History of Water Supply of the Mobile Area, Alabama

GEOLOGICAL SURVEY OF ALABAMA
CIRCULAR 92

GEOLOGICAL SURVEY OF ALABAMA

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HISTORY OF WATER SUPPLY OF THE MOBILE AREA, ALABAMA

CIRCULAR 92

By Joseph F. Riccio and Conrad A. Gazzier

UNIVERSITY, ALABAMA

1973

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October 19, 1973

Honorable George C. Wallace
Governor of Alabama
Montgomery, Alabama

Dear Governor Wallace:

I have the honor to transmit herewith the report entitled "History of Water Supply of the Mobile Area, Alabama," by Joseph F. Riccio and Conrad A. Gazzier, which has been published as Circular 92, of the Geological Survey of Alabama.

This report, the first of a planned series of geoarchaeological investigations of our more populous urban centers, relates the hydrology and geology of the Mobile area to the history of its water supply. This research effort traces the occurrence and use of potable water from the early French settlement on Dauphin Island through subsequent French, British, Spanish, and American occupations of the Mobile area. The report provides the local people with historic documentation concerning one of their most important assets, potable water.

Respectfully,

Philip E. LaMoreaux

Philip E. LaMoreaux
State Geologist

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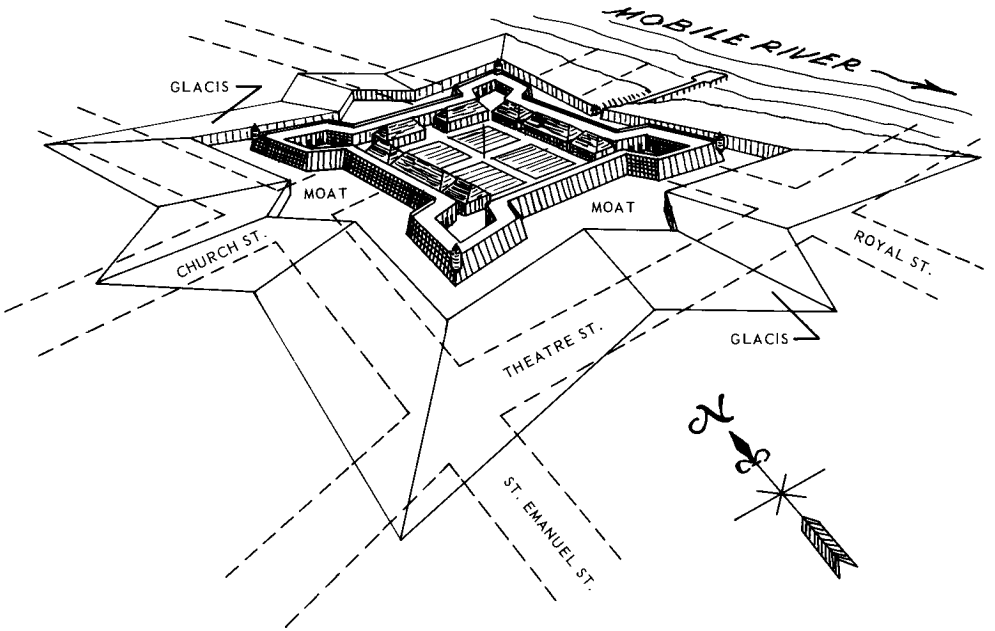


Fort Conde as it relates to the present streets of downtown Mobile.

The cover is an artist's conception of Fort Conde as viewed from the Mobile River.

Information regarding Fort Conde was obtained from Port of Mobile, v. 45, no. 6, p. 24-31. 1972.

HISTORY OF WATER SUPPLY OF THE MOBILE AREA, ALABAMA

By Joseph F. Riccio and Conrad A. Gazzier

ABSTRACT

The history of water supply of the greater Mobile area is traced from its initial beginnings with the French settlement on Dauphin Island through the subsequent French, British, Spanish and American occupations of the city of Mobile and its environs. Surface water from local streams and shallow ground water were utilized as a source of potable supply by the colonists and later settlers.

The Mobile Water Service System is the result of acquisition by the city of Mobile of the water rights of the Stein Water Works in 1898 and the Bienville Water Supply Company in 1907. Mobile's principal source of domestic and industrial water is the 3,600-acre Big Creek Lake completed in 1952. An additional source of industrial water is the Mobile River and Cold Creek, a tributary thereof.

The practical sustained yield of both the surface- and ground-water resources of the area is approximately 11.84 billion gallons per day. Total water resources of the area, therefore, greatly exceed water demands of the foreseeable future.

INTRODUCTION

Ever since the first cave man scratched a record of water availability on cave walls, water has been the driving force of all subsequent civilizations. Excavated ruins in India dating to over 5,000 years ago display water supply and drainage systems so complete as to include public swimming pools and baths. About the same time, the world's first known dam for storage of drinking and irrigation waters was completed in Egypt. Even the Bible is interspersed with references to water; i.e., Moses smote the rock with his rod and brought forth a fountain of water, and ad infinitum does history indicate the continuing importance of water supply.

It should be of interest to the reader, considering Mobile's French heritage, that the science of well drilling developed in France during the 12th century with the successful completion of a well at Artois in 1126. The word "artesian" is derived from the name of this French community. In 1841 the deepest well in the world to that time, 1,798 feet in depth, was completed at Grenelle

near Paris. The Passy well of Paris, 28 inches in diameter and lined to 1,923 feet, completed in 1857 was an engineering marvel of its day.

The authors have attempted to relate the history of water supply of the Mobile area to its geology and hydrology wherever possible. Data on the water habits of the early colonists are scarce and usually it is only when the archeologists excavate in historical areas that such information comes to light. When additional old French manuscripts and letters relating to the settlement of Mobile and the Gulf Coast are translated, other information concerning the area's water supply may be uncovered. It is hoped that this report will be further enlarged by such discoveries.

ACKNOWLEDGEMENTS

This report was prepared as part of the continuing research program of geohydrologic investigations in Alabama conducted by the Geological Survey of Alabama. The study was administered jointly by the University of South Alabama and the Geological Survey of Alabama and was supported in part by the Water Resources Research Institute of Auburn University and the Office of Water Resources Research of the Department of the Interior under the Water Resources Research Act of 1964 as amended (Project B-038-ALA).

The cooperation and assistance of numerous organizations and individuals in providing basic data were invaluable for the successful completion of this report. The authors express grateful appreciation to: Mobile Water Service System; Mobile Historic Development Commission; Mobile Public Library, special collections and genealogy division; South Alabama Regional Planning Commission; First National Bank of Mobile; and Mr. N. Read Stowe, archeologist with the University of South Alabama.

HISTORICAL SYNOPSIS

History indicates that Mobile Bay was first discovered by the Spanish Admiral Alonza de Peneda in 1519 who named the bay *"Spiritu Santo."* His expedition charts of the bay were received in Spain the following year. In 1528, Panfilo de Narvaez, with crude ships constructed on the Florida coast, attempted to reach Mexico

by sailing westward along the Gulf coast. It has been assumed by some historians that the human bones found on Massacre (Dauphin) Island by the French Iberville expedition in 1699 were the remains of Narvaez's followers who had perished there. No doubt those of the party (among them, Cabeza de Vaca) who reached Mexico safely passed by Dauphin Island and the mouth of the bay. The final report of the DeSoto Commission indicates that Captain Maldonado, who was to rendezvous with DeSoto (he probably was somewhere in Alabama at the time) on the Florida coast, explored part of the Gulf coast as far west as Mobile Point in 1539 (McWilliams, 1954). In 1558, Guido de Bazares in his quest for a site for a Spanish colony visited the bay and its environs. The expedition of Tristan de Luna y Arellano with 1,000 colonists and 500 soldiers came to Mobile Bay in 1559 and his efforts to establish a post on its shores met with failure. The Spanish explorers left nothing tangible associated with Mobile Bay except nautical charts that were to furnish the French with geographical knowledge of the area.

