

A HYDROLOGIC DESCRIPTION OF LAKE THONOTOSASSA NEAR TAMPA, FLORIDA

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Prepared by
UNITED STATES GEOLOGICAL SURVEY
in cooperation with
FLORIDA BUREAU OF GEOLOGY
and
SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT
TALLAHASSEE, FLORIDA
1972

INTRODUCTION

Lake Thonotosassa, a 1,29-square-mile (824 acres) lake in eastern Hillsborough County typifies hundreds of Florida lakes, in that it helps provide a desirable environment for people to live. Demands for lake-front property in Florida have led to an increasing concern by interested public officials toward maintaining the water quality of the lakes at a level suitable for recreational use.

Degradation of lake water may result from the input of pollutants, oxygen-demanding wastes, and excessive nutrients and from an increase in turbidity. All these elements have degraded the water quality of Lake Thonotosassa in recent years. Inflow to the lake through Baker Creek consists of runoff from 60 square miles of agricultural land and undeveloped marshland and includes waste effluents from Plant City, the only city in the basin. Untreated industrial wastes (principally from food-processing industries in the Plant City vicinity) and municipal wastes had been entering Lake Thonotosassa for many years. Consequently, in 1969 the lake became the site of the Nation's largest single pollution-caused fish kill reported, when 26.5 million fish in the lake died. (U.S. Department of the Interior, FWQA 1970). Investigations at the time confirmed the cause of the kill to be low concentrations of DO (dissolved oxygen) caused by untreated oxygen-demanding wastes in the water (Hillsborough County Health Department, 1969).

The U.S. Geological Survey, in cooperation with the Southwest Florida Water Management District undertook the study of Lake Thonotosassa in 1971. The objectives were to provide an understanding of the hydrologic setting of the lake basin and to document water-quality problems. This information will be useful in assessing the present character of the lake and predicting the effects of water management, such as the Four River Basins project proposed by the U.S. Army Corps of Engineers (1965). This project would incorporate Lake Thonotosassa and a part of Baker Creek within a plan to reduce flooding in the lower Hillsborough River.

To meet the foregoing objectives, selected water-quality parameters were periodically measured in the lake and its tributaries, and streamflow was determined at selected points in the basin. Lake depths were measured in May 1971 and were used to contour the lake bottom, as shown on the aerial photograph (base map-photo). Observation wells were drilled to provide details of geology and water levels in the shallow aquifer in the vicinity of the lake.

Basin Description

The Lake Thonotosassa drainage basin (fig. 1) is an area of low relief. The elevation of the land surface ranges from 20 feet above msl (mean sea level) near the Hillsborough River to 140 above msl near Plant City, at the head of the basin. The basin contains many intermittent streams and drainage ditches, which are tributary to Mill, Pemberton, Sparkman, and Baker Creeks. Baker Creek flows into the southeast corner of Lake Thonotosassa through a dredged channel. Outflow from Lake Thonotosassa is through Flint Creek, which joins the Hillsborough River about 2 miles north of the lake. Campbell Branch drains a small area east of the lake and is tributary to Flint Creek.

The major land-use features of the basin are citrus groves, vegetable crops, and rural residential areas. The principal industry in the basin is food processing, most of which takes place near Plant City.

The drainage basin is underlain by a sequence of undifferentiated sand and clay strata that is 60 to 100 feet thick and that overlies the confined Floridan (limestone) aquifer. The shallow aquifer is contained within this sand and clay and is as much as 40 feet thick near the lake (table 1). Along the west side of the lake the surficial sand is very fine to medium grained, light colored, permeable, and well drained. Along the east side of the lake and elsewhere in much of the basin, the surficial sand is very fine to medium grained, clayey, silty, dark colored, semipermeable, poorly drained, and contains much organic matter (Stewart and Hanan, 1970). The shallow aquifer is hydraulically separated from the underlying Floridan aquifer by a confining clay layer. The separation of the two aquifers is probably general throughout the basin except where sinkholes breach the relatively impermeable clay beds, or where the impermeable clay beds are absent.

Contrary to local understanding, Lake Thonotosassa is not fed by springs from the underlying Floridan aquifer. The surface elevation of the lake in 1971 closely corresponded to the water-table elevation in the surrounding shallow sand aquifer and was about 10 feet higher than water levels in nearby tightly cased wells penetrating the Floridan aquifer. Thus, if the impermeable layer separating the two aquifers were breached, water from the shallow aquifer or the lake would move downward into the Floridan aquifer.

