STATE OF FLORIDA
STATE BOARD OF CONSERVATION
Ernest Mitts, Director

FLORIDA GEOLOGICAL SURVEY
Robert O. Vernon, Director

INFORMATION CIRCULAR NO. 21

FINAL REPORT ON AN INVENTORY OF FLOWING ARTESIAN WELLS IN FLORIDA

LEADING TO THE ENFORCEMENT OF
SECTIONS 373.021-373.061
FLORIDA STATUTES
1957

By
Charles W. Hendry, Jr.
and
James A. Lavender

Tallahassee, Florida
1959

LETTER OF TRANSMITTAL

FLORIDA GEOLOGICAL SURVEY
Tallahassee
April 1, 1959

Mr. Ernest Mitts, Director
Florida State Board of Conservation
Tallahassee, Florida

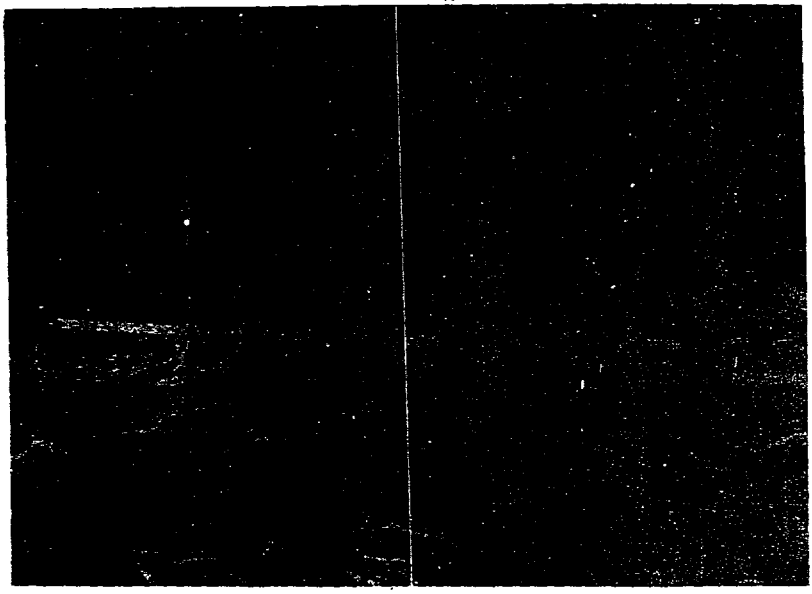
Dear Mr. Mitts:

I respectfully transmit the final report on an inventory leading to the enforcement of Sections 373.021-373.061, Florida Statutes, 1957, prepared by Charles W. Hendry, Jr. and James A. Lavender of the Water Investigations, Florida Geological Survey.

This report published as Information Circular No. 21, together with the interim report published in 1957 as Information Circular No. 10, Florida Geological Survey, illustrates as completely as possible the situation that now exists among the freely flowing wells of the State.

Submitted,

Robert O. Vernon, Director



An abandoned 8-inch well flowing in excess of 800 gallons per minute. This well is located in section 32, T. 7 S., R. 30 E., St. Johns County, Florida.

CHAPTER 28253, 1953 LAWS OF FLORIDA
SENATE BILL NO. 57, 1953

AN ACT to protect and control the Artesian Waters of the State; providing duties of certain State and county officers in regard thereto; and providing a penalty for the violation of this Act.

Be It Enacted by the Legislature of the State of Florida:

Section 1. Every person, stock company, association or corporation, county or municipality, owning or controlling the real estate upon which is located a flowing artesian well in this state, shall, within ninety (90) days after the passage of this act, provide each such well with a valve capable of controlling the discharge from such well, and shall keep such valve so adjusted that only such supply of water shall be available as is necessary for ordinary use by the owner, tenant, occupant or person in control of said land for personal use and in conducting his business.

Section 2. The owner, tenant, occupant or person in control of an artesian well who shall allow the same to flow continuously without a valve, or mechanical device for checking or controlling the flow, or shall permit the water to flow unnecessarily, or shall pump a well unnecessarily, or shall permit the water from such well to go to waste, shall be guilty of a misdemeanor and subject to the penalties provided by law.