Under the leadership of the French-Canadian Pierre LeMoyne, Sieur d'Iberville, who made use of the Spanish charts, a temporary French post was founded on Dauphin Island in 1699. Iberville's younger brother, Jean Baptiste, Sieur de Bienville, established a permanent colony, Fort Louis de la Mobile at 27 Mile Bluff on the Mobile River in 1702. Settlement of Fort Louis was concurrent with the establishment of a permanent post on Dauphin Island. Fort Louis was the first capital of the vast Louisiana territory, and Dauphin Island, 60 miles south, served as its port for 15 years until May 1717 when a severe southwest storm washed sand into the narrow pass connecting the anchorage with the Gulf of Mexico and effectively sealed the harbor. Fort Louis was abandoned in 1711 and the French moved and settled the present site of Mobile. Prior to that time, the French had contemplated this move to reduce the distance from the fort to the *magasins* (warehouses) on Dauphin Island to assure the safety of the King's goods; to place the new settlement within earshot of the signal cannon on the island which notified of approaching ships; and to find better arable land. The immediate cause of abandonment, however, was a river flood and high tides resulting from a hurricane in August 1717. The French commenced construction of Fort Conde in 1717 and occupied it until 1763, when the Treaty of Paris, the result of the Seven Years' War

(the French and Indian War of the North American continent), turned over the French territory east of the Mississippi River with the exception of New Orleans to the British.

In October 1763, the 22nd and 34th Regiments of the British Army occupied the fort at Mobile and renamed it Fort Charlotte in honor of the English queen. The British, noting the shape of the bay, called it "Gunstock Bay," although it was so named (*Baia de Culata*) on Spanish maps of 1570.

The British occupied the fort until it was surrendered to Don Bernardo Galvez on March 14, 1780, after a two-week seige. The Spanish occupation of Mobile was due to their belief that the British would attack Spanish Louisiana as part of their Revolutionary War strategy. With this justification for their action they seized Mobile, Fort Charlotte (now renamed Fort Carlota) and Dauphin Island (Isla Delfina) which remained under Spanish control for 33 years.

On April 15, 1813, Cayetano Perez, Spanish commander of Fort Carlota, evacuated the garrison to Pensacola leaving the fort, Mobile, and Dauphin Island to the American Army led by Major General James Wilkinson during the War of 1812.

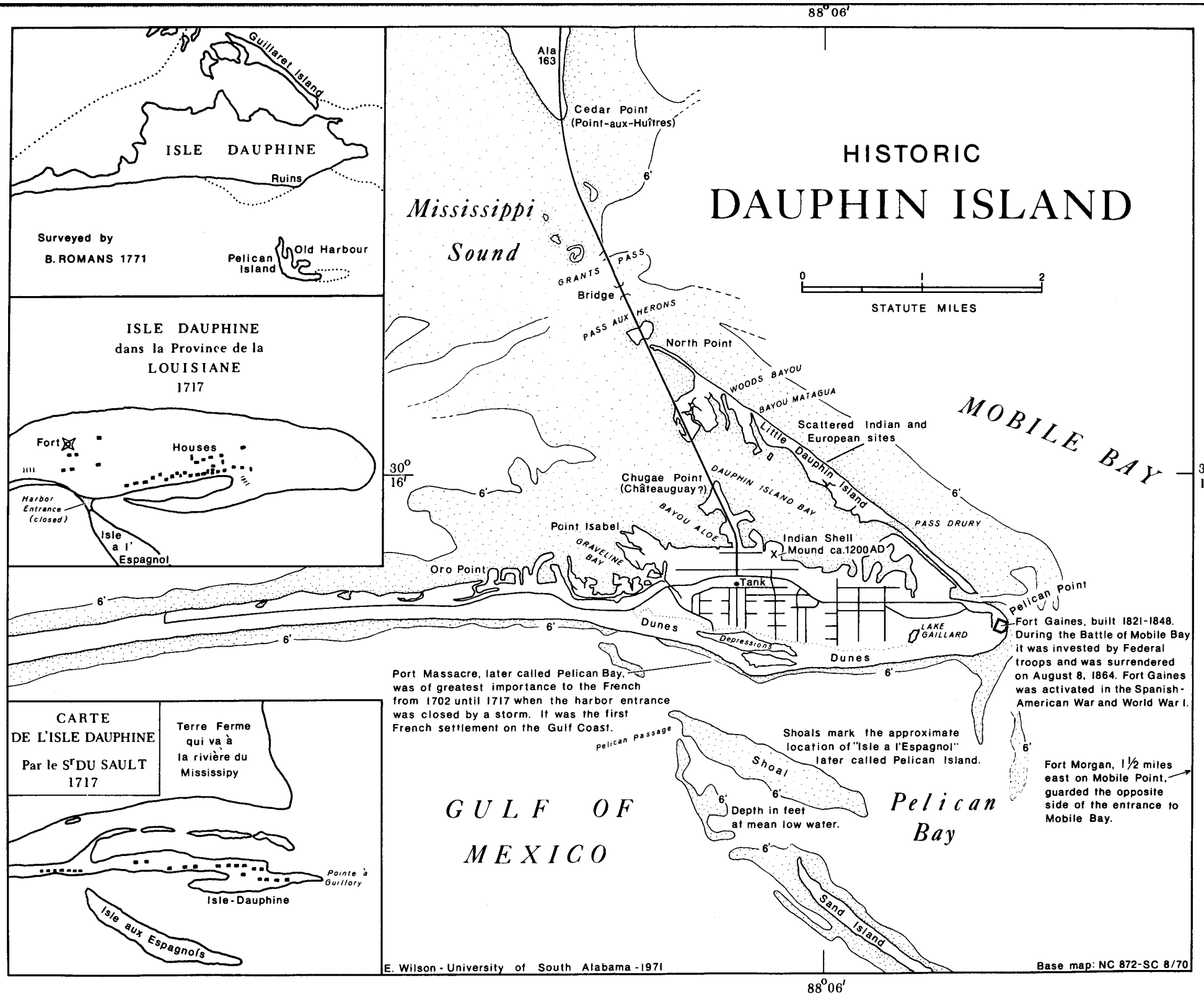
Mobile, now a part of the then United States, was granted a town charter in 1814 and a city charter in 1819 shortly after Alabama was admitted to the Union. In October 1820, old Fort Conde had outlived its usefulness and was sold at auction and subsequently destroyed to make way for the burgeoning city of Mobile.

FRENCH PERIOD

1699–1763

DAUPHIN ISLAND

To date, wells, cisterns or other man-made features indicative of water supply associated with the French occupation of Dauphin Island have not been found. Early French maps of 1717 and 1771 (fig. 1) do not show evidence of any fresh water lakes nor does the 22-year narrative account of French adventure in Louisiana by Penicaut mention any (McWilliams, 1953) and streams were not known to exist on the island. The earliest known lakes on the island of which the authors are aware are shown on the Survey of the Coast of the United States published in 1851 entitled "Entrance to Mobile Bay" (fig. 2). An archeological study of the island has


88°06'
Guillaret Island
ISLE DAUPHINE
Ruins
Surveyed by
B. ROMANS 1771
Pelican Island
Old Harbour
ISLE DAUPHINE
dans la Province de la
LOUISIANE
1717
Fort
Houses
Harbor Entrance (closed)
Isle a l' Espagnol
CARTE
DE L'ISLE DAUPHINE
Par le Sr DU SAULT
1717
Terre Ferme qui va à la rivière du Mississipy
Pointe à Guillory
Isle-Dauphine
Isle aux Espagnols
Ala 163
Cedar Point
(Point-aux-Huîtres)
HISTORIC
DAUPHIN ISLAND
Mississippi Sound
GRANTS PASS
Bridge
PASS AUX HERONS
North Point
0 1 2
STATUTE MILES
WOODS BAYOU
BAYOU MATAGUA
Scattered Indian and European sites
Little Dauphin Island
MOBILE BAY
30° 16'
Chugae Point
(Châteauguay?)
DAUPHIN ISLAND BAY
BAYOU ALOE
PASS DRURY
Point Isabel
GRAVELINE BAY
Indian Shell Mound ca.1200 AD
Oro Point
Tank
Pelican Point
Dunes
Depressions
LAKE GAILLARD
Fort Gaines, built 1821-1848. During the Battle of Mobile Bay it was invested by Federal troops and was surrendered on August 8, 1864. Fort Gaines was activated in the Spanish-American War and World War I.
Port Massacre, later called Pelican Bay, was of greatest importance to the French from 1702 until 1717 when the harbor entrance was closed by a storm. It was the first French settlement on the Gulf Coast.
Pelican Passage
Shoals mark the approximate location of "Isle a l'Espagnol" later called Pelican Island.
Shoal
Depth in feet at mean low water.
GULF OF MEXICO
Pelican Bay
Fort Morgan, 1½ miles east on Mobile Point, guarded the opposite side of the entrance to Mobile Bay.
Sand Island
6'
E. Wilson - University of South Alabama - 1971
Base map: NC 872-SC 8/70
88°06'