Annual rainfall in the Lake Thonotosassa vicinity is about 56 inches. It is unevenly distributed throughout the year. About 59 percent of the rain falls from June to September, and 16 percent from November to February (U.S. Dept. of Commerce, Environmental Data Service, 1970).

The fluctuation of the lake level has been generally less than 2 feet from 1956 to 1971 (fig. 2). The lake surface probably had an elevation of about 40 feet in the recent geologic past, (see inferred location of the paleoshoreline on the aerial photograph). The lake level is controlled at the outlet by a concrete structure with removable boards. County engineers report that most of the control operations are at the request of owners of land adjacent to the lake.

The depth-to-bottom contours (aerial photograph) are based on sonic-depth soundings recorded in May, 1971, when the lake stage was 34.9 feet above msl. The bottom of Lake Thonotosassa is nearly flat in the deeper west-central part. The lake bottom slopes gradually downward from the east shore and more steeply from the west shore. A borrow channel had been dredged adjacent to the seawall along the east shore of the lake. Reported sinkholes or springs in the lake were not confirmed by the depth survey. The maximum depth recorded was 14 feet at several places in the west-central part of the lake, and repeated attempts to locate reported holes deeper than 14 feet proved futile. The absence of recognizable sinkholes and similar irregularities in the uniformly flat lake bottom indicates that the lake occupies an original depression on the rolling land surface although the shoreline irregularity on the northwest corner of the lake may indicate a land-collapse feature in the lake near that spot.

Biologists of the Florida Game and Fresh Water Fish Commission report that in 1969 the bottom of the lake was generally sandy above the 10-foot contour of Kenner (1964) and that much covered the bottom where the water was more than 10 feet deep; the muck was reported to be an organic nutrient-rich ooze resulting from fallout of phytoplankton in the lake and organic wastes carried into the lake through Baker Creek. (Buntz, Jon, Regional Fisheries Biologist, Florida Game and Fresh Water Fish Commission, Tallahassee, 1971). The location of Kenner's 10-foot contour is similar to the 10-foot contour shown in the aerial photograph in this report, with the slight differences attributable to stage differences at the times of mapping.

Water Quality

General Aspects

Water quality in the Lake Thonotosassa drainage system has been affected by runoff from agricultural lands, undeveloped marsh lands, and the municipal-industrial effluents from Plant City and vicinity. The most significant of these in the degradation of Lake Thonotosassa water quality has been the municipal-industrial effluents.

For many years the domestic sewage and some industrial wastes from Plant City were treated in a biofilter treatment plant constructed in 1951 and modified in 1961. The waste-treatment facility was not designed to treat all the industrial (principally food-processing) waste waters, which, typically, were high in suspended carbonaceous material with a high BOD (biochemical oxygen demand) and a high nutrient content (nitrogen and phosphorus). Most of the effluents were discharged, untreated, to ditches near the plants and eventually reached Mill, Pemberton, and Baker Creeks, and the Lake Thonotosassa.

Preliminary plans for a combined domestic and industrial waste treatment plant were drawn in December 1967, and Plant City began operation of the new modified activated-sludge treatment plant in April 1970. The facility was designed to yield an effluent to Mill Creek that would not exceed 30 mg/l (milligrams per liter) BOD and 30 mg/l suspended solids.

Water samples were collected at several sites in the basin in March 1970, just before the treatment plant was placed into operation to document existing water-quality conditions. Data from these samples and from others collected subsequently are shown in table 2, and the sites where the samples were collected are shown on figure 1.

Comparison of streamflow and water-quality data collected in March 1970 from site 2 below the food processing waste outfalls and from site 1 above the outfalls reveals that temperature and streamflow increased below the outfalls, total coliform concentration increased, DO decreased, and organic nitrogen and total nitrogen loads (ammonium, nitrite, and nitrate) increased, as did the total phosphorus load.

Comparisons of data from samples collected at that time at site 3 below the waste-treatment plant and site 2, above the plant, indicates that the temperature decreased, streamflow increased, total coliform numbers increased, DO decreased, total nitrogen and total phosphorus loads increased, and organic nitrogen load decreased.

