DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

Prepared in cooperation with
LEE COUNTY AND HENDRY COUNTY

WATER-RESOURCES INVESTIGATIONS
OPEN-FILE REPORT 81-638

INTRODUCTION

Most of the freshwater underlying Lee, western Hendry, and northern Collier Counties (fig. 1) occurs within the uppermost 400 feet of sediments which comprise the marine terrace sands, Fort Thompson Formation, Caloosahatchee Formation, Tamiami Formation, and part of the Hawthorn Formation. Although all these sediments contain water, they may be divided into those which yield water to wells (aquifers) and those which yield little or no water to wells (confining beds). The aquifers are composed of permeable materials including sand, sandstone, limestone, or combinations of these sediments. The confining beds are of low permeability and usually consist of fine-grained materials, such as clay or marl or mixtures of these sediments with sand, sandstone, or limestone. Thus, limestone usually yields water to wells, whereas marly limestone does not.

The purpose of this report is to describe the geologic formations underlying the area and to show the position, thickness, and areal extent of the principal freshwater zones. The hydrogeologic sections (figs. 2–6) are based on information from drill cuttings obtained during 1966–78 from sources including individual well owners, well drillers, private corporations, and government agencies. The information was collected and compiled in cooperation with Lee and Hendry Counties.

GEOLOGY

The surficial materials throughout most of the area consist of fine to medium, light gray to brown, quartz sands that contain much shell and variable concentrations of clay and silt. Locally, the quartz sand has been consolidated into sandstone. These sandy sediments are part of the Pamlico and Talbot Formations of late Pleistocene age and are shown as marine terrace sands on the hydrogeologic sections.

The Fort Thompson and Caloosahatchee Formations are shown as an undifferentiated geologic unit because of the difficulty of distinguishing between them by drill cuttings. These formations underlie most of northern Lee and northwestern Hendry Counties. The Fort Thompson Formation is Pleistocene in age and the Caloosahatchee Formation is Pliocene and Pleistocene in age (Bender, 1972). The lithology of the two formations is highly variable and includes limestone, marl, unconsolidated shell, lime mud, and quartz sand and various combinations of these components. Detailed geologic descriptions of these units in the area near the Caloosahatchee River are given by Dubar (1958).

The Tamiami Formation of Pliocene age unconformably underlies the Fort Thompson and Caloosahatchee deposits. The Tamiami Formation consists of mixed marine and terrestrial clastic deposits and contains variable lithologies, which resulted from rapid lateral changes in depositional environments. The upper part of the formation usually consists of green clay or marl mixed with some quartz sand or silt; the middle part contains interbedded limestone, sandstone, and unconsolidated quartz sand. These sediments, deposited at the outfall of a delta in a broad, shallow bay, form a wedge which thickens from west to east. The lower part of the Tamiami Formation usually consists of sandy clay or marl and phosphorite nodules. Most of the coarse sediments in the Tamiami Formation have a dark gray color due to high concentrations of black phosphorite, and were largely derived from local erosion of the older Hawthorn Formation.

The Hawthorn Formation of middle Miocene age occurs throughout the area. In central and western Lee County, the eastward-dipping upper part of the Hawthorn Formation consists of gray-white, sandy, phosphatic limestone which grades laterally eastward to a marl. The full section of the Hawthorn Formation, which attains a maximum thickness of 500 feet, is not shown on any of the hydrogeologic sections.

AQUIFERS

Three principal water-bearing zones (aquifers) occur within the formations shown on the hydrogeologic sections; the surficial (unconfined) aquifer, an artesian aquifer in the Tamiami Formation, and an artesian aquifer in the upper part of the Hawthorn Formation. These aquifers are separated by confining beds of clay, marl, or marly limestone.

The surficial aquifer extends from near land surface to the first confining bed of clay or marl. This aquifer is usually found in the marine terrace sands, but locally may extend downward into the Fort Thompson and Caloosahatchee Formations or into the uppermost part of the Tamiami Formation. Recharge to the surficial aquifer is largely from direct infiltration of rainfall. The water table reaches its highest level during the rainy season, June through September. The average annual range in fluctuation of the water table is about 3 feet based on records from 33 observation wells in Lee and Hendry Counties. Discharge from the aquifer occurs as a result of evapotranspiration, lateral seepage to streams or other surface-water bodies, downward leakage, and pumpage from wells.