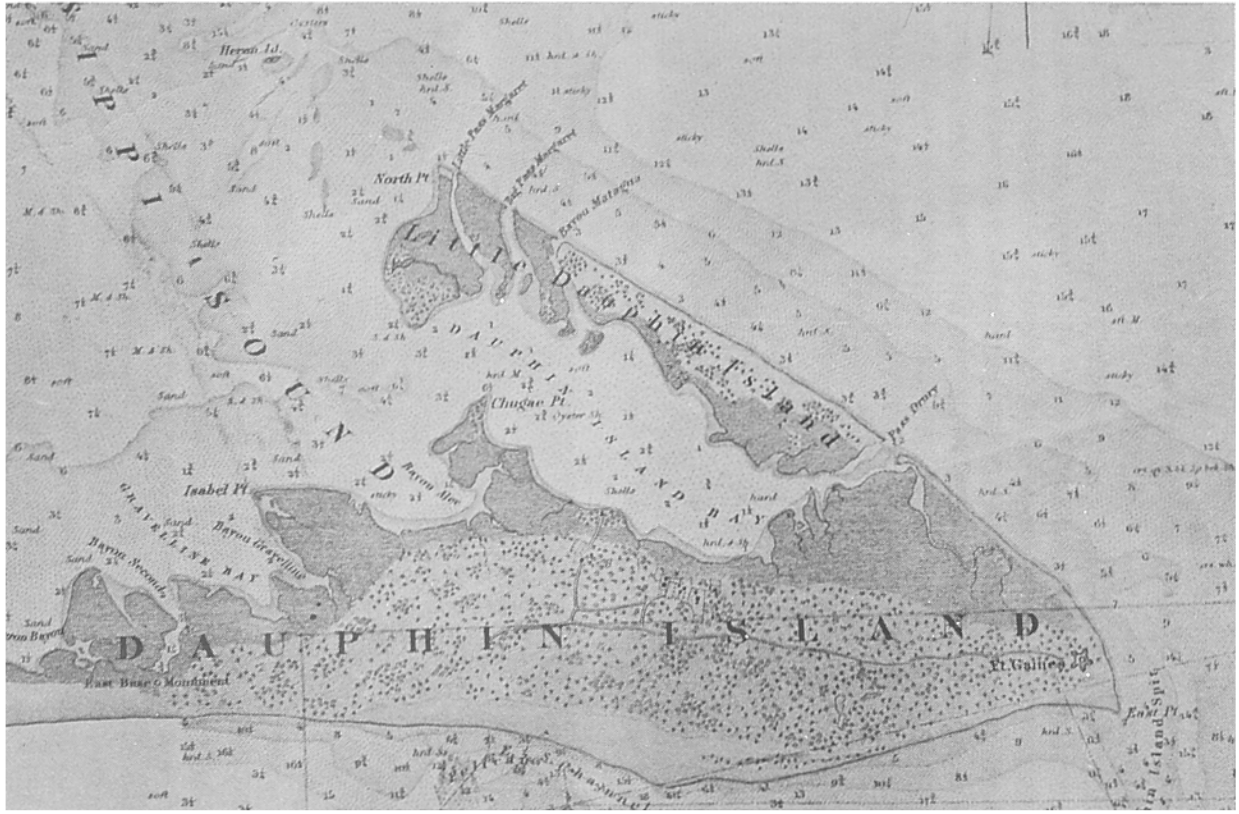


Figure 2.—Map of the eastern part of Dauphin Island. After: The Survey of the Coast of the United States, 1851.

not as yet been carried out to any great extent even though French artifacts have been unearthed during local residential construction as recently as early 1973. Inasmuch as the French did dig wells in other nearby areas, the possibility that one or more will be uncovered is real.

In 1711, a pirate ship from British Jamaica raided Dauphin Island. According to the Pénicaut narrative, the settlement consisted of some 20 residences and a church, *Fort Belle Eglise*. Local legend has it that a gold cross, the church's sole item of great monetary worth, was thrown into a well by the Abbe when he feared it would fall into the hands of the pirates. If true, this is the only "record" of a French well as yet known on the island.

Pénicaut further indicates that English ships took on water at Dauphin Island. In order to supply these and French ships as well, a source of water must have existed on the island.

Where an offshore island is underlain by permeable sediments and the ground water recharge is from rainfall, ground water percolates laterally toward the shore and mingles with the saline water of the sea. On such small islands fresh water usually occurs at an elevation slightly above mean sea level and the islands are found to contain a dome-shaped lens of fresh water underlain by a concave surface of saline water. The fresh water floats on the saline water because its density is lower.

According to the Ghyben-Herzberg principle (fig. 3), a column of fresh water (H) is balanced by a column of saline water (h) in order to maintain equilibrium. If (g) is the specific gravity of the saline water and 1.0 is that of the fresh water, then $H = h + t = hg$ where (t) is equal to the height of the water table above sea level; accordingly, $h = t/(g-1)$.

The water table has been measured at one foot below the ground surface at an elevation of seven feet in the eastern part of Dauphin Island. The specific gravity of the underlying saline water was computed to be 1.012. Based on the above formula, the fresh water lens extends to a depth of 507 feet. Therefore, assuming status quo conditions, there apparently was an adequate supply of ground water to sustain the French settlement and enough to satisfy the ships' requirements.

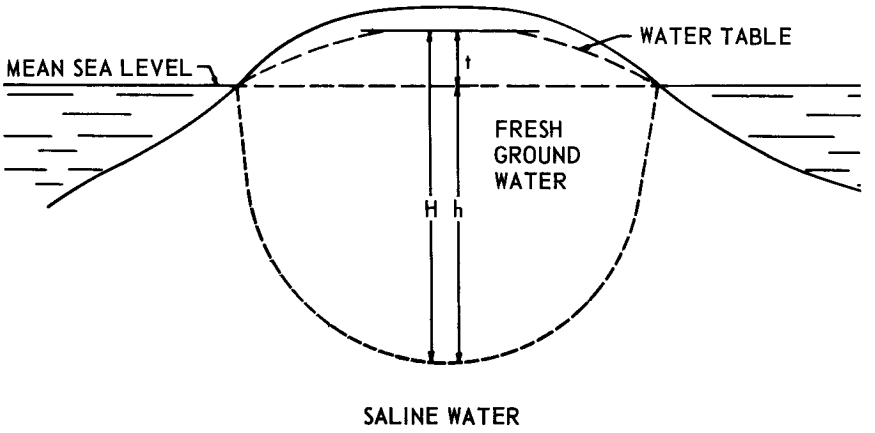


Figure 3.—Ghyben-Herzberg lens. Fresh ground water floats on saline water. *H* is the thickness of the fresh-water lens; *h* is the depth of fresh water below sea level; and *t* is the height of the fresh water above sea level. (Not to scale. After Tolman, 1937).

FORT LOUIS DE LA MOBILE

Two maps or plats of Fort Louis de la Mobile are shown by Hamilton (1952). The older map, dated 1702, shows the original settlement extending from an unnamed creek to the fort. Street names were not used and there is no notation concerning any wells. The map of 1706 (?) shows a settlement of possibly 1,000 inhabitants clustered in three districts, and streets are named. The first district is the old settlement near the creek, the second extends westward from the fort, and the third is grouped about *Le Marché* (market or trading center). The location of the community well is obvious and the word *puy* (puits: well) is shown thereon.

Only minor archeological excavations and study have been conducted on this French site and the exact location of the well has not been ascertained to date. Besides this well, the inhabitants of Fort Louis, no doubt, also obtained potable water from the nearby creeks and the Mobile River.

MON LOUIS ISLAND

Belle Fontaine on Mobile Bay marked the location of a large spring known to the French, British and Spaniards. Nicolas Bodin, a landowner on the island, made mention of this spring in 1710 that served the local populace (Hamilton, 1952). It is not known whether the spring is now under water as erosion of the coast line has occurred since that time, or if it is one that has been recently discovered in that general vicinity.

