in this area be dredged even though hard bottom would not be reached. It should be noted that very little submersed vegetation occurs in the north end of the lake, that fish usage appears low perhaps due to lack of cover, and that there is probably more organic sediment deposited here than in most areas of the lake.

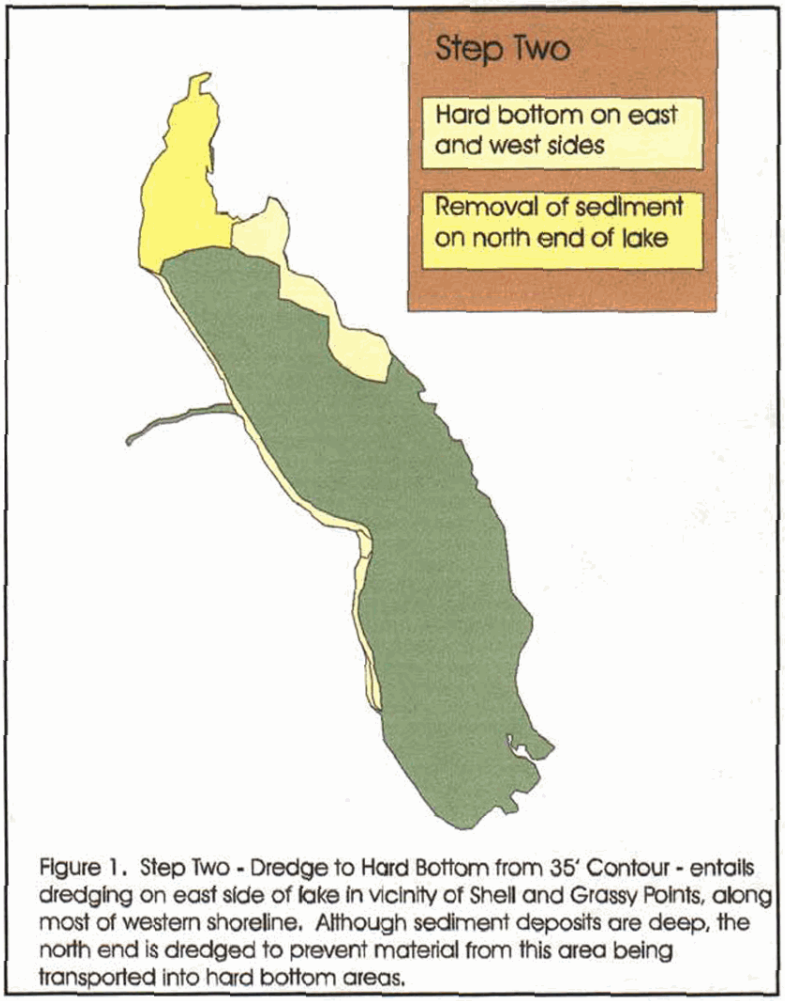


Figure 1. Step Two - Dredge to Hard Bottom from 35' Contour - entails dredging on east side of lake in vicinity of Shell and Grassy Points, along most of western shoreline. Although sediment deposits are deep, the north end is dredged to prevent material from this area being transported into hard bottom areas.

To accomplish Step Two, it is estimated that as much as 4.9 million cubic yards of sediment will have to be removed and that approximately 900 acres (30 percent) of the lake bottom will be affected. The actual cubic yards of material to be removed should be less; however, the actual depth of sediment covering hard bottom is not accurately known. More accurate estimates can be made once a detailed bathymetric map is made.

Annual Budget Estimates:

	FY 1999	FY 2000	FY 2001	FY 2002
Salaries		$5,000	$5,000	$5,000
Contracts		$2,081,000	$2,081,000	$2,081,000
Expenses		$42,000	$42,000	$42,000
Total		$2,128,000	$2,128,000	$2,128,000

Agency or Local Government Partnering:
Due to the estimated cost of this project, the District will seek funding from a variety of state and federal sources, including the FDOT mitigation banking program. Permitting will be coordinated with the USACOE and the FDEP.

Project Title: Step Three - East Side Emergent Removal - Tied to the 35-foot Contour

Summary:
There is a broad band of emergent vegetation along the eastern shoreline of Lake Panasoffkee that runs from just south of Shell Point to the southern end of the lake (Figure 2). This band of emergent vegetation is composed largely of pickerelweed, cattail and arrowhead. Although much of the vegetation is rooted to the lake bottom, a substantial amount could be classified as tussocks and much of the tussock problem on the lake is generated by this band of vegetation. The band is more than 1,000 feet wide in some sections, and is so dense and impenetrable that much of it does not provide productive fish habitat. Removal of this vegetation would improve fish habitat, restore much of the eastern shoreline and improve navigation. Dredging to a depth of two to three feet will open the area to fish and encourage the growth of submersed vegetation while discouraging emergents. It is proposed that sediment be dredged from the 35-foot contour toward the shore, and the area be sloped or stepped so that a narrow emergent zone is preserved. The entire project area is almost 800 acres, and this step would remove upwards

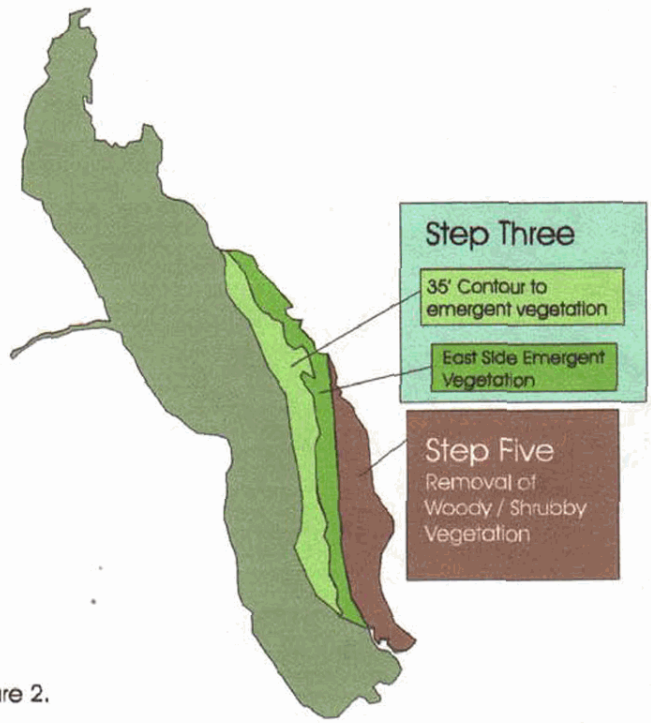


Figure 2.

Step Three - Removal of East side emergent vegetation and sediments from the 35' Contour.

Step Five - Removal of woody/shrubby vegetation and associated sediments.

of 3.2 million cubic yards of sediment and open up approximately 388 acres for possible colonization by submersed plants.

It should be noted that land bordering the entire eastern shoreline of Lake Panasoffkee is in public ownership, and the proposed dredging will enhance public access to the lake's resources. Defined as the East Lake Panasoffkee property, approximately 9,950 acres were purchased through the Save Our Rivers program. The majority of the property consists of flood plain swamp, and most of the property remains in a relatively natural, unaltered condition. Public ownership of the property will contribute directly to the long-term protection and management of the lake (SWFWMD 1996).

Annual Budget Estimates:

	FY 1999	FY 2000	FY 2001	FY 2002
Salaries		$5,000	$5,000	$5,000
Contracts		$1,530,000	$1,530,000	$1,530,000
Expenses		$2,000	$2,000	$2,000
Total		$1,537,000	$1,537,000	$1,537,000

Agency or Local Government Partnering:
Due to the estimated cost of this project, the District will seek funding from a variety of state and federal sources, including the FDOT mitigation banking program. Permitting will be coordinated with the USACOE and the FDEP.

Project Title: Step Four - Canals

Summary:
The Council recognizes that should Step Two be implemented, dredging will occur in close proximity to the many existing residential canals on the lake's western shoreline. In trying to provide navigation from the canals to the lake, and realizing that dredging can be costly and that a substantial portion of the costs can be associated with sediment disposal and mobilization of equipment, the Council proposes to make project disposal areas available to residents at no cost should they choose to retain the services of the dredge. There are 37 residential canals on Lake Panasoffkee with a total surface area of about 34 acres. Assuming maintenance dredging would require removal of approximately three feet of sediment depth from each canal, it is estimated that there are 160,000 cubic yards of sediment in these canals. This represents a minimal capacity in any disposal site prepared to handle material for Step Two. Any group living on a residential canal that would be willing to independently fund dredging in their canal and retain the services of the dredger could take advantage of the project disposal area and equipment in place (e.g., piping) provided that project implementation is not unreasonable.

Annual Budget Estimates:

	FY 1999	FY 2000	FY 2001	FY 2002
Salaries		$2,000	$2,000	$2,000
Contracts				
Expenses		$1,000	$1,000	$1,000
Total		$3,000	$3,000	$3,000

Agency or Local Government Partnering:
The District will cooperate with Sumter County to assist with implementation on this project. The project will require that the citizens take the lead for their respective canals. Coordination between the various permitting agencies will also be required.

Project Title: Step Five - Woody/ Shrubby Vegetation Encroachment

Summary:
Inspection of aerial photography of Lake Panasoffkee clearly indicates a historic shoreline on the lake's east side that roughly coincides with the 40-foot contour; however, it has been documented that the area between the 40- and 38.5-foot contours has been taken over by extensive stands of primrose willow, willow, button bush and other successional species. It is currently estimated that approximately 780 acres of lake area (refer to Figure 2) have been lost by this encroachment; valuable lake habitat has yielded to fairly rapid succession. Reclamation of this area would increase the surface area of the lake by 22 percent. Given current regulations regarding wetlands and the Outstanding Florida Waterbody status of Lake Panasoffkee, reclamation of this area will present some challenges. The cost associated with dredging and disposal is high and the Council is continuing to explore different restoration options including in-lake disposal and creation of in-lake "habitat islands."