The uppermost major artesian aquifer underlying Lee and western Hendry Counties lies entirely within the Tamiami Formation. This aquifer, formerly termed the "Sandstone aquifer" (Sproul and others, 1972; Boggess and Missimer, 1975), is now locally termed the "Tamiami aquifer" because several rock types other than sandstone have been found to be hydraulically connected to the sandstone. The aquifer within the Tamiami Formation is thickest in central and eastern Lee and western Hendry Counties, and extends an undetermined distance into northern Collier County. The aquifer thins to the west in Lee County and apparently does not occur east of central Hendry County.

Recharge to the aquifer within the Tamiami occurs as a result of downward leakage from the surficial aquifer. In low-lying areas along the Caloosahatchee River, water levels in the aquifer in the Tamiami are higher than the water table, and wells that tap the aquifer in the Tamiami flow at land surface. In this area water may seep upward into the surficial aquifer. Water-level fluctuations in the aquifer in the Tamiami are similar to those in the surficial aquifer. Water levels in the aquifer in the Tamiami are highest, about 31 feet above sea level, near Felda in Hendry County (fig. 1). Based on long-term records from 25 observations wells, the average annual water-level fluctuation in the aquifer within the Tamiami is about 5 feet.

A deeper artesian aquifer lies within the upper part of the Hawthorn Formation. This aquifer occurs throughout the western half of Lee County and extends northward into Charlotte County, where it is described as hydrogeologic unit Zone 2 (Sutcliffe, 1975). Most likely the aquifer extends southward into Collier County, where little is known of its hydrologic characteristics. The aquifer does not occur in eastern Lee or western Hendry Counties, except in small areas which may yield minor quantities of water. In eastern Lee County the Hawthorn Formation consists predominantly of marl or marly limestone.

Recharge to the artesian aquifer in the upper part of the Hawthorn Formation occurs north and northeast of Lee County, where the aquifer is apparently in direct contact with the surficial aquifer. Some recharge, resulting from upward or downward leakage through confining beds, probably occurs in areas where the artesian pressure in the aquifer has been lowered by pumping. Before extensive development for water supply occurred in the aquifer, artesian pressures were sufficiently high that wells penetrating the aquifer would flow at land surface throughout Lee County; water levels have since declined to below sea level in most of the area. Records from 11 observation wells indicate the average annual range in fluctuation of water levels in nonpumping areas is about 3 feet, whereas in pumping areas the average fluctuation is about 17 feet.

WELL YIELDS AND WATER QUALITY

The yield of water obtained from a well is related in part to the construction of the well and to the pumping equipment. However, well yield is largely determined by the hydraulic characteristics of the geologic formation from which the water is obtained. Permeable sediments, such as sands, limestones, or sandstones, yield water much more readily than clays or marls. The thickness and lateral extent of a water-bearing formation may also affect well yield.

Most wells that tap the surficial aquifer in the study area range in depth from 10 to 50 feet. Yields range from about 5 gal/min from wells less than 2 inches in diameter drilled in less permeable parts of the aquifer to 500 gal/min from wells of more than 8 inches in diameter drilled in the more permeable parts of the aquifer.

The surficial aquifer generally contains water with dissolved solids concentrations of less than 500 milligrams per liter (mg/L) and chloride concentrations of less than 100 mg/L. However, the water usually contains concentrations of iron exceeding 1 mg/L and has color values ranging from 30 to 600 platinum-cobalt units, making the water unsuitable for some uses.

Wells that tap the aquifer within the Tamiami Formation range in depth from about 60 to 300 feet, depending largely on the depth to more permeable zones in the aquifer. Most wells tap the upper part of the aquifer and are less than 100 feet deep and 4 inches or less in diameter. Well yields range from about 20 to 100 gal/min. Wells of 6 inches or more in diameter yield 200 to 500 gal/min; one well was tested at 1,100 gal/min.