FORT CONDE

Compliance with the Federal Antiquities Act by the Alabama Highway Department permitted Fort Conde to be excavated within the right-of-way of the west portal of the I-10 tunnel in 1968 by the University of Alabama (Harris and Nielsen, 1972). Three old wells were found within the boundary of the fort.

Well no. 1 (fig. 4) has an outside diameter of 6.7 feet and an

Figure 4.—Well no. 1 excavated at Fort Conde, Mobile, Alabama. (Photograph from Harris and Nielsen, 1972)

inside diameter of 3.5 feet and extends through sand to a depth of 16.6 feet and is underlain by a stratum of blue clay. At a depth of 15.7 feet a circular wooden seat or well-digging device constructed of cypress was found (fig. 5). Atop this device lay unmortared blocks of sandstone which terminate 4.1 feet from the top of the well. The sandstone "casing" is capped by mortared brick curbing that continues to above the ground surface. Along the interior of the well the sandstone blocks were neatly laid, but on the back side other blocks were irregular in shape, smaller in size and more jumbled. They may have acted as a "gravel-pack" to filter out sand inasmuch as the water table may have been 3 to 4 feet below what was then ground surface. How long the well remained in use is not known, but artifacts from the well excavation represent British, Spanish, and American occupations of the fort (fig. 6). Apparently the well was abandoned by the British inasmuch as French artifacts were not found.

The method of well construction employed by the French to complete the well enabled them to dig through unconsolidated sands that had practically no slope-holding ability. They evidently excavated several feet and positioned their well-digging device and unmortared sandstone blocks were then fitted into place. Sediment was then dug out of the center of the device and the weight and height of the "casing" kept the unconsolidated sediment from sloughing into the well and aided in the downward movement of the device. Apparently, the well was constructed as it was excavated.

Well no. 2 has an inside diameter of 3.0 feet and is 11.4 feet in depth; 3.7 feet above mean sea level. A circular well-digging device of oak was found at the bottom of the well. The well's construction is similar to that of well no. 1 except that it lacks the upper mortared brick curbing.

Well no. 3, which is believed to have been the first well dug in the fort (1710-11), was found slightly to the west of the entrance of the Mobile County Courthouse subterranean garage within the right-of-way of Church Street. The well has a diameter of 5.5 feet and a depth of 9.5 feet. Construction of this well is similar to that of well no. 1 except that the well-digging device is octagonally shaped.

The approximate position of Fort Conde and the wells are shown

a. Device set in position as encountered in the excavation.
Note hammer for scale.

b. End view of one quadrant of the device.
Note beveled edge that aided in digging the well.

Figure 5.—French well-digging device from well no. 1, Fort Conde.

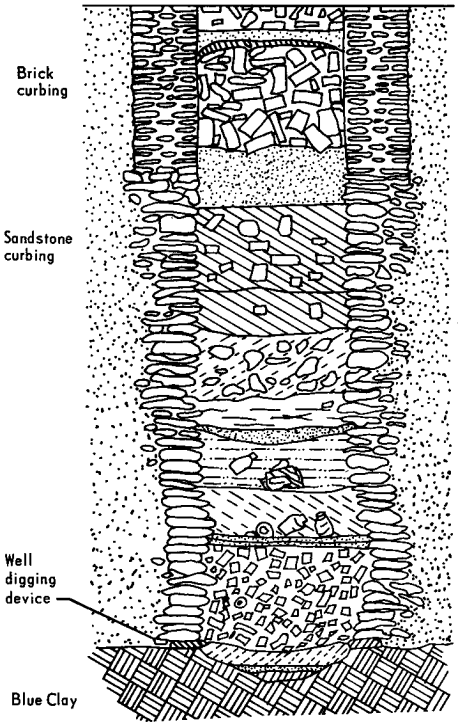


Figure 6.-Cross section of French well no. 1 at Fort Conde.

on the map of downtown Mobile and cross section drawn through the I-10 right-of-way (fig. 7). It is apparent that the fort's source of supply was perched water. Therefore, during periods of little or no precipitation, the amount of water undoubtedly would decrease and concomitantly, its quality would deteriorate. Whether the French were aware of the bountiful supply of potable water underlying the clay stratum is problematical. Further, as is noted below, both the British and Spanish during their occupancy of the fort must not have been aware of this deeper source of water either, as they did not deepen or use the fort's wells and obtained their water from surface sources.

BRITISH PERIOD

1763–1780

In 1769, Dr. Lorimer, a surgeon with the 21st Regiment, now stationed at Mobile, expressed concern about the quality of water and the resultant outbreak of yellow fever and had this to say: "From the wells at Mobile they can only draw what we call hard water, except it is after a considerable rain; and the river (Mobile River) contains innumerable impurities."

According to Hamilton (1952), the British dug two wells at Fort Charlotte in 1770 and evidently the water encountered did not ease the existing situation because in the same year Dr. Lorimer stated: "If the Three Mile Creek was then made to run through the town according to a plan which was long ago proposed and for a moderate sum would have been executed, we might expect to see Mobile a very comfortable place to live in all the year around ..."

There is nothing to indicate that these suggested improvements were carried out. Swamps, dead fish in the marsh opposite the town to the east, and the absence of wholesome water within 1.5 miles caused great suffering to the 21st Regiment (Pickett, 1851).

SPANISH PERIOD

1780–1813

Drinking water for Fort Carlota was brought from a stream (*Ruisseau*) about a league away. This stream undoubtedly was Three Mile Creek. Water also may have been obtained from Bayou Marmotte (*La Marmata*), One Mile Creek. Evidently, the Spaniards did not expand the water-supply system as utilized by the French and British.