The principal tributaries to Pemberton Creek downstream from sampling site 3 are Sparkman Branch (site 4) and the Baker Creek Tributary Canal (site 7). Analysis of samples collected at these two sites in March 1970 showed the total nitrogen and phosphorus loads to be much lower than loads in Pemberton Creek. At that time, the natural processes of biodegradation, nutrient uptake, chemical alteration, and particulate fallout had diminished the total nitrogen and phosphorus loads in the mainstream somewhat, though samples collected on March 18, 1970, at the mouth of Baker Creek (site 8) showed about 650 pounds per day total nitrogen and about 320 pounds per day total phosphorus were in transport into Lake Thonotosassa. The effluent of a very high total coliform concentration and a DO less than 4 mg/l, too low to support fish life adequately.

Analyses of the water samples collected in Lake Thonotosassa in March 1970 indicate that the lake waters were reasonably well mixed. At that time, concentrations of organic nitrogen tended to be slightly higher in samples collected from near the bottom at most sites, probably because the near-bottom samples contained more particulate matter. The highest concentrations of total coliform in the lake (based on membrane-filter determinations) were in samples from sites 13, 14, and 15 near the mouth of Baker Creek. At these sites, coliform concentrations were over 25,000 colonies per 100 ml. Concentrations of DO measured at several sites in the lake (during the daytime) ranged from 6.8 to 9.5 mg/l.

Water-quality data collected after the new treatment plant was placed in operation and compared with previously collected data in March 1970 (table 2) indicate a reduction in nutrient loads at the mouth of Baker Creek. For example, on September 24, 1970, the total nitrogen load was 111 pounds per day, and the total phosphorus load was 98 pounds per day. On April 20, 1971, the total nitrogen load was 203 pounds per day, and total phosphorus load was 32.4 pounds per day. The nutrient load of March, 1970 represents to a large extent the effects of effluent that now passes through the new treatment plant. The average daily discharge of the plant is about 3.4 cfs or 2.2 mgd.

Although the new sewage-treatment plant is designed principally to reduce BOD and suspended solids, indications are that some nutrient removal is effected. Analyses of waste-water samples collected within the treatment plant in May 1971 indicated a one-third reduction in total nitrogen and a four-fourths reduction in orthophosphate. The reduction is probably attributable to solids removal and nutrient uptake by vegetation in the polishing pond (Larson, Ronald L., Public Works Director, City of Plant City, Florida, oral commun., 1971).

Comparison of the effluent from the new treatment plant to that of the former facility reflects the degree of improved treatment given the wastes. The former facility treated predominantly domestic wastes to 60 to 80 percent BOD removal and yielded an effluent that reportedly varied from 30 to 130 mg/l BOD. The new plant treats the combined waste waters to better than 98 percent BOD removal and yields an effluent that usually contains less than 10 mg/l BOD (Larson, oral commun., 1970).

Records indicate that in the first 16 months of operation of the new waste-treatment plant the industrial BOD load varied seasonally as did food-processing activities. Industrial BOD load averaged 67 percent of the total monthly plant load and peaked at 82 percent of plant load in December 1970; the minimum was 54 percent of plant load in April 1971. During this period, the average total (domestic and industrial) BOD load to the plant was about 250,000 pounds per month.

Effects on Biota

Lake Thonotosassa was established as a fish-management area by the Florida Game and Fresh Water Fish Commission in 1964. Under the fish-management program, frequent investigations are made by the Commission to determine the capability of the fishery to maintain good fishing. Fish-population studies made in 1964, resulted in chemical treatment to kill about 50,000 pounds of undesirable fish. After that, in early 1965, desirable fish species constituted about 74 percent, by weight, of the total fish population sampled, and the lake was judged to be a good fishery.

By 1968 the lake had changed drastically. Elodea, which once covered all the shoreline and grew in water as deep as 12 feet, had died back, covered only about 30 percent of shoreline, and grew only in water less than 4 feet deep. Water clarity had decreased considerably, indicating increased phytoplankton growth. A sizeable area in the lake near the mouth of Baker Creek was unusable for fish life because of DO depletion. Extensive mats of pollution-tolerant worms and sewage fungus were reported in Pemberton Creek, and floating aquatic plants were growing in the lake. The game-fish population was generally lower than in 1965, and undesirable fish species constituted over 50 percent by weight of samples collected (Florida Game and Fresh Water Fish Commission, 1965-68).