Where unaffected by upward leakage from deep artesian wells, water from the aquifer in the Tamiami contains concentrations of dissolved solids which average about 600 mg/L; concentrations of chloride less than 150 mg/L; concentrations of iron less than 0.1 mg/L; and platinum-cobalt color values of less than 100 units.

Wells drilled to the artesian aquifer in the upper part of the Hawthorn Formation range in depth from about 100 to 300 feet. The majority of these wells are 4 inches or less in diameter and are less than 200 feet deep. Most wells yield 10 to 50 gal/min, but large diameter wells may yield 200 to 500 gal/min.

Water quality in the aquifer in the upper part of the Hawthorn Formation is variable, depending on the effects of upward leakage of saline water from deep artesian zones. Where unaffected by such leakage, water from the aquifer contains dissolved solids concentrations which average about 500 mg/L and chloride concentrations of about 150 mg/L. Where upward leakage of saline water has occurred, dissolved solids and chloride concentrations may exceed 2,000 mg/L and 800 mg/L, respectively. Iron concentrations in water from the aquifer are generally less than 0.1 mg/L, and color values are 10 platinum-cobalt units or less. Usually the water has a relatively high concentration of hydrogen sulfide gas which imparts an objectionable odor. Most wells that tap the aquifer are used for domestic or lawn-watering purposes.

REFERENCES CITED

Bender, M.L., 1972, Notes on the fauna of the Chipola Formation–XI: Helium-Uranium dating studies of corals: Tulane Studies in Geology and Paleontology, v. 10, p. 51–52.

Boggess, D.H., and Missimer, T.M., 1975, A reconnaissance of hydrogeologic conditions in Lehigh Acres and adjacent areas of Lee County, Florida: U.S. Geological Survey Open-File Report 75-55, 88 p.

DuBar, J.R., 1958, Stratigraphy and paleontology of the late Neogene strata of the Caloosahatchee River area of southern Florida: Florida Geological Survey Bulletin 40, 267 p.

Sproul, C.R., Boggess, D.H., and Woodard, H.J., 1972, Saline-water intrusion from deep artesian sources in the McGregor Isles area of Lee County, Florida: Florida Bureau of Geology Information Circular 75, 30 p.

Sutcliffe, Horace, Jr., 1975, Appraisal of the water resources of Charlotte County, Florida: Florida Bureau of Geology Report of Investigations 78, 53 p.

ABBREVIATIONS AND CONVERSION FACTORS

Factors for converting inch-pound units to International System (SI) units and abbreviation of units

Multiply	*By*	*To obtain*
inch (in)	25.40	millimeter (mm)
foot (ft)	0.3048	meter (m)
gallons per minute (gal/min)	0.06309	liters per second (L/s)

National Geodetic Vertical Datum of 1929 (NGVD of 1929): A geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called "mean sea level." NGVD of 1929 is referred to as sea level in the text of this report.

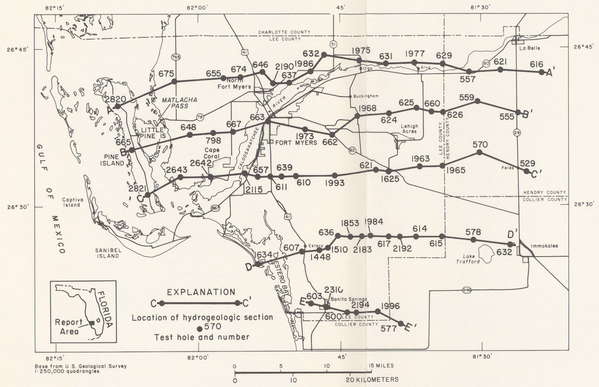
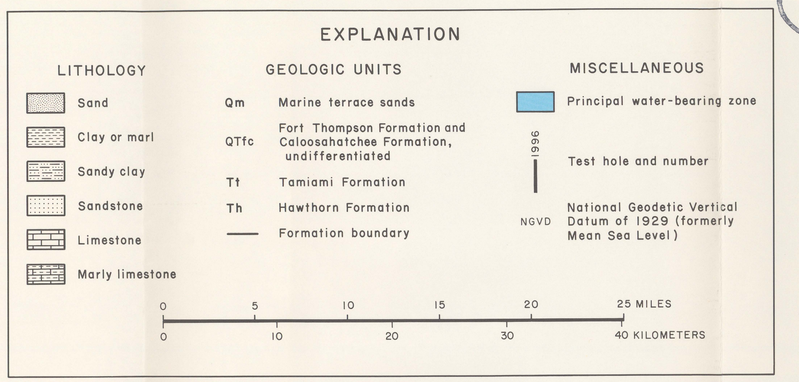