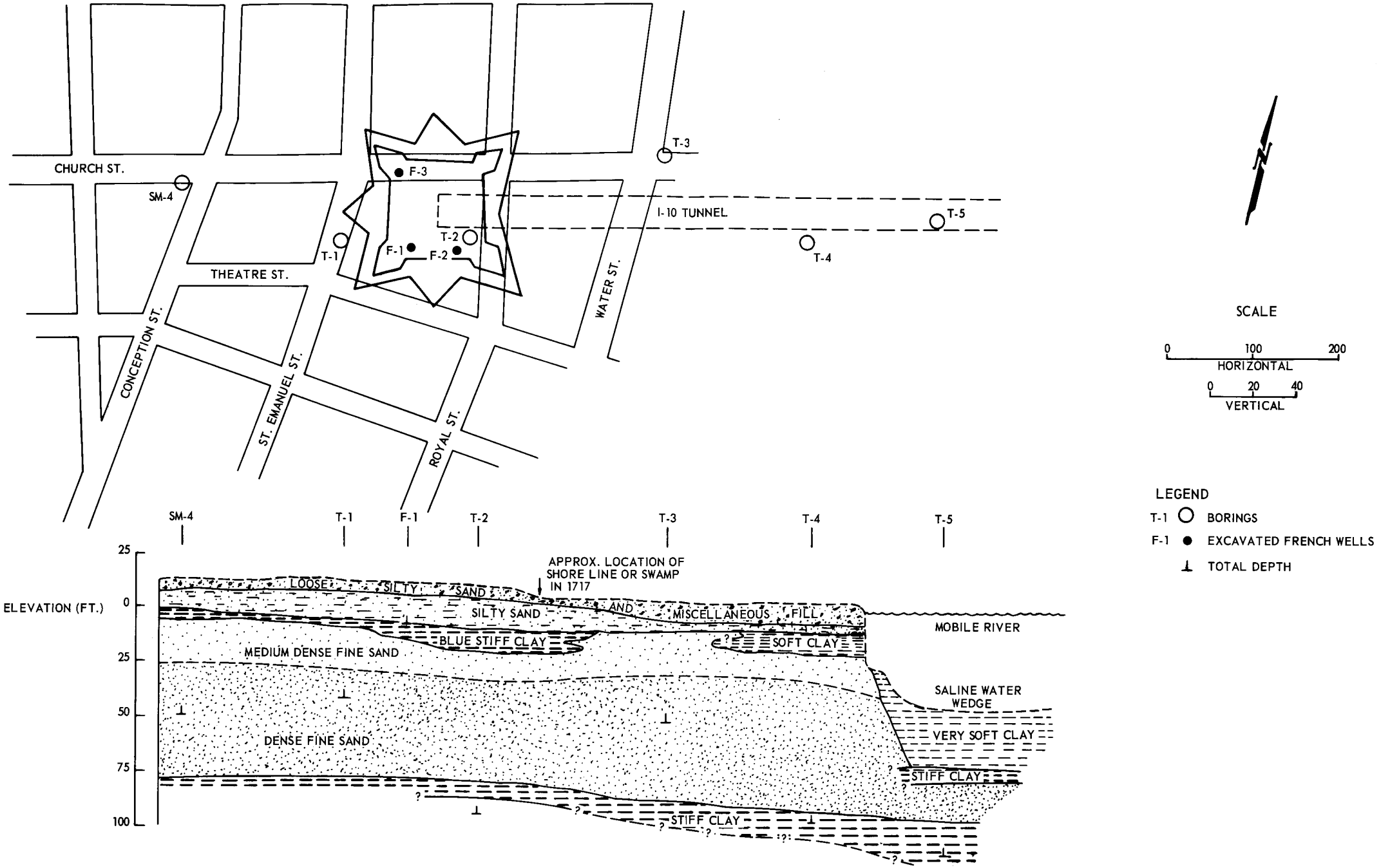


Figure 7.—Map and cross section of approximate position of Fort Conde and excavated wells relative to downtown Mobile.

AMERICAN PERIOD

1813–1973

In 1814 the Portage on Bayou Chotage (Three Mile Creek) was the important source of water supply for the city of Mobile. Water was hauled into the city for the use of the American troops and the citizenry. Several years later a charge of 50 cents per barrel for hauling was levied. Undoubtedly, the citizens of Mobile who owned residences or places of business had cisterns to collect rainwater. During the recent excavation of Fort Conde, a plaster-lined brick cistern, 6.0 feet deep with a top opening of 6.0 feet in diameter belled to 9.0 feet at its base was uncovered that contained artifacts that date to 1830-40. A few of the older residences yet standing in Mobile dating to the 1860's and earlier have similar cisterns. Also, it is believed that some residences may have had individual dug wells on their properties so that several sources of potable water were available.

In 1819 a public well was installed at the intersection of Dauphin and Royal Streets at what is now Bienville Square. This well was part of a plan for "sinking pumps," which was carried out several years later.

In 1820 the State legislature authorized the formation of a corporation known as "The Mobile Aqueduct Company." The act which was approved on December 20, 1820 stated:

> Whereas, it has been represented, that it would be of singular advantage to the health and convenience of the city of Mobile to be supplied with water from some of the running streams in its vicinity" ... "and whereas it has also been represented that certain individuals have agreed to associate themselves together for the purpose of conducting a supply of water from a creek called "Three Mile Creek" and provided that said corporation should construct an aqueduct of logs "with a calibre large enough to contain and conduct a sufficient amount to supply the citizens and other persons of Mobile with water" and that the corporation should "have and enjoy the exclusive right and privilege of conducting and bringing water for the supply of said city for a period of 40 years, ...

at the expiration of which time the works were to become the property of the city. Under the terms of the act, water was to be supplied to the city within three years.

The corporation failed to construct the water works as provided in the legislative act and on December 24, 1824, the State legislature transferred to, and vested in, the corporation to the city of Mobile for the use and benefit of the inhabitants thereof all the rights, privileges and immunities, powers, prerogatives and authority, which appertained to the defunct company.

In 1824 Henry Hitchcock had a canal dug from Three Mile Creek to convey water to the city. The extent of this canal is not known, and whether any water did flow through Mobile to the river is problematical.

Six years elapsed and the city did nothing about construction of the water works. In 1830 a committee was appointed by the city officials to determine the feasibility of bringing water into the city. On November 10 of the same year a report was submitted with reference to a spring which was recommended as a source of supply: "A spring situated about three quarters of a mile north of Three Mile Creek, a tributary of said Creek, and near the residence of Judge Lipscomb at Spring Hill." The committee stated that the spring was about 6.5 miles distant from the east side of Commerce Street at an elevation of 36 feet 7.5 inches above ground surface at the intersection of Dauphin and St. Joseph Streets.

On December 12, 1830, articles of agreement by the city of Mobile indicated that they would on or before the first day of January 1832, construct an aqueduct for the introduction of water into the city from a spring near the late country residence of Judge Lipscomb at Spring Hill.

The conduits were to be of good quality yellow pine and laid in the most direct way to the city "so as to cross Three Mile Creek just below Page's old place at Spring Hill, and at or near the place where Eslava commenced a canal; thence in a straight direction, as the ground would allow to Spring Hill Road, thence along said road to Dauphin Street. The calibre of each conduit is to be 5½ inches in diameter from the spring to Pollard's Hill and from thence to town, or the intersection of Dauphin and Dearborn Streets, 4½ inches."

Up to December 1836, wooden and cast-iron distribution pipes had been installed by the city along the middle or center line of the following streets:

WOOD SYSTEM

Dauphin Street	Dearborn Street to the Mobile River
Claiborne Street	Dauphin Street to Government Street
Government Street	Claiborne Street to the Mobile River
Conception Street	Government Street to St. Michael Street
St. Michael Street	Conception Street to the Mobile River
Water Street	St. Michael Street to Church Street

CAST-IRON SYSTEM

Dearborn Street	Dauphin Street to Conti Street
Lawrence Street	Dauphin Street to St. Louis Street
Joachim Street	Dauphin Street to St. Louis Street
Conception Street	Government Street to Church Street
St. Emanuel Street	Government Street to Eslava Street
Water Street	Church Street to Eslava Street
Conti Street	Dearborn Street to Royal Street
St. Francis Street	Franklin Street to Joachim Street
St. Louis Street	Hamilton Street to St. Joseph Street
Eslava Street	St. Emanuel Street to Water Street

The aqueduct and distribution system constituted the "Mobile City Water Works."

On December 1, 1836, the city of Mobile leased the water works to Henry Hitchcock and he was given a franchise to provide water for a period of 20 years. For the distribution system, other appurtenances and privileges, he was to pay the city the sum of $26,000 over a period of 5 years. The following water rates are noted on the Hitchcock document:

(a) Each person in private dwellings, including servants (persons 1 to 12 years of age to be estimated as "2 for 1"), $2.00 per annum

(b) Retail stores, $50.00

(c) Liquor stores doing a business of drawing off and bottling wine and other liquers, $100.00

(d) Coffee houses, $100.00

(e) For a bath in a private home, $5.00 each

(f) For ships, 50 cents per hogshead of 120 gallons

If an average family used more than 120 gallons per day, terms had to be arranged with the water company for the additional usage.

On December 25, 1837, the State legislature incorporated the Mobile Aqueduct Company and as a result Hitchcock in 1838 surrendered the water works and all appurtenances to the city of Mobile. Hitchcock's letter of January 17, 1838, to the city offered to transfer his contract with the city to the newly organized company provided that it assume his note for $26,000, buy certain property from him and pay him $10,000 in stock of the company for the privilege of the charter. The proposition was accepted by the city. And as a result, Hitchcock engaged an engineer, Albert Stein of New Orleans, who submitted a report to him dated January 29, 1838, concerning the introduction of water from Three Mile Creek into the city of Mobile. Stein stated:

> I examined the creek last year, and found it to contain an abundant supply of excellent water fully adequate to furnish a population of 50,000 or 60,000 persons with wholesome water for all domestic purposes, and at the same time to furnish an ample supply for public objects, in cleaning the streets and extinguishing fires. The mode of introducing this water must be by constructing a reservoir about 1,000 yards from the margin of the creek, where there is an eligible site; the reservoir to be filled by forcing pumps, and the water so obtained to be conveyed to the city, as far as Dauphin Street, by a main pipe, 2,700 yards in length.

He estimated the capital outlay for the entire system exclusive of land for the pump house and reservoir to be $120,000 and the net yearly income to be $23,000 based on water use by 2,000 families.