Section 3. For the purposes of this act, an artesian well is defined as an artifical hole in the ground from which water supplies may be obtained and which penetrates any water bearing rock, the water in which is raised to the surface by natural flow, or which rises to an elevation above the top of the water bearing bed. Artesian wells are defined further to include all holes, drilled as a source of water, that penetrate any water bearing beds that are a part of the artesian water system of Florida, as determined by representatives of the Florida Geological Survey.

Section 4. Waste is defined for the purposes of this act to be the causing, suffering, or permitting any water flowing

from, or being pumped from an artesian well to run into any river, creek, or other natural watercourse or channel, or into any bay or pond (unless used thereafter for the beneficial purposes of irrigation of land, mining or other industrial purposes of domestic use), or into any street, road or highway, or upon the land of any person, or upon the public lands of the United States, or of the State of Florida, unless it be used thereon for the beneficial purposes of the irrigation thereof, industrial purposes, domestic use, or the propagation of fish. The use of any water flowing from an artesian well for the irrigation of land shall be restricted to a minimum by the use of proper structural devices in the irrigation system.

Section 5. The state geologist, assistant geologists, or any authorized representative of the Florida Geological Survey, the sheriff or any deputy sheriff, shall have access to all wells in the state with the consent of the owner.

Should any well be not provided with a valve as required in section one (1) of this act, or should any well be allowed to flow in violation of section two (2) of this act, then and in such event, the state geologist, assistant geologists, or any authorized representative of the Florida Geological Survey, or the sheriff or any deputy sheriff shall, upon being informed of such fact, give notice to the owner to correct such defect, and if the same be not corrected within ten (10) days thereafter, shall have authority to install the necessary valve or cap upon such well and control the flow therefrom in accord with the provisions of section one (1) and two (2) of this act. The cost of such installation of such valve and the control of the flow from such wells if made by such officials shall be at the expense of the owner, and for the payment thereof, the agency or party incurring the expense shall have a lien upon the lands upon which such well is located. Said lien may be duly recorded in the public records in counties wherein such lands are located and may be enforced by foreclosure in the circuit courts of the circuit wherein such lands are located. In such foreclosure proceedings, the court shall allow a reasonable attorney's fee to the plaintiff for the preparation and recording of such lien and the legal proceedings incident to the foreclosure of same. Such liens shall be assignable

both before and after recording, and the assignee thereof shall have all authority of foreclosure which the assignor thereof originally had.

Section 6. Nothing in this act shall be construed to apply to an artesian well feeding a lake already in existence prior to the passage of this act, which lake is used or intended to be used for public bathing and/or the propogation of fish, where the continuous flow of water is necessary to maintain its purity for bathing and the water level of said lake for fish.

Section 7. All laws and parts of laws in conflict with this act are hereby repealed.

Section 8. This act shall take effect immediately upon becoming a law.

Became a law without the Governor's approval.

Filed in Office Secretary of State June 15, 1953.

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INTRODUCTION

An adequate supply of potable water serves as one of the foremost requirements in our expanding society today. This vital resource ranks high among the many that make Florida attractive to the nation's growing industry and population. Our State, as a whole, is blessed with an abundance of potable ground water, and at the present time over four-fifths of the water used in Florida is derived from subsurface sources. In some specific areas of the State there are problems in maintaining an adequate ground-water supply. The problem of salt-water intrusion is one which may be found in some coastal areas where large volumes of water must be withdrawn from permeable formations in contact with sea water. Also, the problems of declining aretesian pressure, water waste and aquifer contamination are becoming more prominent because of their widespread occurrence. A major contributing cause of these problems is the misuse and insufficient care of artesian wells. Not only has population and industrial growth in these problem areas been retarded, but there have been ill effects on valuable property in the State.

Water conservationists have long sought legislative measures and controls that would help to conserve the water resources of Florida. Advocating sound water management has always been part of the program of the Florida Geological Survey. The earliest reports of the Survey point out the importance of adequate water supplies to the growth of Florida

and the necessity for proper conservation practices. Following the wet years of 1948 and 1949 Florida experienced a period of severe drought. During this dry period many misuses of the artesian waters of the State stood out as glaring examples of water waste. This waste, along with the inconvenience caused by low streams and dry lakes, and the increased expenditure to secure adequate water supplies encouraged water conservationists to seek and gain from the 1953 Legislature regulatory measures with which to curtail the misuse and insufficient care of artesian wells in Florida.