In January 1969, the Lake Thonotosassa was the site of the largest documented fish kill in the Nation that year. Investigations were made at the time by the Hillsborough County Health Department (1969) and Florida Game and Fresh Water Fish Commission (Buntz, 1969). They attributed the deaths of over 80 percent of the fish in the lake to 126.5 million fish) primarily to asphyxiation, resulting from the depletion of oxygen in the water by oxygen-demanding organic wastes flowing into the lake from Mill, Pemberton and Baker Creeks.

During February and March 1971 DO was depleted in the streams and a part of Lake Thonotosassa, resulting in a minor fish kill. The kill was concurrent with a mechanical breakdown in the newly constructed Plant City sewage-treatment plant. During the breakdown, treatment efficiency was sufficiently impaired that BOD in the plant effluent increased to about 300 mg/l (Larson, oral commun., 1971).

Fish were observed dying in the lake again in May 1971. The kill was the consequence of oxygen depletion caused by an algal bloom. During algal blooms in shallow lakes, daytime DO measurements typically indicate high oxygen content as a result of plant photosynthesis; nighttime DO measurements usually indicate oxygen depletion resulting from respiration by these same organisms and the decomposition of organic matter (Welch, 1952). Because the lake is enriched, and analyses of waters from Baker Creek indicate the continued though reduced input of nutrients, algal blooms are likely to occur again, and the resulting low DO content will probably cause periods of fish distress or death.

Lake Thonotosassa and Regional Water Management

The Four River Basin project proposal by the U.S. Army Corps of Engineers (1961) includes a series of short-term and long-term detention reservoirs on the Hillsborough River basin as part of an overall objective of the project to reduce flood-water problems and to provide surface-water storage in four river basins in north-central Florida. As proposed, the lower Hillsborough River basin would receive controlled discharges from upstream structures and tributaries and would provide short-term storage and controlled releases of excess streamflow down both the Hillsborough River and the Tampa Bypass Canal (fig. 3). The Tampa Bypass Canal, already under construction, is designed to carry flood water directly to Tampa Bay, bypassing the lower Hillsborough River and the City of Tampa.

Lake Thonotosassa has a single outlet, Flint Creek, to the Hillsborough River. As presently proposed (U.S. Army Corps of Engineers, 1965) a new control structure would be built on Flint Creek and the present channel dredged. A canal and control structure would connect Baker Creek through the Tampa Bypass Canal. Normal operations would permit flow from Baker Creek through the lake and Flint Creek to the lower Hillsborough River. During flood, the structures would route flows from the lake and Baker Creek directly to the Tampa Bypass Canal.

In addition to the Four River Basins project, a work plan for the Pemberton Creek watershed in Hillsborough County has been prepared by the Hillsborough Soil and Water Conservation District, the Hillsborough County Board of County Commissioners, assisted by the U.S. Department of Agriculture Soil Conservation Service and Forest Service (Hillsborough Soil and Water Conservation District 1971). The objective outlined in that report is to provide adequate water-management capability of sufficient flexibility to meet the needs of different crops and hundreds of landowners with small acreages. The objective is to be achieved by providing for flood-water removal, profile drainage for citrus, and capabilities for water conservation.

Summary

Inflow to Lake Thonotosassa is primarily rural-area runoff combined with treated municipal and industrial waste water. The lake bottom is uniform and is covered with muck in deeper parts of the lake. Wells near the lake show that the water level in the shallow sand aquifer and the level of the lake are similar, and both are at a higher elevation than the potentiometric surface in the confined limestone aquifer. The lake level has varied little in recent years.

Lake Thonotosassa had received inadequately treated municipal and industrial (food-processing) wastes for many years. The input of these wastes has enriched the lake. The clarity of the lake water has decreased and the population of undesirable fish has increased. Periodically, fish kills in the streams and lake have resulted from oxygen depletion which is attributable to both biochemical oxygen demand of inadequately treated wastes and oxygen depletion during algal blooms.

Plant City had improved waste treatment in April 1970, when a modified activated-sludge treatment plant was placed into operation to treat the combined municipal and industrial wastes. The oxygen-demanding waste load reaching the lake has been reduced since that time, and the nutrient load has been somewhat reduced. Because the lake is presently enriched and the nutrient input continues, algal blooms in the lake are likely to continue to cause periods of low DO content and fish distress or death.