Annual Budget Estimates:

	FY 1999	FY 2000	FY 2001	FY 2002
Salaries		$5,000	$5,000	$5,000
Contracts		$3,300,000	$3,300,000	$3,300,000
Expenses		$2,000	$2,000	$2,000
Total		$3,307,000	$3,307,000	$3,307,000

Agency or Local Government Partnering:
Due to the estimated cost of this project, the District will seek funding from a variety of state and federal sources, including the FDOT mitigation banking program. Permitting will be coordinated with the USACOE and the FDEP.

Project Title: Step Six - Dredging from 34-foot Contour

Summary:

Dredging of the lake bottom from the 34-foot contour shoreward would deepen approximately 78% of the lake by another foot and essentially prolong the life of Lake Panasoffkee by at least 100 years (Figure 3). It should be appreciated that this option would affect most of the lake bottom and a considerable amount of submersed vegetation. Implementation of this step would remove at least 4,000,000 cubic yards of sediment in addition to that proposed in Step Two and Step Three. A demonstrated ability of desirable submersed plants to adequately recolonize dredged zones is a prerequisite for implementation of this step.

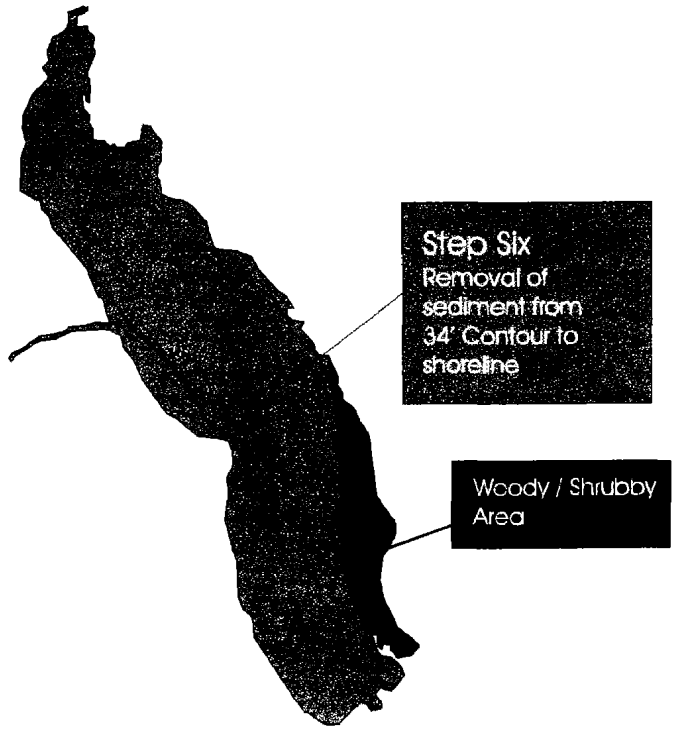


Figure 3. Step Six - Removal of sediment from 34' contour to shoreline (38.5' contour), does not include woody / shrubby area.

Annual Budget Estimates:

	FY 1999	FY 2000	FY 2001	FY 2002
Salaries		$5,000	$5,000	$5,000
Contracts		$1,573,000	$1,573,000	$1,573,000
Expenses		$2,000	$2,000	$2,000
Total		$1,580,000	$1,580,000	$1,580,000

Agency or Local Government Partnering:

Due to the estimated cost of this project, the District will seek funding from a variety of state and federal sources, including the FDOT mitigation banking program. Permitting will be coordinated with the USACOE and the FDEP.

Project Title: Bathymetric Mapping

Summary:

To make accurate estimates of the amount of material to be removed, an updated bathymetric map (i.e., contour map of the lake bottom) of the lake is needed. Estimates of sediment volumes used to compute dredging and other costs presented in the *Lake Panasoffkee Restoration Council Report, November 25, 1998* were based on a bathymetric map prepared by Greiner (1978). Their map was developed using data collected in 1955 and spot checked with soundings made in 1973. The lake's bottom contours have changed due to the accumulation of sediment that has occurred during the nearly twenty-five years that have elapsed since the bathymetric map was made. Although sediments accumulate at a relatively low rate in Lake Panasoffkee, neither the map prepared by Greiner (1978) nor the sediment thickness map prepared by Belanger et al. (1993) were constructed with sediment dredging in mind. Although sufficient for estimation purposes, bidding and budgeting of projects requiring sediment removal will require more accurate estimates of the volumes of sediment involved. It will also be necessary to know the depth of sediment overlying hard bottom. While this type of information was gathered by Belanger et al. (1993), coverage is not as detailed as needed, particularly for work proposed in Step Two.

Annual Budget Estimates:

	FY 1999	FY 2000	FY 2001	FY 2002
Salaries	$5,000			
Contracts	$25,000			
Expenses				
Total	$30,000			

Agency or Local Government Partnering:

See Step 2 under priority projects. This project will be rolled into the work performed for the design of the Step 2 project.

Project Title: Vegetative Mapping

Summary:

Lake Panasoffkee is a lake dominated by aquatic vegetation with the dominant submersed plants a mix of eelgrass, coontail and pondweed. Submersed plants cover 70-80 percent of the lake and extend upward in the water column often to the surface. While dense submersed plant populations can pose a navigation problem, particularly under low water level conditions, these plant beds maintain the generally good water clarity and quality characteristic of Lake Panasoffkee. It was recognized by the agencies represented on the Council's Advisory Group and acknowledged by the Council that maintenance of desirable submersed vegetation is important for sustaining the ecological health and character of Lake Panasoffkee, and that dredging and other restoration techniques that might be employed should not cause submersed plant coverage to go below 60 percent. To insure that adequate submersed plant

coverage is maintained an accurate vegetative map of the lake needs to be constructed so that equally accurate estimates can be made of areas likely to be impacted by dredging or other activities. In addition, revegetation will need to be monitored since expansion of restoration activities into vegetated areas can occur while maintaining a minimum desirable coverage (60 percent or greater).

Annual Budget Estimates:

	FY 1999	FY 2000	FY 2001	FY 2002
Salaries	$5,000	$5,000	$5,000	$5,000
Contracts	$25,000	$5,000	$5,000	$5,000
Expenses				
Total	$30,000	$10,000	$10,000	$10,000

Agency or Local Government Partnering:
See Step 2 under priority projects. This project will be rolled into the work performed for the design of the Step 2 project.

Project Title: Acquisition of Spoil Disposal and Containment Areas

Summary:
Implementation of the dredging project for Lake Panasoffkee will require the containment, possible treatment and ultimate disposal of the dredged sediment. Therefore, one of the first tasks will be to determine the size of the upland containment areas. Upon identification of the size of the area(s) needed, parcels suitable for this purpose will be identified for acquisition and the acquisition process will be initiated.

Annual Budget Estimates:

	FY 1999	FY 2000	FY 2001	FY 2002
Salaries				
Contracts				
Expenses		TBD	TBD	
Total				

*TBD - To be determined - Acquisition of lands for this task will include costs for the land as well as costs for appraisals, title work and other requirements of the acquisition process.

Agency or Local Government Partnering:
No agency or local government partnering is anticipated.

Project Title: **Fish Food Survey - Macroinvertebrate Diversity, Abundance and Distribution**

Summary:
The Council's Advisory Group noted what appears to be a scarcity of macroinvertebrates (a group of animals without backbones that includes snails, clams and aquatic insects and worms) in lake sediments and on much of the submersed vegetation. It is possible that macroinvertebrate abundance should be low given the generally inorganic nature of the sediments and the fact that submersed vegetation is typically encrusted or covered with precipitated calcium carbonate. However, the lake is known or was known to produce a quality redear sunfish fishery. Redear sunfish are specially adapted to feeding on snails and mussels. It is also known that extensive deposits of unbroken snail shells can be found in certain areas of the lake and, in fact, serve as bedding areas for these sunfish. The occurrence of these snail shell deposits and the fact that these shells are unbroken are evidence that snail production was high in Lake Panasoffkee. Only cursory examinations have been made of the lake's macroinvertebrates; there is a need to quantify the abundance, diversity and distribution of macroinvertebrates in the lake since macroinvertebrates are a significant source of food for fish.

Annual Budget Estimates:

	FY 1999	FY 2000	FY 2001	FY 2002
Salaries		$2,500	$2,500	$2,500
Contracts		$67,000	$50,000	$50,000
Expenses		$1,000	$1,000	$1,000
Total		$70,500	$53,500	$53,500

Agency or Local Government Partnering:
The District intends to contract with the FWCC and/or the University of Florida to conduct this study.

Project Title: **Fish Community Survey - Analysis of Fish Community Structure**

Summary:
Although creel censuses have been conducted on the lake a number of times (a creel census is currently ongoing), such data does not give complete insight into fish populations in the lake, especially non-game species. Electrofishing does provide additional information; however, other techniques could provide more complete information relative to fish abundance (such as number of fish per surface acre). Unfortunately techniques such as block netting are not often nor routinely applied due to the considerable man power and other resources required. Given that much of the restoration effort is directed at fish habitat improvement and given the economic resources requested, it will be incumbent upon the agencies involved to demonstrate the expected improvement in the lake's sport fishery and overall fish community structure that result from the proposed restoration activities. It is expected that such data

would include not only standing crop estimates (e.g., pounds per acre), but data on the age structure.

Annual Budget Estimates:

	FY 1999	FY 2000	FY 2001	FY 2002
Salaries		$2,500	$2,500	$2,500
Contracts		$40,000	$40,000	$40,000
Expenses		$1,000	$1,000	$1,000
Total		$43,500	$43,500	$43,500

Agency or Local Government Partnering:
The FWCC has begun some work to document fish populations in the Lake through creel surveys. It is the intent of the District to contract with the FWCC to conduct more extensive fisheries population studies.