This legislation required that valves be installed (wild flowing wells to be capped) on all flowing wells and that the artesian water not be wasted. Since the Florida Geological Survey is empowered to designate which of the water-bearing beds in Florida are a part of the artesian system of the State, the Survey was made the regulating agency of this 1953 statute pertaining to artesian wells. Acting upon this mandate of the Legislature (Chapter 370.051-370.055, Florida Statutes, 1953), the Florida Geological Survey initiated a program designed to help protect and control the artesian water of Florida. Not until 1955 (Ch. 29966, F. S. 1955), however, did the legislature provide an appropriation with which to fully implement the program.

A management or conservation program would be relatively ineffective if based on the premise that not using the resource was the best approach to conservation. Fortunately, Florida's legislation dealing with water conservation is set up not to deny consumer demands, but to correct wasteful practices in water consumption. Large sums of money and much effort have been expended in these endeavors with varying degrees of success. Chapter 373.021-373.061, Florida Statutes, 1957, provides for the final disposition of all artesian wells coming under the jurisdiction of this law. No final solution of any problem dealing with the water resources of the State can be had without first gathering data on the various aspects concerning the water supply. These pertinent facts must be observed, recorded and correlated, since these operations constitute the first step upon which the remainder of the program depends.

During the planning stages of the current program it was

estimated that the time required to complete an inventory of all artesian wells in the State would far exceed the interim, 1955-57. However, it did seem advisable to undertake an inventory, primarily, of wildly flowing wells as the first phase of the program. It was preferred that a well-inventory program be initiated that would provide enough data to determine the extent of the problem by the time the 1957 Legislature convened. In outlining a well-inventory program to meet this requirement, the following conditions were considered: (1) that the data collected would, very likely, be used in the enforcement of Chapter 370.051-370.055, Florida Statutes, 1953; (2) that the data collected would be included in the report to be furnished the Legislature; and (3) that the program should encompass as much of the State as possible and be representative, if not comprehensive.

A progress report on the first phase of the program was submitted to the 1957 Legislature as Florida Geological Survey Information Circular No. 10. Included in that report was a description of the classification and occurrence of subsurface water. The supply of Information Circular No. 10 is exhausted and is no longer available for reissue to the 1959 Legislature; therefore, the discussion on the occurrence of subsurface water is repeated herein. There was also included in Information Circular No. 10 a table listing detailed information on 967 inventoried wells. These data and those collected since the publication of the 1957 interim report are a part of the permanent files of the Florida Geological Survey. The inventory program to date has information on over 4,000 wells, covering 45 counties. Since it would be impractical to prepare a table illustrating detailed information on each well as was done in the first report, there are included in this report tables that reveal the information statistically.

It is presumptuous to assume that any single phase of data collecting could produce a comprehensive evaluation of the ground-water resources. These basic data that are essential for an understanding of our ground-water resources have been collected by numerous agencies. Some of it has been collected sporadically, some collected in very limited areas, and some by special-interest groups who do not make it available for public use. In that this report deals only with a single facet of our water-problem investigations, the reader's

attention is directed to the conclusions and, specifically, the recommendations of this report.

SUBSURFACE WATER

Florida's growth has left its mark on our ground water in lowered well-water levels and increased contamination. Perhaps such is the cost of expansion, but reports about declining water levels, recklessness in withdrawal, and contamination of water are to no avail unless they stimulate the creation of control authority, both administrative and technical, which will carry out the task of sound ground-water management. The following description of the classification and occurrence of subsurface water is inserted as an aid to those who have the responsibility of evaluating our water-resource investigations and of providing legislation which would contribute to the proper use and development of our subsurface supplies.

Classification

Water occurs underground in two zones: the zone of aeration and the zone of saturation. These two zones are separated by the water-table which may be defined as plane above which the voids in the rock contain both water and air (zone of aeration) and below which all the voids are fully filled with water (zone of saturation) (fig. 1). The water table conforms rather generally with the configuration of the land surface, normally intersecting the surface of ponds, lakes and streams.