The people of Mobile did not respond favorably to Hitchcock's proposal and, therefore, the company was not formed. Hitchcock sold his interests in the water works to the city. It was 1840 before the city met with any success with its public water system. On December 26, 1840, the city of Mobile entered into a contract with Albert Stein which, in effect, gave him a franchise to supply the city with water for 20 years. Further, the contract provided that Stein deliver water to the city within 2 years. Also, that at the expiration of the 20 years, the value of the works constructed should

be determined by 6 arbitrators and the amount determined paid Stein by the city or any time thereafter when the works would become the property of the city of Mobile. All pipe on hand and that already installed were to be purchased by Stein from the city at the price they could be delivered at Mobile at the time of purchase.

On January 7, 1841, the agreement between the city of Mobile and Albert Stein was confirmed by the State legislature.

Stein, born in Dusseldorf, Germany, in either 1785 or 1786, was employed by Napoleon as a hydraulic engineer. He came to Cincinnati in 1817 and founded the water works for that city, and in the ensuing years established systems in Lynchburg and Richmond, Virginia; Nashville, Tennessee; and "engineered" the canal construction from Dayton to Cincinnati, Ohio. He arrived in New Orleans in 1832 and established their public water system and served as an engineer on channel improvements until he moved to Mobile in the latter part of 1840.

His first act after obtaining the franchise was to construct a pumping plant near the foot of Spring Hill, on Three Mile Creek, and to install a pipe line to an elevated tank located at the present site of Lyons Park (fig. 8). The pump site at Spring Hill was about 7 miles west of the downtown area whereas the tank site was about 2 miles from town. From the elevated tank, a system of lines extended throughout the city. Some of the lines consisted of cast-iron but the majority were bored-out pine logs. The log pipes that were used in the system were heart pine from 12 to 20 feet in length with a 5-inch bore. These logs were joined by an iron sleeve that was tapered from center to each end (fig. 9). According to Kay (1912), both an undershot water-wheel and a steam pump were installed at the point of intake (several miles further upstream than indicated in Stein's report to Hitchcock) on Three Mile Creek until purchased by the city in 1898. This was Mobile's only public water system until 1886.

Mobile's first sewer was installed in Conti Street in 1868, at the time the old Gulf City Hotel, later known as the Southern Hotel, was erected at the southeast corner of Conti and Water Streets. In 1889 the city granted a franchise to the Conti Street Sewer Company for construction of a sewer line in Conti Street. This line, with laterals into several side streets, served the immediate downtown

Figure 8—Lyons Park at Springhill Avenue and Catherine Street in Mobile, site of the old Stein Water Works Reservoir. Offices and shop of the Mobile Water Service System are in the background. View is to the north.

Captain Pat J. Lyons served as a Mobile city official for 21 years from 1897 to 1918 and mayor from 1904 to 1918. He was the central figure in the city's drive for a municipal water works system. His political supporters contended that he had induced the Bienville Water Supply Company to reduce the price of their plant from $600,000 to $350,000, the price the city finally paid for it. During his adminstration, the city transformed the old Stein reservoir site into a playground. In recognition of his pioneer work in beautifying Mobile, the city named Lyons Park after him.

Figure 9—Wooden pipe, circa 1840, excavated from one of the streets in downtown Mobile. Note the dark circle which represents a part of an iron sleeve used to connect the log pipes. The bore is approximately 5 inches. The pipe is on display at the office of the Mobile Water Service System.

area. About 10 years after the sewer was installed, the city acquired it in May, 1899, and it became a part of the general sewer system. Those persons who owned property served by the Conti Street Sewer Company were exempt from payment of sewage taxes levied by the city.

Users of Mobile's sewer system were required by law to pay a fixed charge of 30 cents a month where water-use did not exceed 3,750 gallons a month, plus a monthly charge of 10 cents for every 1,000 gallons used in excess of 1,750 gallons and not exceeding 3,750 gallons. If the use exceeded this amount, then a schedule of fixed monthly charges ranging from 30 cents to $7.50 applied, and in addition, the user paid a charge based on the quantity of water used.

On April 9, 1886, the Bienville Water Supply Company was organized with Dr. George A. Ketcham as its president. This company constructed a pumping plant on Clear Creek off Moffat Road (fig. 10) and a 10 million-gallon reservoir, still in use, on Moffat Road

a. View along axis of the masonry dam that impounded water for the pumping plant.

b. Downstream view of dam. Apparently, gate valve was used in lieu of a spillway. Paved channel downstream of dam leads to creek.

Figure 10—The remains of the Bienville Water Supply Company pumping plant (?) on Clear Creek off Moffat Road.

across from the present E. Morgan Stickney filtration plant (fig. 11).

Figure 11—The 10 million-gallon reservoir, still in use, constructed by the Bienville Water Supply Company on Moffat Road across from the E. Morgan Stickney filtration plant.

A 24-inch diameter cast-iron pipe was installed into the heart of the city with necessary distribution lines into the business district and residential areas in 1887. Mobile, for the first time in its 175-year history had a water supply system that approached adequacy.

Albert Stein died in 1874, but the water system continued to operate in his name and separate from the Bienville Water Supply Company until 1898. Because neither the Stein nor the Bienville Companies were able to extend their distribution lines to meet the demand of the expanding population, in 1898, after some litigation, the city acquired the properties and water-rights of the Stein interests, and decided to construct a public-owned supply. In 1900, the city system was put into operation. The pumping station was on Three Mile Creek at the east end of what is now city park property and the reservoir, still in use, was atop Spring Hill near the small elevated tank. On July 1, 1901, the operation of the old Stein plant

was discontinued. Most of the cast-iron distribution system of the old plant was removed and either relaid or sold.

By 1904 so many connections to the new city works had been made that the supply in Three Mile Creek at the Spring Hill pumping station was insufficient to furnish the required water. An auxilliary pumping plant of 3.5 million gallons daily capacity was installed on the site of the old Stein plant. This auxilliary plant was put into operation on October 2, 1905.

The Beinville and the city systems, after the abandonment of the Stein system, operated as virtually parallel, but separate systems until January 8, 1907, when the city acquired the Bienville holdings for $350,000. Since that time the two systems have been interconnected and operated as one.

During the period from 1907 to 1940, the city kept pace with providing water service for the population growth until the outbreak of World War II when it became increasingly apparent that the existing sources of supply were inadequate and undependable. A new source was necessary not only because of lack of a sufficient quantity, but because the water sheds of Clear and Three Mile Creeks were becoming more urbanized and the quality of the supply was endangered. The source of supply recommended by the Mobile Water Works to the City and Planning Commissions was Big Creek, in the western part of Mobile County. The Big Creek project was placed in service in 1952 at a cost of about $7,000,000 including land, dams, pumphouse, reservoir and pipelines. Construction required two years.

Water is delivered from the 3,600-acre lake (fig. 12) and pumping station by means of two 60-inch diameter pipes, 9 miles each in length, to reservoirs of 20 and 50 million gallon capacity, where it is diverted either to domestic or industrial use. The reservoirs are at an elevation of 220 feet and industrial water is delivered by gravity through a 48-inch diameter pipe to industry at an elevation of about 25 feet. The industrial water line extends from the filter plant northwardly about 7 miles to the industrial sites at Magazine Point. Pumps at Big Creek Lake can handle about 100 million gallons per day (mgd) of which only 20 to 30 mgd are filtered for the Mobile supply. The remainder is delivered, untreated, to local industries such as chemical plants and paper mills.

Figure 12—Part of Big Creek Lake. View is northeast showing earth-filled dam and gated spillway. Paved channel leads to Big Creek. (Photograph courtesy of Mobile Water Service System)

The E. Morgan Stickney filtration plant on Moffat Road (fig. 13) has a nominal capacity of 40 mgd but in an emergency 45 mgd can be processed. Current usage is about 25 mgd. Treated water storage is 24 million gallons, on gravity to the city. The old Bienville and Spring Hill reservoirs, each of 10 million gallon capacity, act as standing wells in the system and furnish the excess needed at peak loads. They also constitute a reserve supply in case the filter plant is shut down. Adequate trunk mains, two 24-, one 30-, and one 48-inch, insure continuous service and maintain pressures of 75 to 85 pounds. The domestic supply is considered adequate for a population of about 400,000.