Lake Thonotosassa and Pemberton Creek are incorporated into two water-management proposals. The lake may have a role in the proposed Four River Basins project, which calls for channel improvements and a second outlet from the lake to be constructed using the present channel of Baker Creek. The Pemberton Creek work plan contains proposals for floodwater routing and land drainage in the basin to assist crops and landowners.

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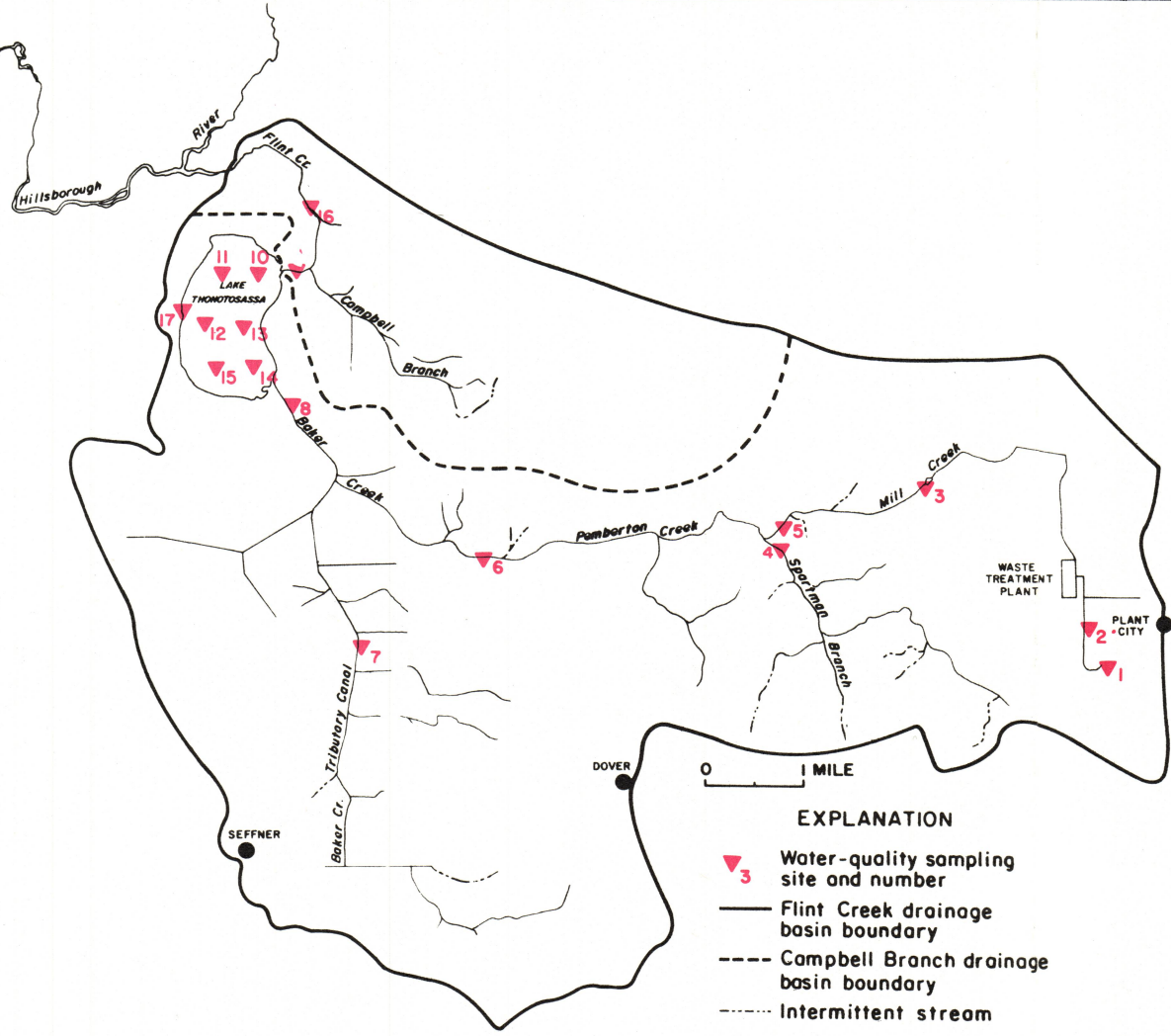


Figure 1. The Lake Thonotosassa drainage basin and selected water-quality sampling sites.