Project Title: Water and Sediment Quality Monitoring

Summary:
Water quality of Lake Panasoffkee is considered good; this is attributed largely to dense stands of desirable aquatic plants and a large groundwater contribution. However, there is evidence of groundwater quality degradation, especially with respect to nutrients, and there are potential surface water quality impacts that may need further investigation.

Generally, the major sources of water quality data for Lake Panasoffkee consist of data collected for special studies (Bays and Crisman 1981; CH2MHill 1995) and some data collected by the USGS at irregular frequencies. Nitrate concentrations in Big Jones Creek and Little Jones Creek increased during the time between the study conducted by Bays and Crisman (1981) and the study conducted by CH2MHill (1995). Additionally, the CH2MHill study (1995) documented copper concentrations in two Shady Brook water samples that exceeded the Class III water quality standard for that metal. The apparent trend in increasing nutrients and the incidence of copper in the Shady Brook water samples supports the need to perform periodic monitoring of the lake and its tributaries for these parameters. Additional parameters should be added, consistent with previous studies, to allow for comparative analysis of existing and historic conditions.

Annual Budget Estimates:

	FY 1999	FY 2000	FY 2001	FY 2002
Salaries		$30,000	$15,000	$15,000
Contracts		$75,000	$50,000	$50,000
Expenses		$1,000	$1,000	$1,000
Total		$106,000	$66,000	$66,000

Agency or Local Government Partnering:

The District will coordinate with Sumter County, the FWCC, the USGS and the FDEP to best utilize all parties resources in implementation of this project and to avoid duplication of effort.

APPENDIX A - Background Information 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 Panasoffkee. Subjects covered include the lake's physical setting and characteristics, fishery resource, plant communities, sediment characteristics, and water quality. Although considered in some detail, much more information is contained in the technical reports referenced. These reports are available from the Southwest Florida Water Management District.

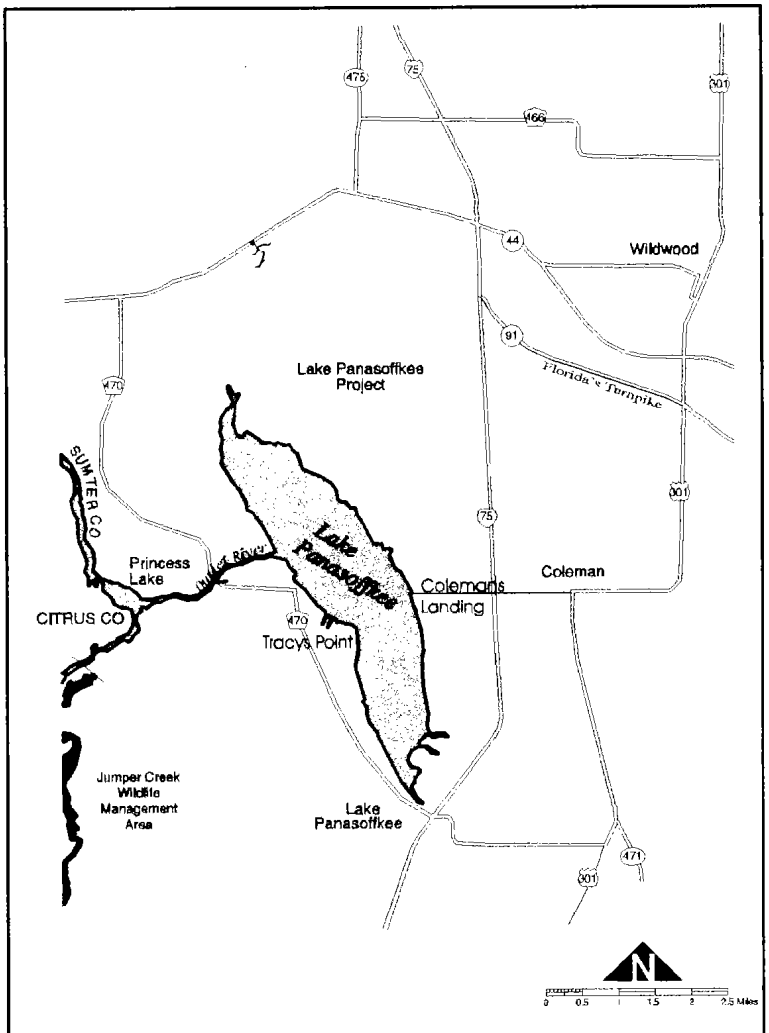


Figure A-1. Location map of Lake Panasoffkee

Background Information

Lake Panasoffkee is the largest lake in Sumter County, with a surface water area of approximately 4,820 acres, or 7.5 square miles (mi^2) (Figure A-1). The lake is shallow with extensive communities of submersed and emergent aquatic plants. Most of the watershed and shoreline are undeveloped or rural; however, a series of residential canals exists along the west side of the lake. The major source of water to the lake is groundwater discharge and spring flow with surface water contributions from Shady Brook (also called Panasoffkee Creek), Little Jones Creek, and Big Jones Creek. The Outlet River, on the lake's west side, connects Lake Panasoffkee to the Withlacoochee River and is the lake's only surface discharge. Lake Panasoffkee has an elongated basin oriented north to south. It is six miles long and 1.5 miles wide with an average depth of seven feet and a maximum depth of ten feet at a stage of 40.95 feet (Taylor 1977). The western shore has a distinct boundary, dotted with residences and some fish camps. The eastern shore transitions from open lake surface to a shallow forested swamp and remains undeveloped.

A rock spillway was located in the Outlet River at the exit from Lake Panasoffkee, but no historical records of its purpose or date of construction exist. Greiner (1978) estimated that it dated from the 1830s to 1880s based on trends in regional economy, and that it was intended as a navigational improvement. A District archaeologist concluded that the spillway was constructed about 1884 to maintain a permanent channel between the Withlacoochee

River and Lake Panasoffkee, in conjunction with other navigational improvements implemented by the Florida Orange Canal and Transit Company (Wharton 1982).

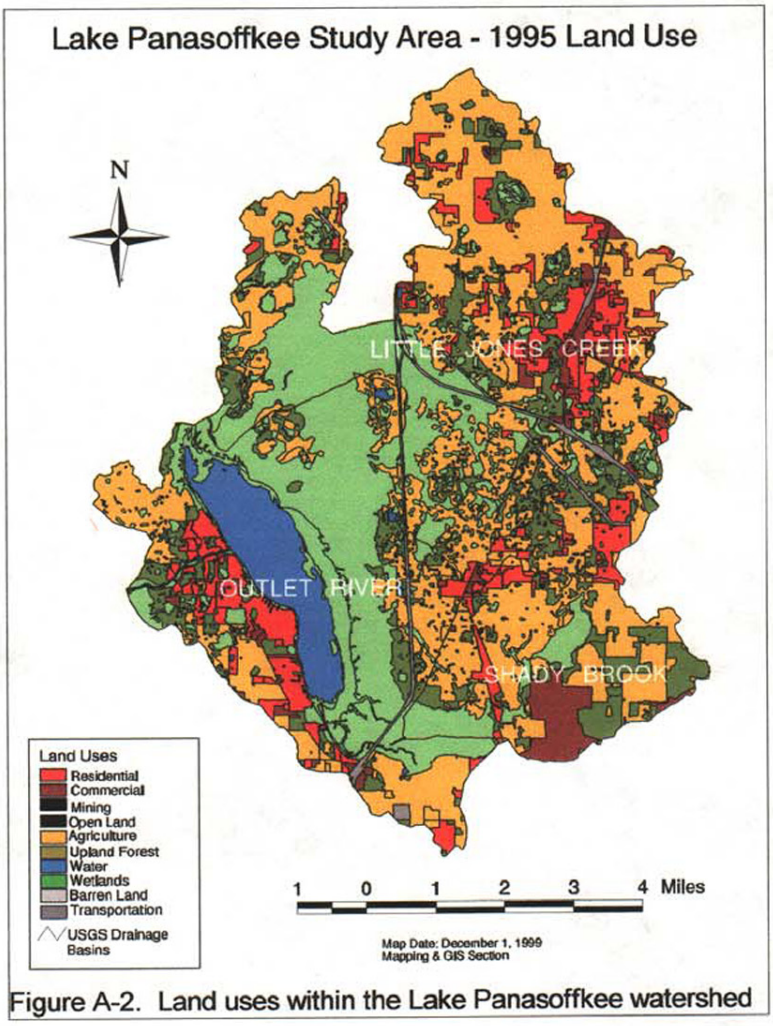


Figure A-2. Land uses within the Lake Panasoffkee watershed

Land Use

An estimate of land use in the basin was performed using the 1995 Land Use and Cover data, which was classified using the Florida Department of Transportation Florida Land Use and Cover and Forms Classification System, second edition (Figure A-2). Nine classes of land use and cover were identified and the coverage areas estimated. These included residential, commercial, wetland, agricultural, open land, mining, barren, open water and forest. Estimates of land use areas for the basin are presented in Table A-1.

Some residential and commercial areas within the basin are located near Wildwood and Coleman, but mostly they are along the western edge of Lake Panasoffkee. A large wetland extends eastward from the lake, and the agricultural, open, and forest lands beyond it typically are buffered from waterways by the wetland. The District owns the East Lake Panasoffkee property a, 9,550 acre tract which borders almost the entire eastern shore of the lake. Current agricultural activities within the basin appear to be mostly low-intensity cattle grazing. It is often difficult to distinguish between the unimproved pasture and unutilized open land.