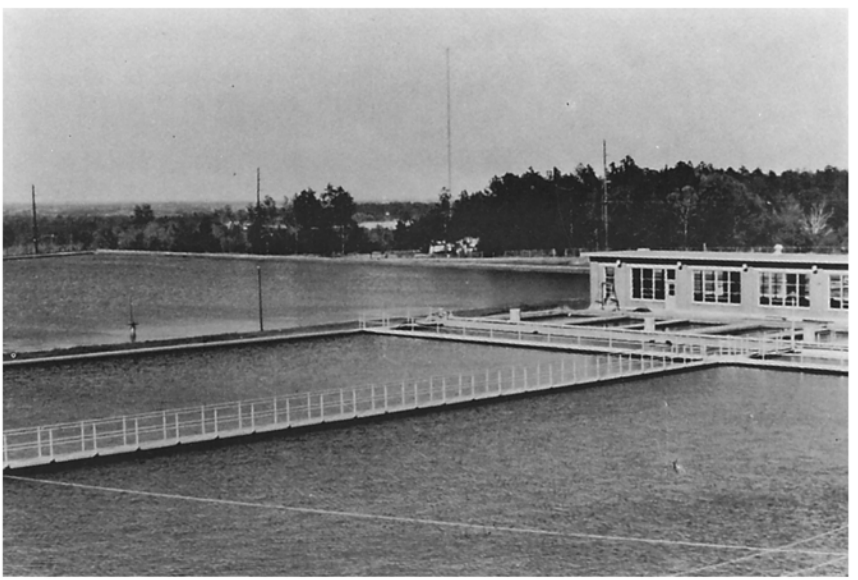


Figure 13—Sedimentation basins of the E. Morgan Stickney filtration plant on Moffat Road.

Raw water from Big Creek Lake is prechlorinated (5 ppm) prior to coagulation with aluminum sulfate and lime to remove sediments and organic matter, brown color, and turbidity. After settling of precipitants in sedimentation basins, the water is passed through a sand filter composed of 30 inches of sand and 12 inches of gravel. The water undergoes secondary lime treatment to adjust the pH.

Post-chemical treatment consists of fluoridation whereby fluoride as sodium silicofluoride is added after filtration because fluoride can be removed by the lime-softening and alum-coagulation processes. In winter 60 ppm is added; in summer, 0.7 ppm.

Prior to distribution and while in storage, the water undergoes a final post-chlorination treatment. The amount of chlorine added to the finished water depends upon the organic matter content as well as those chemicals in the water that will react with the chlorine. Sufficient chlorine must be added to assure that bacterial growth is suppressed during delivery.

Coagulation, water softening and pH adjustment change the chemical composition of the raw water. Chemical analyses of raw and finished water from Big Creek Lake are shown in table 1. The amount and value of chemicals used by the filter plant in 1970 is shown in table 2.

Table 1—*Chemical analyses of raw and finished water from Big Creek Lake*

Chemical Analyses (In parts per million)		
	Big Creek*	Finished Water
Silica (SiO_2)	3.2	3.2
Iron (Fe)	.03	.00
Calcium (Ca)	.0	11
Magnesium (Mg)	.6	.4
Sodium (Na)	2.1	2.8
Potassium (K)	.3	.4
Bicarbonate (HCO_3)	4	14
Carbonate (CO_3)	0	16
Sulfate (SO_4)	.6	16
Chloride (Cl)	2.3	3.0
Fluoride (F)	.0	1.1
Nitrate (NO_3)	.2	.2
Dissolved solids (residue at 180° C)	34	83
Hardness as $CaCO_3$	2	30
Noncarbonate hardness as $CaCO_3$	0	18
Specific conductance (micromhos at 25° C)	18	94
pH	5.8	6.5
Color	40	20

*1962

Table 2—*Chemicals used by the E. Morgan Stickney filtration plant in 1970 for treatment of raw water*

Chemical	Pounds	Ppm	Cost
Aluminum sulfate	1,369,682	18.23	$28,615.58
Lime, primary	472,460	6.27	
Lime, secondary	747,150	9.88	
Lime, total	1,219,610	16.15	12,186.28
Chlorine	379,525	5.04	17,312.28
Sodium silicofluoride	98,341	7.88	9,549.05

Filtration costs, including the cost of the above chemicals, cost of raw water, labor and electricity, and miscellaneous costs, are $1.78 per 1,000 gallons of finished water.

Prior to World War II, there was no treatment of the raw water other than minor chlorination. Even though the city was aware of the situation, lack of funds prevented the construction of a treatment plant. During the early part of the war, the U.S. Government, cognizant of the circumstances, decided that properly treated water would help the war effort. This resulted in the construction of a 20 mgd plant on Moffat Road with Federal Works Administration funds at a cost of 1.3 million dollars. The plant went into operation in 1944. After the war, the Government turned the plant over to the city of Mobile for a small fraction of the original cost. In 1956, the plant capacity was increased to 30 mgd with filtering facilities capable of 40 mgd.

On September 18, 1952, the State legislature enacted "The Enabling Act" which empowered a municipality to create an entity with powers to acquire, purchase, maintain and operate a water system or any part thereof. So that money could be raised from issuance of bonds to update the existing water system, the Board of Water and Sewer Commissioners was created. The Board entered into a contract with the city of Mobile on October 1, 1952, whereby the Board agreed to purchase the water and sanitary sewer systems on behalf of the city.

The Mobile Water Service System, comprised of the finished water-supply and the sanitary-sewer systems, is publicly owned and is operated by the Board under a deed of trust from the city. This Board consists of five members that are appointed by the City Commission. Raw water was purchased from the City Water Works

Board from 1952 to 1968, an entity which was established prior to the creation of the Board of Water and Sewer Commissioners. The two Boards were merged on January 1, 1968, with the Board of Water and Sewer Commissioners taking over the raw water system.

A new water system, which consisted of a 60 million-gallon reservoir, 2 pumphouses, 12 miles of open canal, a 100-acre lake and pipe lines of 60-, 72-, and 78-inch diameter, was completed and placed in operation in 1969. Initially, a pumping capacity of 70 mgd was installed that can be increased by the addition of more pumps. Canal capacity is 350 mgd. This supply is obtained from the Mobile River and, a tributary, Cold Creek. The industrial rates for averages of 1 mgd or more vary from $35 to $75 per million gallons depending on the average rate of use.

Not all of the water supply for the city of Mobile was from surface sources; ground water also was utilized. In fact, ground water was used commercially in the city prior to 1900 in breweries and for the manufacture of ice. Water-table conditions exist in the shallow alluvial sand and gravel aquifer that underlies the downtown business district of Mobile. Unconfined water which is encountered in wells 25 to 100 feet deep was used extensively for air-conditioning (1937 and thereafter) for stores and other commercial establishments, and to a lesser degree for the manufacture of ice, other industrial uses and probably for small domestic supplies even though the city supplied most of the water for domestic and industrial use. Maximum use of these wells occurred about 1942 when heavy withdrawals of ground water (2 mgd) caused salt-water intrusion into parts of the shallow aquifer.

Saline water from the Gulf of Mexico flows into Mobile Bay and Mobile River and some of its tributaries as a wedge that extends upstream along their bottoms. This upstream flow is impeded when the downstream flow of fresh water is increased.

Before extensive pumping of the numerous wells began, salt-water intrusion into the shallow aquifer was prevented by an adequate head of fresh water above sea level which was sustained by local precipitation. During the early stage of well-field development in the business district, recharge by rainfall kept pace with ground water withdrawals. However, overdevelopment of the well field coupled with a well-point system to dewater the excavation for the

construction of the Bankhead Tunnel under the Mobile River in 1941 increased the quantity of water withdrawn. The amount of water pumped exceeded that of recharge so that the head of fresh ground water above sea level was sufficiently lowered to allow salt water to infiltrate the shallow aquifer. The cone of depression created by this concentrated withdrawal caused movement of high chloride water from the Mobile River into the aquifer.

According to chemical analyses, the chloride content of the ground water increased rapidly between 1942 and 1945 (Peterson, 1947). Since 1945, however, because of abandoned shallow wells and removal of the well-point system, recharge apparently had exceeded withdrawal and a decrease in chloride content was noted.