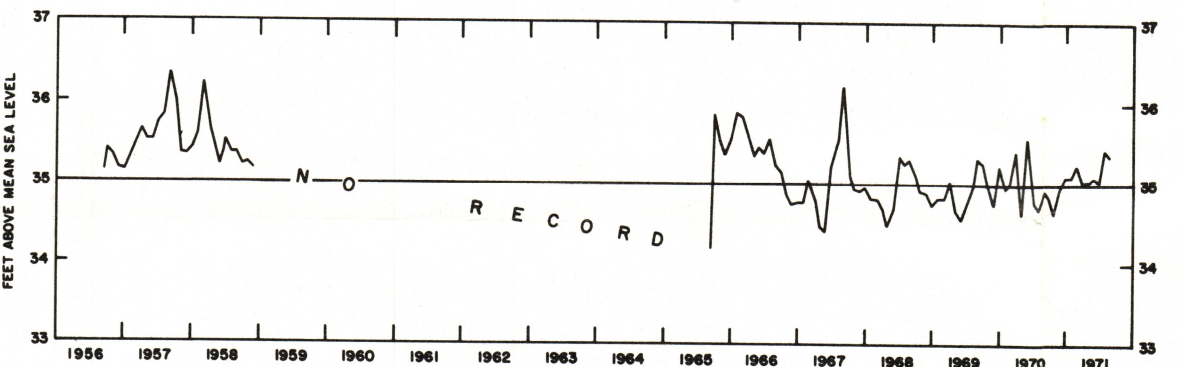


Figure 2. Month-end stage hydrograph, Lake Thonotosassa at Thonotosassa, Florida.

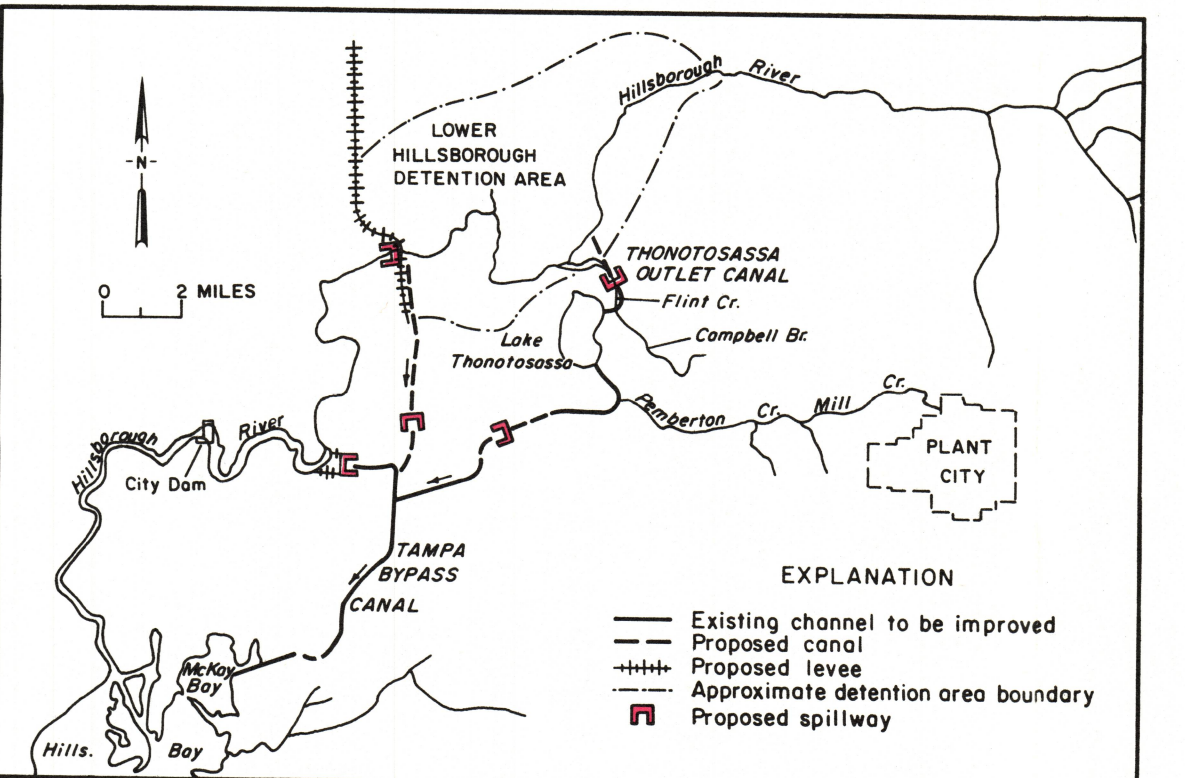


Figure 3. Structures proposed for the lower Hillsborough River Basin part of the Four River Basins project.