Table A-1. Estimated Land Use Cover within the Lake Panasoffkee Watershed

Land Use Category	Estimated Area (acres)	Percent Cover
Open Water	2503	5
Residential	4130	9
Commercial	768	2
Wetland	13,810	28
Agricultural	18,254	38
Mining	835	2
Barren/Transportation	808	2
Open Land	501	1
Forest	6306	13
Total	**47,915**	**100.00**

Fisheries Data

Sport fishing is the primary recreational use of Lake Panasoffkee. It was recognized nationally as one of Florida's most productive fishing lakes for redear sunfish, and it also supported a good bass and bluegill fishery. The FWCC has studied Lake Panasoffkee's fishery resource since the 1950s (Moody 1955, 1957), and the lake was designated a Florida Fish Management Area in 1963. Declines in fish populations were reported as early as the 1950s. Residential development had just begun along the western shoreline, and 15 fishing camps were in existence (Moody 1957). By 1978, there were more than 200 residences along the lake and five fish camps in operation (Greiner 1978).

The earliest recorded creel census was conducted over 18 months during 1954 and 1955 and included interviews with 6,000 fishermen (Moody 1957). Survey results showed a total of 18,000 gamefish were caught in 13,000 hours of fishing. In 1967, fish populations and water quality were considered excellent; however, concern was expressed for the increasing amount of aquatic vegetation, and by 1972, the FWCC (FGFWFC 1972) suggested that the vegetation and muck in the lake's shallow areas needed corrective action. A study of the effects of natural water fluctuations on aquatic vegetation and fisheries was performed between October 1973 and March 1975 (FGFWFC 1975). The Wysong Dam (an inflatable dam located on the Withlacoochee River downstream of Lake Panasoffkee) was lowered at their request so the study could be performed. A creel census was taken between March and May 1973, and an excellent gamefish harvest was reported. The number of fish caught per hour per angler was high for the State as well as for the nation. Redear sunfish showed the highest catch per unit effort followed by bream. The FWCC recommended that the dam should continue to be lowered to allow the greatest extent of natural fluctuation, retardation of hydrilla growth, growth of desirable vegetation, and an increase the game fish population and they noted that a "gradual decline in total fish populations appeared to be directly related to steady recession in water level" (FGFWFC 1975).

A documented fish kill occurred in Lake Panasoffkee in July 1974. The FWCC (McKinney 1975) noted that multiple months of dry weather dropped water levels below 40 feet mean sea level, which is equal to the District's minimum desirable lake stage. Then, heavy rains during July 1974, raised the lake level two feet in 14 days. Tannin-stained flow from adjacent swamps turned the lake coffee-colored. Shortly after, dissolved oxygen levels dropped sharply. Prolonged cloudy weather and high color reduced light penetration and photosynthetic activity in the submersed vegetation. The combination of reduced photosynthetic oxygen production, a die-back of aquatic plants, and increased biochemical oxygen demand depressed dissolved oxygen levels in the lake and caused a fish kill. A significant amount of submersed vegetation was lost, and the lake became phytoplankton dominated. Macrophytes gradually recolonized the lake bottom, and by 1978 the lake was once again macrophyte dominated.

The FWCC's most recent creel survey (FGFWFC 1993) was conducted during six, two-week periods from March 11 - June 2, 1991, and March 2 - May 24, 1992. The goals of the study were to evaluate the recreational fishery, document additional recreational use of Lake Panasoffkee, and to compare the findings with historical information. A diversity of fish were

present in Lake Panasoffkee, but this study concentrated on the three major species: largemouth bass, redear sunfish and bluegill. There was approximately the same amount of effort directed toward catching largemouth bass in 1991 as 1992, but the catch per unit effort (CPUE) and the harvest per unit effort (HPUE) increased in 1992. The survey years showed a trend of increasing harvest of bass (36 percent) over the survey period. Similarly, the redear sunfish catch and harvest rose in 1992 by 75 percent and 81 percent, respectively, from 1991, and CPUE and HPUE nearly doubled. This was supported by electrofishing data. On the other hand, declines in bluegill harvest (62 percent) and HPUE (29 percent) were recorded from 1991 to 1992, and declines were supported by electrofishing data.

Creel surveys from 1974 and 1977 were compared with surveys from 1991 and 1992. As with the later surveys, the 1974 and 1977 surveys were performed over a twelve week period. Factors affecting fishery comparisons include spring weather patterns, water levels, extent of vegetative coverage, and year class strength of target species. One of the stated goals of 1991/92 surveys was to document additional recreational use of the lake; however, other recreational users besides fishermen numbered so few in 1991 that this element of the survey was discontinued for 1992. Eight percent of the users on Lake Panasoffkee in 1991 were pleasure boating and not observed fishing during the four hour sample time. No other recreational users were observed. The charts below show some historical data by fish species for effort in hours, harvest per unit effort, and harvest. Harvest is defined as all fish retained at the completion of a fishing trip.

Table A-2. A comparison of creel survey results for several years.

	1974	1977	1991	1992
Largemouth Bass				
Effort (hours)	10265	19704	15146	14951
Harvest/unit effort	0.38	0.41	0.09	0.17
Harvest	3198	8799	2105	2868
Redear				
Effort (hours)	14936	22547	13909	14904
Harvest/unit effort	2.71	0.98	0.73	1.43
Harvest	38011	26263	13154	23793
Bluegill				
Effort (hours)	2824	3529	9148	5762
Harvest/unit effort	1.88	1.60	0.62	0.44
Harvest	6383	5070	9977	3832

Overall, harvest estimates for largemouth bass, redear sunfish, and bluegill fishery have declined between the 1974/1977 survey and the 1991/1992 survey.

Aquatic Vegetation

Extensive communities of submersed aquatic plants in the lake provide the habitat conditions needed by gamefish populations, although the plants also restrict access to large areas of the

lake during periods of low lake levels. In addition to sportfish, the lake and its relatively undeveloped shoreline support a diversity of birds, amphibians, reptiles, and mammals.

Two types of vegetation have been of concern to lake managers and residents: hydrilla and tussocks. Hydrilla (*Hydrilla verticillata*), an exotic that frequently obstructs navigation in Florida lakes, is a submersed macrophyte that was introduced in Florida during the early 1950s. It is now the most severe aquatic weed problem in the southern United States and is rapidly expanding its range.

Hydrilla was first reported in Lake Panasoffkee in October 1973, when it was found around the mouth of Little Jones Creek and along the southern shore. The dominance of eel grass in the lake has restricted the expansion of hydrilla, however, based on anecdotal information, hydrilla coverage has increased.

Islands or mats of marsh plants, called tussocks, have been found floating in the lake for decades (FGFWFC 1974). They are typically vegetated by pickerelweed (*Pontederia cordata*), arrowhead (*Sagittaria graminea*), cattail (*Typha* sp.), pennywort (*Hydrocotyle umbellata*) and primrose willow (*Ludwidgia octovalis*).

The lake contains submersed plants as well as emergent marshes and floating islands of vegetation (i.e., tussocks). Submersed vegetation has historically been dominated by eelgrass (*Vallisneria americana*), with smaller areas of coontail (*Ceratophyllum demersum*), southern naiad (*Najas guadalupensis*), parrot feather (*Myriophyllum aquaticum*), and pondweed (*Potamogeton illinoensis*).

The species composition and distribution of aquatic plants in Lake Panasoffkee has varied in response to man-made changes and natural influences (natural water level fluctuations). The first vegetative communities map was made in March 1973 and showed eelgrass (at 3-7 foot depths) to be the dominant species (57 percent) followed by coontail (less than 3 foot depths) and pondweed. A March 1974 vegetation map, once again, showed eelgrass, coontail and pondweed as the dominant species with increases from 47 percent to 342 percent of pure stands to combinations of species. Another map was produced for March 1975. After subsequent heavy rains in July 1974, there was a major die-back of aquatic plants which reduced the total acreage of vegetative cover from 3184 acres in 1974 to 320 acres in 1975. The percent vegetative coverage of the lake was recorded at 57 percent in 1973, rose to 71 percent in 1974 and dropped to 7 percent in 1975 (FGFWFC 1975). Perhaps the most dramatic change in recent years was the reduction in total coverage by aquatic plants that preceded the fish kill in July 1974. Aquatic plant coverage remained sparse through 1978, but by 1980, eelgrass was once again the dominant species.

Aquatic plant management in the Withlacoochee area has been directed largely at the control of exotic species, specifically water hyacinth, water lettuce, and hydrilla. Management of these invasive species has been for purposes of access and navigation of water bodies such as Lake Panasoffkee. The responsibility for aquatic plant management in the State rests with FDEP. Specific jurisdictional areas have been delegated to the water management districts due to manpower limitations and, Lake Panasoffkee is one of them. The majority of aquatic

plant management effort targets exotic species. Some limited tussock removal has been done when navigation channels were blocked.