Dewatering, however, for the west portal excavation for the I-10 Tunnel beneath the Mobile River in 1970-71 increased the amount of water withdrawn and salt water again invaded the shallow aquifer. Water analyses from two dewatering wells, one to a depth of 60 feet and the other 100 feet deep, indicated chloride contents of 8,200 and 1,200 ppm, respectively, in 1971. A chloride content of 6,170 ppm was noted for the latter well in 1970. Since completion of the tunnel in early 1973, chemical analyses indicate the chloride content of the shallow water is decreasing. The acceptable concentration of chloride for a public water supply, according to the Public Health Service (1962), should not be in excess of 250 ppm.

The deep Miocene aquifer that underlies the alluvium in the downtown area at 700 to 850 feet below the surface currently supplies considerable quantities of ground water. Wells are reportedly pumped at rates up to 1,000 gallons per minute (gpm). Although this water contains a chloride content ranging from 1,400 to 2,500 ppm, its use in large industrial cooling systems has proved to be satisfactory to date.

Water-use for public water supply for Mobile County in 1970 is shown in table 3.

OUTLOOK

It is estimated that the projected population of Mobile will approach 730,800 by the year 2020 (South Alabama Regional Planning Commission, 1972). This projection is based upon the assumption that Mobile will annex several adjacent municipalities and the

Table 3—*Water use for public water supply for Mobile County, 1970*

Population served			Number of services	Persons per service	Average water use (mgd)					Per capita use (gpd)	
By ground water	By surface water	Total			Ground water	Surface water	Residential	Commercial and industrial	Total	Residential	Total
18,600	239,800	258,400	76,114	3.4	2.97	115.82	23.88	94.91	118.79	92	460

After: **Peirce, 1972**

more populous unincorporated areas. Also, it is assumed that the current trend of rural to suburban shift of population will continue.

Assuming residential water-use in the Mobile area remains at 23.88 mgd (table 3), and the population estimate is correct, the municipal demand for water for residential use will be 50.0 mgd in 1995 and 86.23 mgd in 2020 as indicated by the low projection in figure 14. Similarly, projection of the current demands for water for all municipal uses results in a future total demand of 258.35 mgd in 1995 and 448.70 in 2020 (fig. 15). However, present trends in water use will undoubtedly affect the low projection because the amount of water that is delivered to each customer had steadily increased caused by larger quantities of water required for personal use; larger quantities required by an increase in service industries; and the increased use of municipal water by medium and heavy industry.

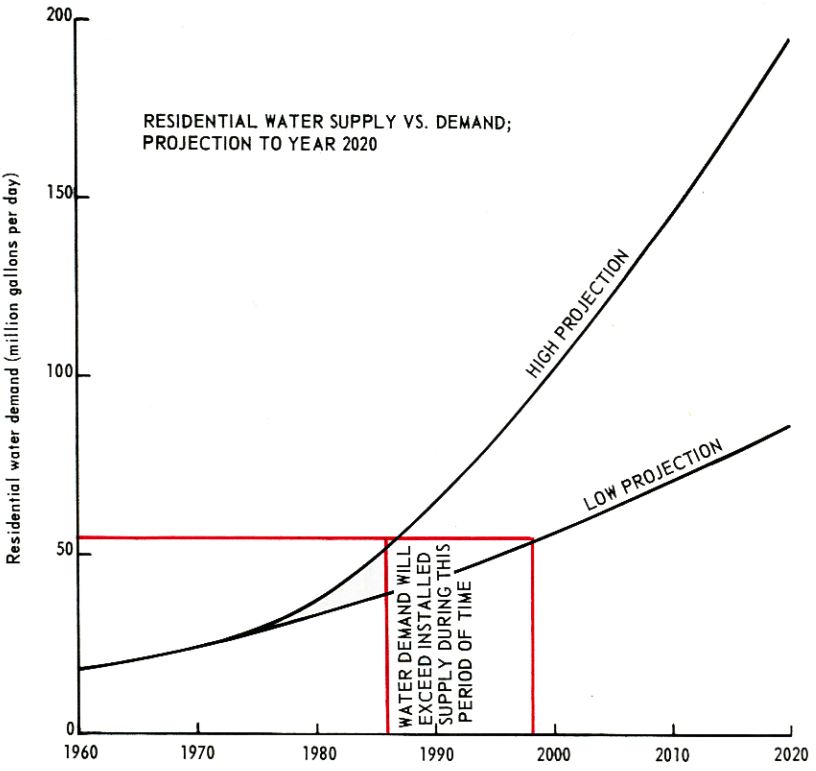


Figure 14—Projected residential water demand for the greater Mobile area.

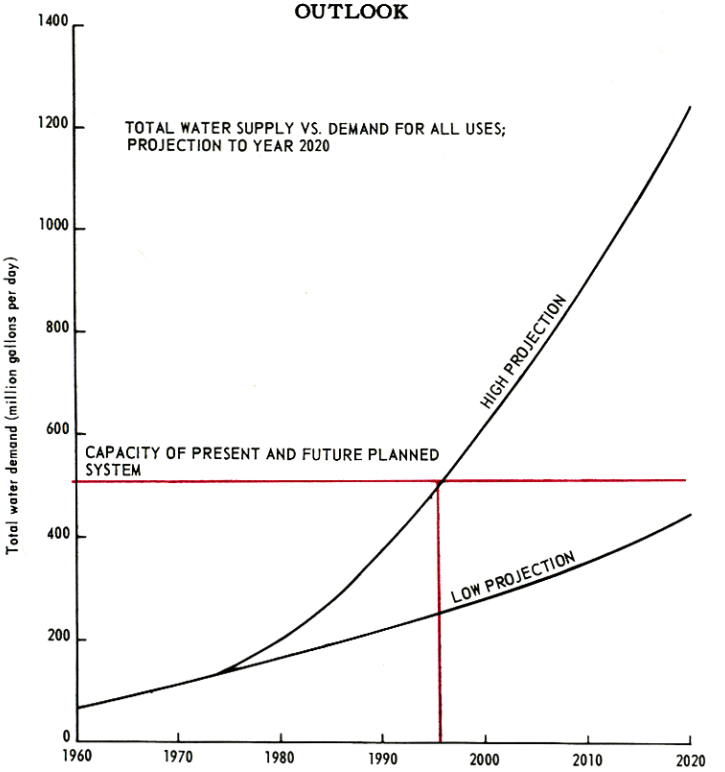


Figure 15—Projected total water demand for the greater Mobile area.

Allowances were not made in the projections for future improvement of practices or advances in technology. For this reason the high projections were computed. These assume that the water demands will increase yearly based on the rate of increase between 1960 and 1970. Therefore, future municipal demands for all uses are anticipated to increase from 118.79 mgd in 1970 to 1242.36 mgd in 2020 (fig. 15).

Inasmuch as water-use was projected based on various criteria, and the existing installed capacities of the Mobile Water Service System and other municipal systems are known, an estimate of the future adequacy of the combined total supply as it now exists and as it may exist in the future can be made. The present municipal water supply for the greater Mobile area consists of 54 mgd total capacity which includes the Big Creek Lake supply (40 mgd), the Prichard supply from Eight Mile Creek (8 mgd), and several municipal water wells (6 mgd). The combined total capacity of these systems, if the high projection proves more accurate, will become inadequate to meet the residential needs in 1984 as indicated in figure 14. If the

low projection holds true, the supply will be adequate to meet the residential needs until 1998. Present trends indicate that the demand probably will follow the high projection more closely, placing the date at which the demand exceeds the supply nearer to 1984 than 1998.

The capacity of the present and future planned municipal water systems for all municipal and industrial uses is shown in figure 15. The future combined system consists of the north Mobile industrial supply (350 mgd), the Big Creek Lake supply (100 mgd), the Escatawpa River supply (50 mgd), the Prichard supply (8 mgd), and several municipal water wells (6 mgd); a total capacity of 514 mgd. If the high projection holds true, the system, as planned, will be adequate for future demands until 1996. Should water-use follow the low projection, the system should be adequate to meet the water demands in 2020. Water demands for all uses probably will follow the high projection more closely, indicating a need for additional capacity sometime after 1996 (Riccio, and others, 1973).

A preliminary analysis of the practical sustained water yield to be expected from both ground and surface sources in the greater Mobile area is approximately 11.84 billion gallons per day (bgd). This yield is the rate at which water can be continuously withdrawn without exceeding the rate of natural replenishment of the source or causing undersirable changes in water quality. It is evident, therefore, that the total water resources of this area greatly exceed the water demands of the forseeable future.

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