Figure 1.—Lee County and adjacent areas in Hendry and Collier Counties showing location of test holes and hydrogeologic sections.



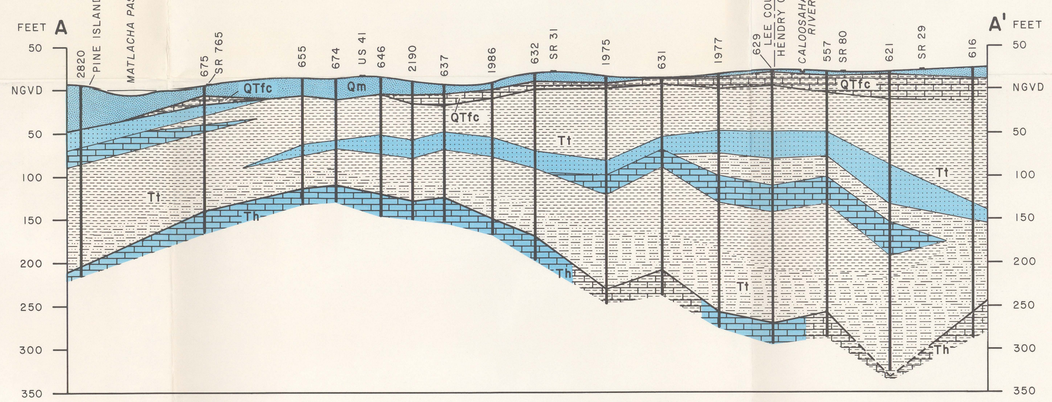


Figure 2.—Hydrogeologic section A-A' in Lee County and western Hendry County.

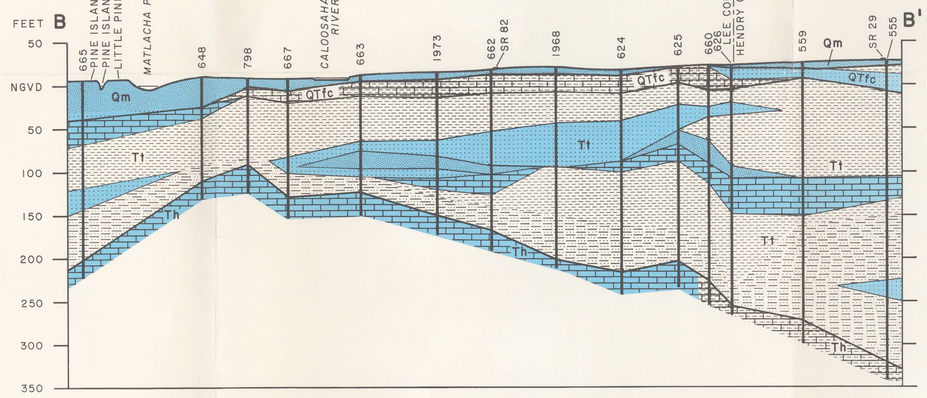


Figure 3.—Hydrogeologic section B-B' in Lee County and western Hendry County.