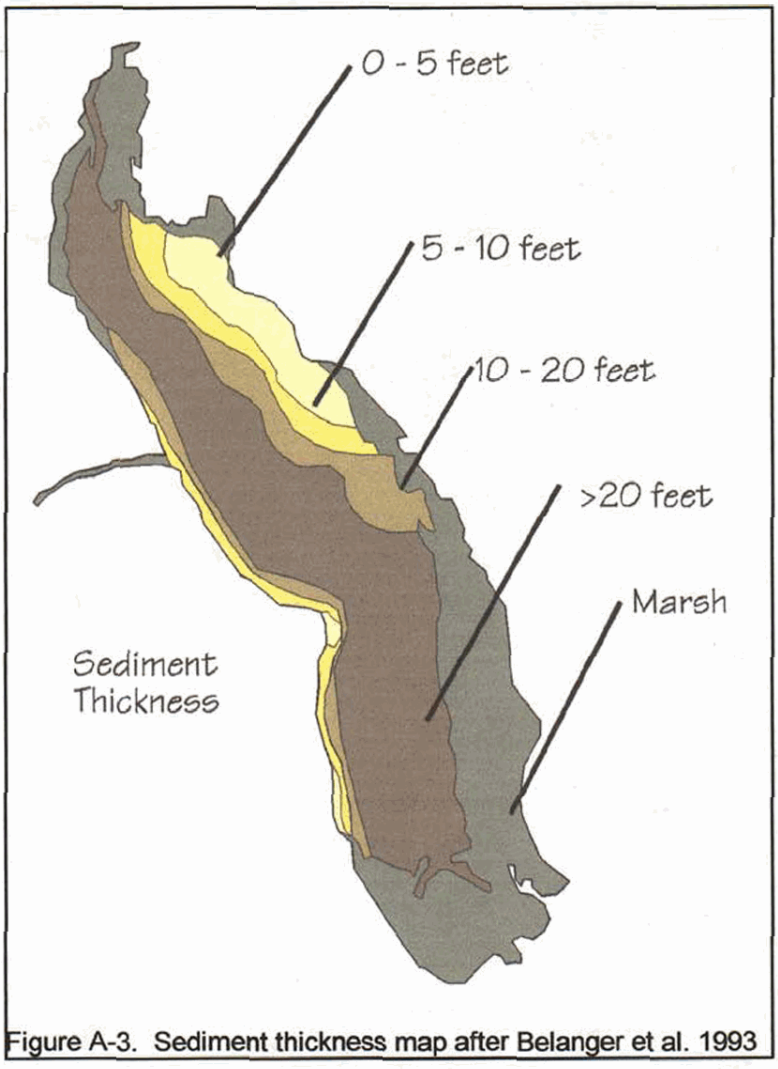


Figure A-3. Sediment thickness map after Belanger et al. 1993

Lake Sediments

In 1957, Lake Panasoffkee sediments were reported to consist predominantly of "deep, fine yellowish inorganic silt underlain by sand, blue clay and limestone" (Moody 1957). Deep black organic muck was found over sand, silt and soft limerock near the lake shore. There is concern that the lake is becoming increasingly shallow. It had been suggested that this could be due to sediment accumulation and that this is the principal ecological problem of the lake (Greiner 1978).

Greiner (1978) stated that lake sediments consisted principally of precipitated limestone rather than organic deposits. This report also concluded that lake depths in the south end of the lake had been decreased by sediments eroding off of uplands and carried to the lake by Shady Brook. Brenner and Binford (1988) sampled mid-lake sediments in Lake Panasoffkee and found that surface sediments had the highest carbonate content out of 97 Floridan lakes sampled which indicates that the sediments are largely inorganic; however, these were mid-lake readings, and no samples were taken from the shallower near-shore areas.

A SWIM-funded project, performed by the Florida Institute of Technology (Belanger et al. 1993), investigated sediment composition and distribution in Lake Panasoffkee. Belanger et al. (1993) determined that sediments in Lake Panasoffkee contain much more inorganic carbonate matter (72.3 percent) than organic matter (17.4 percent). The study focused on the possible causes of the increasing shallowness, the sources of sediment, and the extent of manmade versus natural lake degradation. Sediments were mapped by depth-to-hardpan and analyzed according to physical and chemical characteristics. Belanger et al. (1993) employed PB-210 dating, organic matter "biomarker" and paleolimnology analysis to assist the investigation.

Paleolimnological analysis was performed based on diatom identifications and TSI reconstruction techniques. Based on their analysis of sediment cores, Belanger et al. (1993) concluded that very few changes have taken place in and around the lake since 1855. In fact, analysis suggests that the trophic state of the lake was once eutrophic during this period and has moved toward a mesotrophic state since about 1970. Patches of plant growth correspond to the various pH readings; the highest pH values, which further accelerate the formation of a calcium carbonate precipitate, were found in areas of dense vegetation. Removal of carbon dioxide due to dense macrophyte growth and photosynthesis causes precipitation of calcium carbonate ($CaCO_3$). The precipitate on eelgrass was found to be 61 percent carbonate and 32 percent organic. The eelgrass plant itself exhibited a carbonate content of 17 percent.

The sediment mapping effort revealed sediment depths greater than 20 feet over 75 percent of the lake bottom (Figure A-3). Despite deep sediment deposits, PB-210 dating (a dating method that is based on the measurement of the radioactive decay of an isotope of lead) results indicate that sedimentation rates have historically been low: 0.04 to 0.06 grams dry weight per cm^2 per year (approximately equivalent to 0.06 to 0.09 inches per year). Sediments accumulate approximately 1 inch in 12 to 13 years. At this rate, it would take at least 2880 years to accumulate a 20 foot layer of sediment.

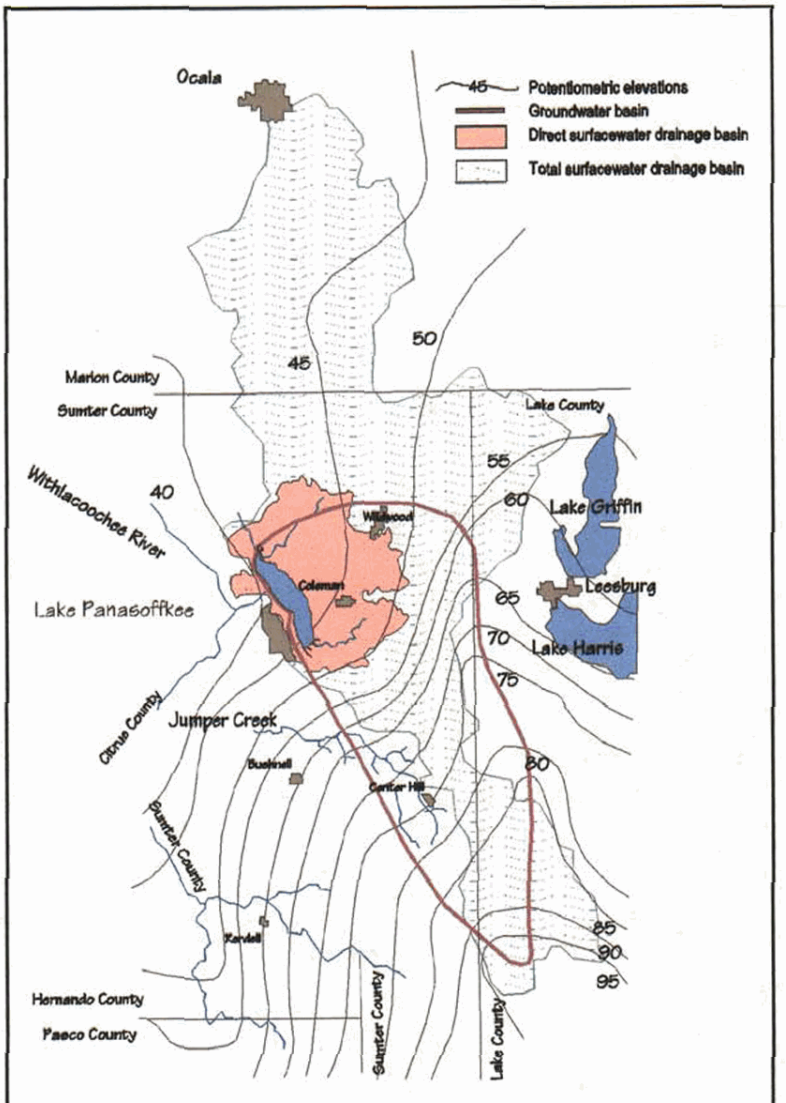


Figure A-4. Groundwater basin, watershed delineations and potentiometric surface map for Lake Panasoffkee

Watershed and Hydrology

The USGS estimates Lake Panasoffkee's drainage basin to be approximately 420 square miles forming a large portion of the Withlacoochee River basin east of the Withlacoochee River (Taylor 1977). Much of this watershed drains to localized depressions that exist due to the karst geology of the region. As a result, only 62.2 mi^2 (39,800 acres) drain directly to the lake. The Lake Panasoffkee drainage basin makes up 27.5 percent of the Withlacoochee River watershed. However, the volume of flow contributed by the lake to the river can account for 50 percent to 70

percent of the river's dry-season flow. Recorded average daily discharge from the lake to the river has ranged from 99 cfs (64 mgd) in 1992 to 288 cfs (186 mgd) in 1973.

Two aquifers lie in connection with Lake Panasoffkee; the water table, or surficial aquifer which exists in the unconsolidated sediments, and the upper part of the Floridan Aquifer found in the deeper limestone layer. The water table is recharged by rainfall. Losses from the lake occur mostly through outflow, evaporation, some through downward leakage into the artesian aquifer, and minor amounts through pumpage. The Floridan Aquifer is recharged via water table leakage, sinkholes, and small discharges from the Green Swamp. Several springs and sinkholes are found in the vicinity of the lake and its tributaries that probably resulted from solution cavities formed along limestone fractures.

Figure A-4 shows the groundwater basin boundaries for the lake as compared to the surface water boundaries. The contributing groundwater basin area is approximately 300 square miles and flows in a northwesterly direction from the Green Swamp to Lake Panasoffkee. Since there is a hydraulic connection between the lake and the aquifer, water level changes in the Floridan Aquifer will directly affect water levels in the lake.

Rainfall is the only recharge source to the lake's ground water supply so the amount and timing of rainfall greatly impacts the ground water table. Since rainfall patterns are erratic, the amount of rainfall on a basin can vary between points; however, in an average year, this basin receives 55 inches of rainfall and loses 48 inches through evaporation (Heath and Conover 1981) leaving an average annual surplus of seven inches. Total annual rainfall for 1969 to 1999 is compared to the period of record (POR) mean in Figure A-5.