Table 1. LOGS OF TEST WELLS									
Elevation of well casing above datum, depth to first section of well described, and location are shown on the base map-photos.									
WELL	ELEVATION	WATER LEVEL	DEPTH	DESCRIPTION OF MATERIALS PENETRATED AND WELLS CONSTRUCTED					
1	38		2	Sand, very fine to medium, brown, some organic matter					
			16	Clay, very fine to medium, brown, some organic matter					
			36	Clay, sandy, brown					
			40	Sand, fine to very fine, silty, white; screened interval					
			40	Clay, sandy, light brown					
			40	Sand, fine to very fine, silty, white; screened interval					
			7	Sand, very fine to medium, light brown, some silt					
			25	Sand, with small, dark, organic					
			36	Clay, green, with some organic fragments					
			44	Clay, brown, with some sandy streaks and rock fragments					
			70	Limestone, white, with some sandy streaks and rock fragments					
			70	Treated 2-inch casing and 2-inch casing					
			20	Sand, very fine to medium, silty, clayey, light brown					
			20	Clay, white, with some organic fragments					
			20	Sand, very fine, silty, clayey, white					
			47	Clay, white, with some sandy streaks and rock fragments					
			47	Sand, rock, with some sandy streaks and rock fragments					
			70	Limestone, white, with some sandy streaks and rock fragments					
			70	Treated 2-inch casing and 2-inch casing					
			40	Sand, very fine to medium, silty, clayey, brown to light brown; screened interval 36-40 feet					
			52	Clay, white, sandy, light brown					
			52	Sand, fine to very fine, silty, clayey, light brown					
			52	Clay, sandy, light brown					
			52	Sand, rock, with some sandy streaks and rock fragments					
			52	Limestone, white, with some sandy streaks and rock fragments					
			52	Treated 2-inch casing and 2-inch casing					

Table 2. WATER QUALITY DATA FOR WATERS IN THE LAKE THONOTOSASSA DRAINAGE BASIN (units in milligrams per liter except where noted)												
Date	Time	Temp (°C)	Temp (°F)	Wind	Clouds	DO (mg/l)	pH	Secchi (ft)	Remarks	Water Depth (ft)	Water Depth (ft)	Water Depth (ft)
10-10-1970	0800	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	1000	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	1200	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	1400	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	1600	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	1800	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	2000	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	2200	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	2400	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	2600	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	2800	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	3000	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	3200	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	3400	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	3600	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	3800	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	4000	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	4200	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	4400	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	4600	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	4800	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	5000	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	5200	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	5400	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	5600	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	5800	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	6000	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	6200	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	6400	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	6600	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	6800	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	7000	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	7200	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	7400	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	7600	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	7800	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	8000	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	8200	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	8400	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	8600	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	8800	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	9000	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	9200	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	9400	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	9600	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	9800	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	10000	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	10200	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	10400	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	10600	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	10800	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	11000	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	11200	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	11400	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	11600	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	11800	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	12000	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	12200	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	12400	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	12600	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	12800	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	13000	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	13200	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	13400	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	13600	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	13800	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	14000	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	14200	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	14400	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	14600	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	14800	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	15000	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	15200	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	15400	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	15600	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	15800	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	16000	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	16200	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	16400	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	16600	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	16800	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	17000	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	17200	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	17400	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	17600	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	17800	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	18000	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	18200	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	18400	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	18600	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	18800	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	19000	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	19200	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	19400	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	19600	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	19800	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	20000	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	20200	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	20400	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	20600	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	20800	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	21000	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	21200	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	21400	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	21600	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	21800	26.0	78.8	20	8	6.8	7.2	22.0	20.2	10	10	10
10-10-1970	22000	26.0	78.8	20	8	6.8	7.2	22.0				