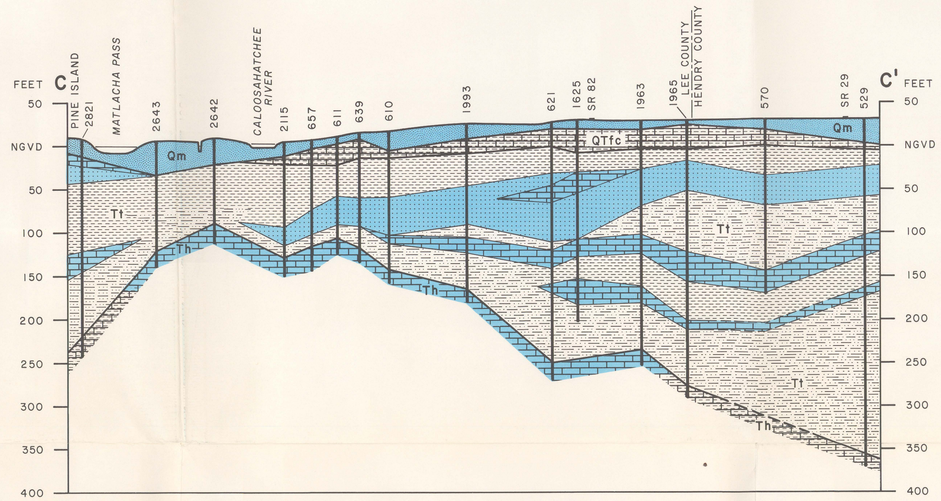


Figure 4.—Hydrogeologic section C-C' in Lee County and western Hendry County.

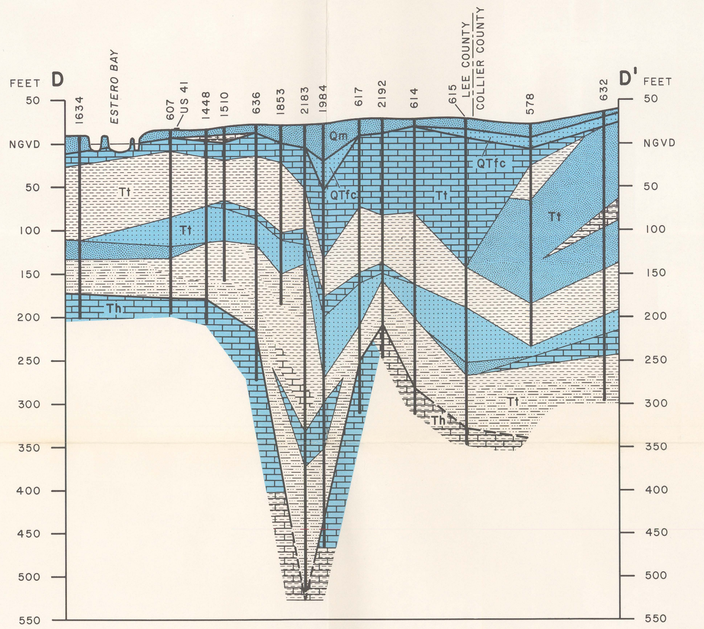


Figure 5.—Hydrogeologic section D-D' in Lee County and northern Collier County.

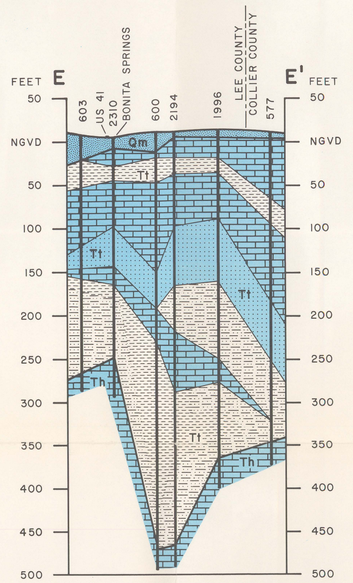


Figure 6.—Hydrogeologic section E-E' in Lee County and northern Collier County.

HYDROGEOLOGIC SECTIONS THROUGH LEE COUNTY AND ADJACENT AREAS OF HENDRY AND COLLIER COUNTIES, FLORIDA

By
D. H. Boggess, T. M. Missimer, and T. H. O'Donnell

1981