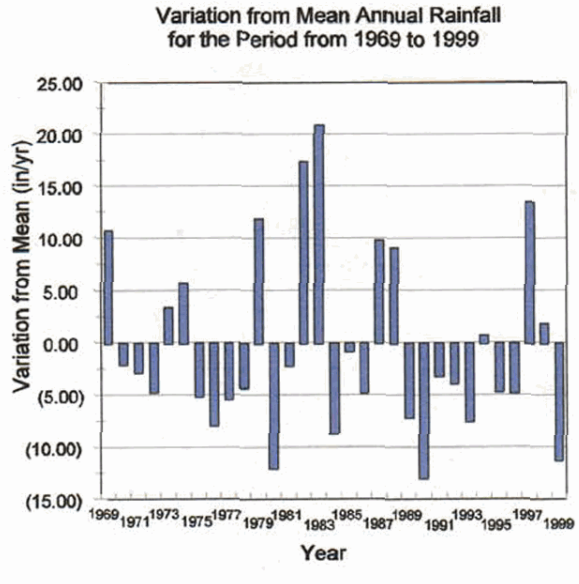
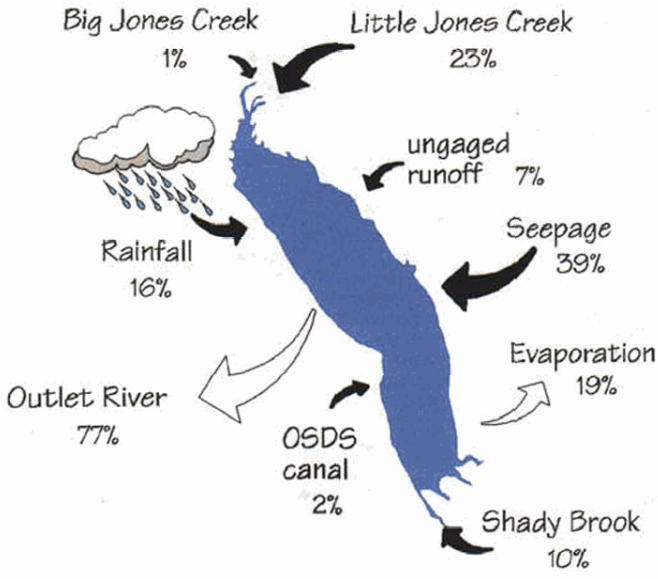


Figure A-5. Comparison of monthly rainfall at St. Leo, FL to POR Mean

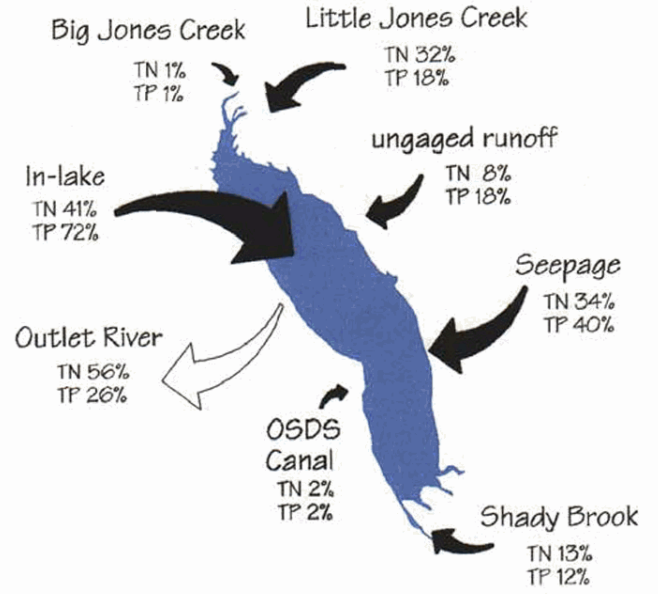
Water Budget

Direct surface water inputs to Lake Panasoffkee include Little Jones Creek, Big Jones Creek, Shady Brook, and small ungaged streams. The subbasins associated with direct inflows to Lake Panasoffkee represent about 13,900 acres, which is 35 percent of the total contributing drainage basin. Therefore, approximately 65 percent of the 39,800 acre (62.2 mi^2) watershed contributes flow to Lake Panasoffkee as sheetflow or via small ungaged streams (CH2MHill 1995). The single output is the Outlet River, historically known as Spring Run. The Outlet River is a two mile run and joins Lake Panasoffkee to the Withlacoochee River at Princess Lake.

A water budget is the difference between flow inputs to and outputs from the lake, and that difference determines whether the lake level increases or decreases; Inputs minus Outputs equals Change in Storage. The input and output sources are shown in Figure A-6. Input and output amounts will vary according to the rainfall amount for a given period; however, the water budget should represent relative conditions in the lake and its watershed. To illustrate, data provided by USGS indicated the 9-year average flow in Shady Brook (1982-1991) was 41.8 cfs. The 1992-1993 average of 13.2 cfs represented about 32 percent of the long-term average value which is indicative of the five year drought period that began in 1988. The annual average outflow from the Outlet River during 1992-1993 represented about 52 percent of the long-term average flow and the annual total rainfall was approximately 13 inches less than the long-term average annual rainfall with evaporation exceeding rainfall. With regards to the distribution of water sources, (Figure A-6), groundwater accounted for 39 percent of the annual water input to the lake, rainfall on the lake surface contributed 16 percent, and surface runoff was 45 percent (although a good percentage of surface runoff is attributable to spring flow into the stream channels). Little Jones Creek contributes the highest gaged flow to Lake Panasoffkee (CH2MHill1995).



WATER BUDGET



Nutrient Budget

Figure A-6. Water and nutrient budgets for Lake Panasoffkee

Water Quality

The water quality of Lake Panasoffkee is considered good; this is attributed largely to dense stands of desirable aquatic plants and a large ground water contribution. There is evidence of degraded water quality in the groundwater entering the lake. Land use activities are the suspected source, since the ground water system is vulnerable to the transmission of contaminants due to the unconfinement of the aquifer and surface water systems collect and convey non-point source pollutants. In addition to the known groundwater impacts, there are some suspected surface water impacts that require further investigation. Fortunately, the threat of groundwater and surface water contamination has been reduced through large land purchases within the basin by the Save Our Rivers (SOR) program and Preservation 2000.

The District, through the SOR program and Preservation 2000, acquires lands necessary for water management, water supply, and the conservation and protection of water resources. The purchases are made through the Water Management Lands Trust Fund. About 952 acres of the East Lake Panasoffkee tract which includes the Berry Tract was acquired by the end of 1990 and 9,553 acres, the Panasoffkee Project, along the eastern shore of Lake Panasoffkee by 1995. These sites consist of relatively undisturbed lands with mixed wetlands and uplands. The project will protect local and regional drainage features such as the two spring-fed creeks. Storage and detention of surface waters will be provided as well as important wildlife habitat. Almost the entire northern end and eastern shore of Lake Panasoffkee which accounts for 25 percent of the drainage basin of Lake Panasoffkee is now protected from development. This action alone eliminates a large area from potential water quality degradation and natural systems destruction.

The FDEP classifies surface water bodies according to designated use. Lake Panasoffkee is a Class III surface water body, and Class III designated use is recreation, and propagation and maintenance of a healthy, well-balanced population of fish and wildlife. Class III waters must also meet general water quality criteria (FAC 17-302.510) and specific criteria (FAC 17-302.560). Historically, no chronic exceedances of applicable water quality standards have been documented in Lake Panasoffkee.

Water quality samples taken from May 1992 to April 1993 (CH2MHill 1995) were used to assess the current water quality of the lake and to determine whether man induced degradation of water quality was occurring. The annual water and nutrient budgets indicate that the relative importance of inputs is generally the same for water, nitrogen and phosphorus (Figure A-6). Groundwater seepage contributed the largest volume of water (39 percent), and greatest nitrogen (34 percent), and phosphorus (40 percent) loads to the lake, followed by Little Jones Creek, which accounted for 23 percent of water inputs and 32 and 18 percent respectively for nitrogen and phosphorus. The Outlet River was the major output of water from the lake, 77 percent, but only 56 percent of nitrogen inputs and 26 percent of phosphorus were lost through the Outlet River. In-lake processes result in retention of about 41 percent of the nitrogen and 72 percent of the phosphorus input loads within Lake Panasoffkee.

During 1992-93, dissolved oxygen levels fell below the 5 milligram per liter (mg/l) standard at the north end and at the west side of the lake; however, this appears to be due to natural

causes and has not been severe enough to cause problems to fish or other aquatic life. One recorded period of low dissolved oxygen that resulted in a fish kill following a large die-off of aquatic plants in the lake occurred in July 1974 after a major rainfall event (McKinney 1975). Elevated pH levels in the lake have been recorded both historically and during the 1992-1993 study, but no adverse effects related to high pH values have been documented. Elevated pH levels are most likely attributable to high rates of photosynthesis (by the extensive macrophyte beds with associated periphytic algae) that remove carbon dioxide from the water.

Copper was the only metal concentration that exceeded Class III water quality criteria. Exceedances were only found for Shady Brook water samples. These concentrations of 0.10 mg/L and 0.22 mg/L exceeded the Class III standard of 0.0065 mg/L. The source of copper had not been identified at this time and needs to be further investigated.

There are two major sources of historic water quality data for Lake Panasoffkee. Bays and Crisman (1981) conducted a baseline study from 1979 to 1981 to monitor various chemical, biological and physical parameters at six stations in and around the lake. Three USGS stations in or near Lake Panasoffkee have been monitored at irregular frequencies. These USGS stations correspond roughly to stations used in the Bays and Crisman (1981) study. Selected water quality data collected in 1979-1981 (Bays and Crisman 1981) were compared with results of the 1992-1993 sampling program for stations sampled in the same location during both periods. Comparisons were made of trophic state parameters such as TN, TP and chlorophyll *a* to determine if any apparent adverse long-term changes in water quality occurred. Special emphasis was placed upon a comparative analysis of nitrate-nitrite data given recent concern over increasing concentrations of this parameter in springs within the region (CH2MHill 1995).

Total phosphorus (TP) has not changed measurably in Lake Panasoffkee or its tributaries since 1980, but mean TP shows a significant decrease at the Outlet River station. Annual mean total nitrogen (TN) in the lake was not significantly different between 1992 and 1980, but mean TN had significantly decreased in Big Jones Creek and the Outlet River from the 1980 sampling to the 1992 sampling event. Similarly, total Kjeldahl nitrogen (TKN) in Big Jones Creek, the Outlet River, the residential canal showed a significant decrease between 1992 and 1980.

Nitrate-nitrogen concentrations have measurably increased in springs in west-central Florida within the past two decades. A similar increase in nitrate concentration in tributary springs to Lake Panasoffkee could be a concern to overall lake trophic state, given that the predominant hydrologic input to the lake is through groundwater seepage and spring discharge. Groundwater monitoring wells were sampled during the 1991-1992 study to determine whether nutrient loading is a problem. Groundwater appears to contribute about 34 percent of the annual total phosphorus input to the lake, and 40 percent of total nitrogen input. Nitrate-nitrite nitrogen increased significantly from 0.15 mg/L in 1980 at Big Jones Creek to 0.33 mg/L in 1992. Similarly, nitrate-nitrite increased significantly at Little Jones Creek from 0.37 mg/L in 1980 to 0.83 mg/l in 1992. Nitrate-nitrite nitrogen in a residential canal also increased to 0.71 mg/L in 1992 from 0.28 mg/L in 1980. Nitrate-nitrite nitrogen in the Outlet River was lower in 1992 (0.02 mg/L) than in 1980 (0.08 mg/L). The extremely low nitrate-nitrate concentrations

within the lake, and in the Outlet River indicate that incremental increases of nitrogen inflows are completely assimilated by the lake ecosystem. This uptake is probably occurring within the macrophyte beds and their encrusting algae. The periodic measurements made by the USGS in Shady Brook show no comparable increase in nitrate-nitrite nitrogen, and concentrations measured in 1980 and 1992 were not statistically significantly different.

Variation in rainfall amounts from the long-term average for the period from 1969 to 1999 are shown in Figure A-5. The five years preceding the 1992 water quality study represented a long-term drought. In contrast for the 1980 water quality study, 1979 was an above average rainfall year preceded by four years of below average rainfall. These rainfall patterns seem to further support that the increased nitrate-nitrite concentrations seen in Big Jones and Little Jones Creeks in 1992 are more likely due to groundwater rather than surface water runoff sources.

It was previously believed that stormwater runoff was a major source of organic sediment due to erosion and that the accumulation of sediments allowed vegetative encroachment from the shoreline waterward. It was also suspected that stormwater runoff was a source of nutrients and heavy metals to the lake (SWFWMD 1989). To validate these concerns, a limited stormwater monitoring program was used to identify differences in levels of pollutants contributed by two major drainage areas to the lake; Shady Brook on the southeastern side and Big Jones Creek on the northwestern side. Three storm events were sampled during the 1992-1993 study to provide information indicating possible non-point pollution sources stemming from man-made impacts. Two storm event samples were taken at Shady Brook and a third at Big Jones Creek. Samples were analyzed for a number of constituents including nutrients and various heavy metals.

Data indicated that baseflow contributes most of the nutrient loading in Big Jones Creek. The data from the two storm event samples from Shady Brook show a much higher flow rate during the March storm but lower values for the measured parameters. Surface inflow contributes about 56 percent of the TN load and 51 percent of the TP load to the lake. However, surface inflow appears to be derived largely from groundwater discharge through springs and not runoff. In consideration of this fact and the fact that the basin is relatively undeveloped, stormwater runoff does not appear to be a critical pollutant contributor.

Residential On-Site Disposal Systems, or OSDS, located on properties adjacent to canals were previously suspected of contributing to the overgrowth of vegetation in the lake by increasing the nutrient load. An OSDS consists of a septic tank and the recipient drain field. A potential for septage leaching into Lake Panasoffkee exists with the usage of residential septic systems along the lake shore and canals. In order to determine the potential nutrient loading due to possible septic system leaching, a residential canal-front was sampled. A properly sited, maintained, and efficient OSDS can treat wastewater to the same degree as a secondary wastewater treatment plant. The degree of potential contamination from an OSDS is predicated on the age, efficiency, and maintenance of a system. The impacts to a water body due to an improperly functioning OSDS are predicated on the volume of septic discharge in relation to the volume of the water body with respect to dilution, and the flushing ability of the water body. Lake Panasoffkee receives a relatively small volume of septic

system discharge and receives a large volume of continuous groundwater inflow. Sampling results indicate that the relatively small nutrient load from the residential canal and shore systems is quickly diluted as this discharge volume enters the lake proper; therefore, OSDS are presently not considered a significant nutrient source.

Trophic State

Lakes can be classified according to many attributes, including physical, chemical, and biological characteristics. The most frequently used classification scheme for lakes is based on their degree of nutrient enrichment (i.e., trophic state); and the most widely used trophic state classification system is a modification of the TSI proposed by Carlson (1977) as modified by Huber et al. (1982). The TSI can be calculated on the basis of chlorophyll *a* concentration, Secchi disk transparency, or limiting nutrient concentrations. The limiting nutrient is determined from the TN to TP ratio. Trophic State classification generally used for Florida lakes begins with a determination of the ratio of TN to TP (Huber et al.). This ratio indicates whether the water body is potentially nitrogen-limited, phosphorus-limited, or nutrient-balanced. Bays and Crisman (1981) found a TN/TP ratio of 24 for Lake Panasoffkee, while 1990 USGS data yielded a value of 27. The TN/TP ratio based upon the CH2MHill study (1995) is 18.8. All three values indicate Lake Panasoffkee is nutrient-balanced, meaning that the lake will respond to increases in either nitrogen or phosphorus.

The 1992-1993 water quality data yield a TSI of 47 which places Lake Panasoffkee in the mesotrophic category. This value is essentially the same calculated by Bays and Crisman (1981), 46, and from the USGS data taken from 1977 to 1990, 45. The TSI value for Lake Panasoffkee was found to be average compared to other lakes included in a statewide study by Huber et al., 1982 (as cited by CH2MHill 1995). Since Lake Panasoffkee is a macrophyte dominated lake, the TSI value may be understated.

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 Panasoffkee.

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APPENDIX B - Regulatory Jurisdictions Within the Lake Panasoffkee Watershed

FEDERAL AGENCIES

Federal jurisdiction in the Lake Panasoffkee watershed involves regulatory responsibilities of the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, the U.S. Coast Guard, the U.S. Department of the Interior (which includes the U.S. Fish and Wildlife Service and the U.S. Geological Survey). 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 Panasoffkee watershed and contributes to the collection of technical data.

U.S. Army Corps of Engineers (USACOE)

The USACOE 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 USACOE 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 USACOE to consider fish and wildlife, conservation, pollution, aesthetics, ecology and other relevant factors of a project.

U.S. Environmental Protection Agency (EPA)

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 water and groundwater. The agency also reviews USACOE permit activities, sets minimum quality standards and sets guidelines for State environmental programs. The EPA also funds sewage system improvements through the FDEP.

U.S. Coast Guard (USCG)

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

U.S. Department of the Interior

Within the U.S. Department of the Interior the Fish and Wildlife Service (FWS) and the USGS perform the primary functions of this agency as they relate to Lake Panasoffkee. The FWS reviews proposed activities which may impact threatened or endangered species and reviews USACOE 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 AGENCIES

Many State agencies are involved in environmental regulation and resource management in the Lake Panasoffkee watershed. They include the Florida Department of Environmental Protection, the Florida Department of Community Affairs, the Fish and Wildlife Conservation Commission, the Florida Department of Agriculture and Consumer Services, and the Florida Department of Health and Rehabilitative Services.

Florida Department of Environmental Protection (FDEP)

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 (DCA)

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 more than one county.

Fish and Wildlife Conservation Commission (FWCC)

In July 1999, a reorganization occurred which lead to the Florida Game and Freshwater Fish Commission begin renamed the Fish and Wildlife Conservation Commission. It is the mission of the FWCC 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 Panasoffkee, the FWCC 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 FWCC 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 (DACS)

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 (HRS)

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 AGENCIES

The primary regional agency that covers the Lake Panasoffkee watershed is the Southwest Florida Water Management District. 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 Panasoffkee watershed.

LOCAL GOVERNMENTS

Local governments with jurisdictions within the Lake Panasoffkee watershed, include the Cities of Wildwood, Center Hill and Coleman and Sumter County. These local governments 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.

Sumter County Ordinance 96-23 relates to surface water quality, and protects lakes, rivers, canals and other waterbodies from adverse effects of development by requiring compliance with EPA, FDEP and the District. Since Lake Panasoffkee is considered and Outstanding Florida Water it is to be regulated to reduce or eliminate adverse impacts to the existing water quality. The ordinance specifically states that:

- Residential development shall not be permitted at a gross density of more than one (1) dwelling unit per ten (10) acres.
- Non-clustered development (minimum lot size 10 acres) may occur within the flood plain. Clustered development must occur outside the flood plain.

APPENDIX C - Permitted Sources and Water Use Permits

This appendix lists point sources and water use permits within the Lake Panasoffkee 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.

Only Dixie Lime and Stone Mine have a permitted surface water discharge. The remaining facilities appear to use percolation ponds, spray fields or other methods that do not involve a direct discharge to surface waters (Letter from Gerold Morrison, FDEP Southwest District Office, 9/22/99)

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

Name	Facility ID	Facility Type	Design Capacity (MGD)
Wildwood WWTP	FLA013497	DW	1.7500
Pana Vista Lodge MH & RVP	FLA013502	DW	0.0210
Turtleback Campground	FLA013503	DW	0.0125
Rivers Edge Estates	FLA013505	DW	0.0150
Lake Panasoffkee Elementary School	FLA013506	DW	0.0120
Panasoffkee Apartments	FLA013508	DW	0.0100
Wildwood Estates	FLA013510	DW	0.0250
Shady Brook R/V Resort	FLA013522	DW	0.0400
Sunshine Travel Center (a.k.a. Fuel City)	FLA013530	DW	0.0110
Dixie Lime and Stone Mine	FL0025569	IW	not provided by FDEP
Woodland Heritage MHP	FLA010520	DW	0.0863
Camp Horizon, STP	FLA010622	DW	0.0090
Rogers Truckwash/I-75 Truckstop	FLA013536	IW	not provided by FDEP
Bedrock Resources, CR 470 Mine	FLA013545	IW	not provided by FDEP

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

Name	RCRA Site ID Number
Spraycore Composites	FLD980837728
Great Southern Wood of Florida	FLD984201400

Table C-3 Landfill Permits

Name	Permit Number
Sumter County Vol. Red. & Landfill	SO60-211179

Table C-4 Petroleum Sites as of 6/29/99

Name	Facility No.
Union 76 Truck Stop	608516878
75 Truck Stop, Inc.	609201938
United 500 # 544	608516880
United 500 # 575	608516881
Speedway # 8237	608516845
Gate # 142	608516823
BP Station	608516830
Exxon # 4 – 5736 – Keiths	608516829
Gas Gardens	609201939
J. Alan Cross Property	609201943
Shell Station	608516858
Amoco # 6005 – Bob's	608516810
Childers, Richard D. & Sheila A.	608942552
CSX Transportation	608521917
Circle K # 00189	608516813
Maddox Realty Services	608942637
Strickland Motor Sales, Inc.	608944266
Amoco # 89	608516885
Rednick Railroad, Inc.	609100922
Former Circle K # 7353	608516861
BP-Mac's	608516836
Wildwood Corner Plaza, Inc.	608837864
Wildwood Trading Post	608516887
Racetrac # 211	608516849
Exxon # 45880 – Jennings' Parkway	608516842
Fina # 401-0196-109	608731713
Monarch Ranch	609200405
Florida Dept. of Transportation – Turnpike	608628420
United 500 # 553	608516879
Union 76 – Cyprett	608516876
Childers, Kathryn	608942604
LaRoche RV Sales	608516884
Chevron # 46963 – Sam's General Store	608516852
Texaco Auto Truck Stop	608516826
Sumter Electric Co-op	608516868
Commercial Carrier Corp.	608521897

Table C-5
Management & Storage of Surface Water (MSSW) permits in the L. Panasoffkee watershed(as of 6/7/1999)

PERMIT NUMBER	REVISION NUMBER	PROJECT SIZE (acres)	PROJECT NAME
000607	000	7	Countryside RV Park
001039	000	11	Sumter Elec.-Andersen Substation
001079	000	1	Hills. Co. Metal Bld. Components
001376	000	3	William's Texaco Station
001376	001	3	William's Texaco Station
001762	000	10	Lake Panasoffkee Elementary Sch.
001762	001	1	Sumter County CR 482/485/470 Widen
001762	002	0	Lake Panasoffkee Elementary School
002092	000	6	Sumter County Landfill Reduction
002092	002	39	Sumter County Landfill
002092	003	3	Sumter Co.-Composting Facility Site Impr
002092	005	5	Sumter Co.-Solid Waste Mgt. Facility Exp
002092	006	6	Sumter Co.-Composting Finishing Bldg.
002092	007	5	Sumter Co-Composting Finishing Bldg.
002883	000	5	Sumter Co.-CR 470
002911	000	20	Montgomery Acres RV Park
002911	001	20	Montgomery Acres Phase I
003408	000	2	Sumter Family Medicine
003797	000	1	HRS Building Addition
004547	000	24	Sunset Shores Unit III
006411	000	1	Bean Furniture Project
006476	000	3	Sumter Co.-CR 527 & 527a Impr.
006500	000	1	Laroche, Barbara-Storage Bldg.
006664	000	27	Great Southern Wood of Florida
006664	001	27	Great Southern Wood of Florida-parking
007012	000	1	Reddy Convenience Store
007012	001	1	Reddy Convenience Store
007511	000	1	Little Food Town-lake Panasoffkee
007582	001	31	Sanders Solid Waste Management Facility
008072	000	0	Guess Realty Office, Emory
008707	000	2	Shoney's Restaurant- Wildwood
008801	000	8	Fuel City
008846	000	1	Groover, Mary Ann-Duplex Project
009588	000	1	Turtleback RV Lots 1-6
009588	001	1	Turtleback RV Park-lots 1-6
009920	001	40	Patterson, RV-project Site
009963	000	6	Project Health, Inc.- Phase I
010090	000	155	Rain Forest RV Park
010090	001	155	Rain Forest RV Park-shady Brook
010352	000	2	Sumter Co.-CR 529 Roadway Extension
010725	000	87	DOT-I-75 from SR 44 to Marion Co. Line
010725	001	75	DOT-I-75/State Road 44 Interchange
010725	002	75	DOT-I-75/State Road 44 Interchange
010725	003	1	DOT-I-75/State Road 44 Interchange
011021	000	21	DOT-I-75 & State Road 44 Interchange
011021	001	21	DOT-I-75 & State Road 44 Interchange
011021	002	0	DOT-I-75 & State Road 44 Interchange
011114	000	0	Peel's Video
011139	000	395	Coleman Federal Correctional Complex
011139	001	4	Coleman Federal Correctional Complex
011139	002	108	Coleman Correctional Facility-US Prisons

Table C-5
Management & Storage of Surface Water (MSSW) permits in the L. Panasoffkee watershed(as of 6/7/1999)

PERMIT NUMBER	REVISION NUMBER	PROJECT SIZE (acres)	PROJECT NAME
011425	000	47	Sumter Co.- 40 Acre Compost Facility
011425	001	46	Central Industrial Park Subdivision
011475	000	2	Chandler, Darrell-Warehouse
011839	001	3	Lake Panasoffkee Apartments II
012046	000	22	Gate Petroleum-SR44/I-75
012339	001	119	DOT-SR 44/CR 229 to US 301 #18070-3517
012339	006	119	DOT-SR 44/CR 229 to US 301
012356	001	1	DOT-State Road 44/CR 229 #18070-3517
012370	000	1	Sumter Co.- County Road 518
012469	001	5	Lake-Sumter Community College
012469	002	5	Lake-Sumter Community College-Sumter Ctr.
012469	003	4	Lake Sumter Comm College-Sumter Ctr. Lib
012572	001	9	Son's Shady Brook Refuge, the
012891	000	7	Sumter Co.- County Road 526a
013338	000	5	Lake Panasoffkee Methodist Church-add.
013504	000	15	Wildwood 76 Auto-Truck Plaza & Parking
013518	000	1	Meyers, Barron-Office & Warehouse
013529	000	1	Coleman, City of- Water Treatment Plant
014171	000	0	DOT-I-75 Resurfacing #18130-1432 & 1433
014171	001	0	DOT-I-75 Resurfacing #18130-1432 & 1433
015523	000	4	Sumter Co.-CR 503 D, E & N Impr.
015929	000	24	Ondick Subdivision (College Ctr. Off Park)
015929	001	1	Ondick Sub.- Sumter Vision Eye Care
016854	000	1	DOT- Shady Brook Bridge Repl. #18010-3528
016974	000	5	Sumter Co-Coleman Connector Rd
017148	000	0	OPM-USA Inc-Wade Site #86736
017313	000	0	Sumter Co-CR 459 Improvements
017744	001	29	Live Oak Terrace Subdivision
018858	000	0	Seco-concrete Paving
019258	000	4	Sumter Co-CR 462-Culvert & Ditch Repair

Table C-6
Ground water permits in the Lake Panasoffkee watershed (as of 6/7/99)

PERMIT NUMBER	AVERAGE ANNUAL PERMITTED QUANTITY (GALLONS PER DAY)	PERMITTEE
00019100	14,300	Howard B. Banes
00041000	480,000	M. Austin Davis Revocable Trust
00133400	12,203,000	Dixie Lime & Stone Company
00136800	410,000	Lake Panasoffkee Water Assoc Inc
00218000	73,300	A.W. & Nellie T. Lee, Jr.
00218200	91,800	A.W. & Nellie T. Lee, Jr.
00271700	40,200	Raiford Dunn, Jr., Myra Staudt &
00279800	58,500	Bigham Farms, Inc.
00280800	50,300	Denco Inc
00281600	84,000	Hugh L. Nichols
00282500	72,400	Darroll Martin
00306600	182,000	Bigham Hide Co Inc and MI Marsh
00308600	99,900	Rolling Hills Horse Complex &
00311000	17,000	R G Bigham
00312400	55,300	R. M. Wade
00315200	82,100	Graham Contracting, Inc.
00328200	17,400	Hugh L. Marshall
00357500	16,300	Taqueral Corporation
00400100	14,300	Willie Graham
00442900	93,000	John C. Coniglio
00502200	300	Elsie B. & Jeanne Wysong and
00615000	17,600	Marion Suwanee Development
00679300	245,000	Rainforest RV Inc
00712000	47,000	Unocal Corporation
00764600	95,000	Bigham Hide Co Inc and MI Marsh
00786100	208,400	Lucy, John, James, & C. Mcleod &
00793300	180,000	C. Herman Beville Estate
00813500	2,469,500	City of Wildwood
00836600	50,300	Barney L. Gentry, III
00860900	25,700	Susie Ann Steele
00912100	44,800	J & B Fernery
00959900	6,100	Sumter Electric Cooperative Inc
00969700	23,800	Leigh Nichols
00994900	38,000	Great Southern Wood of Florida,
00996000	147,000	Eudora B. Cowart
01048800	148,000	City of Coleman
01051900	143,000	John Rogers
01062600	24,000	William Mizell
01065900	14,600	Willie F. Timpson
01101200	95,000	United States Dept. Of Justice
01105100	41,400	Jimmy & Joyce Myles
01105400	55,800	George M. Derewenko
01125900	124,600	Sumter County Board of Co Comm
01161100	28,500	Steven M & Eugenia Bowling
01163200	98,200	Terry N & Elizabeth S Gideons
01165500	43,100	Louis Schieferdecker
01167600	39,500	E A Merritt Jr
01173000	17,000	Kenneth a & Peggy a Jones
Total Permitted Quantity	**18,626,300 average annual gallons per day**	