Subsurface water is derived from rainfall, but not all of the water that falls on the earth as precipitation becomes subsurface water. Some of it remains as surface water or is returned to the atmosphere as evaporation. That which seeps into the subsurface is partially utilized by the roots of shrubs and trees, and the remainder percolates downward to the zone of saturation. Only the subsurface water that reaches this zone of saturation is available to supply wells and springs.

All the water below the ground surface is called subsurface water, but only that which is in the zone of saturation is

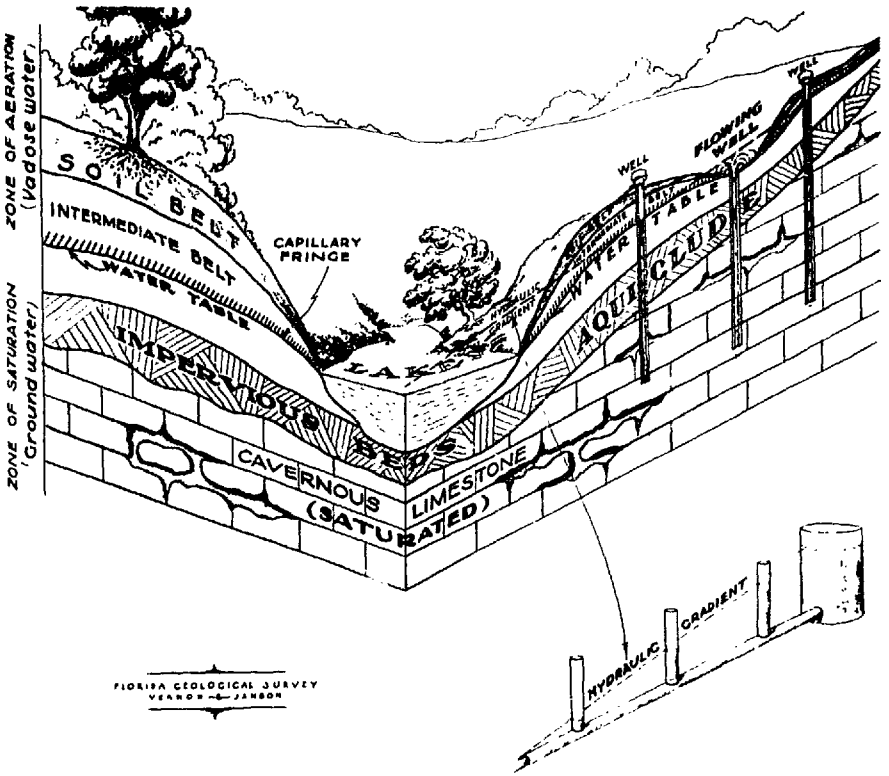


Figure 1. Ground water classification.

referred to as ground water. A bed of sediment that is permeable enough to allow movement of this ground water to supply wells and springs is called an aquifer.

Ground water may occur as nonartesian (water table) water or as artesian water. Where water in an aquifer freely rises and falls, responding to rainfall, evaporation, transpiration, and withdrawal by supply wells, it is said to be under water-table conditions. Water that has moved into a permeable bed that lies beneath a relatively impervious bed, called an aquiclude, is confined and its surface is not free to rise and fall. This water is under artesian conditions.

Occurrence

Ground water in Florida occurs under both water-table and artesian conditions. The largest portion of that known as the artesian water occurs in an extensive limestone system,

called the Floridan aquifer. Where the Floridan aquifer is absent (santa Rosa and Escambia counties) or where this aquifer yields water that is too highly mineralized for most uses (along the east coast and the peninsula below Lake Okeechobee), there are several shallow formations of relatively small areal extent that provide ground water for use under water-table or localized artesian conditions (fig. 2).

Floridan Aquifer

The Floridan aquifer serves as our principal source of ground water and it underlies the southern parts of Georgia, South Carolina, and Alabama, and all of Florida except for the westernmost part of the Panhandle (fig. 3). The limestone strata that comprise this aquifer underlie these states up to depths of several thousand feet. At some places, the top of this aquifer is exposed but generally it is covered by several hundred feet of an impervious cover of sands, sandstones, dense limestones and clays which confine the artesian water.

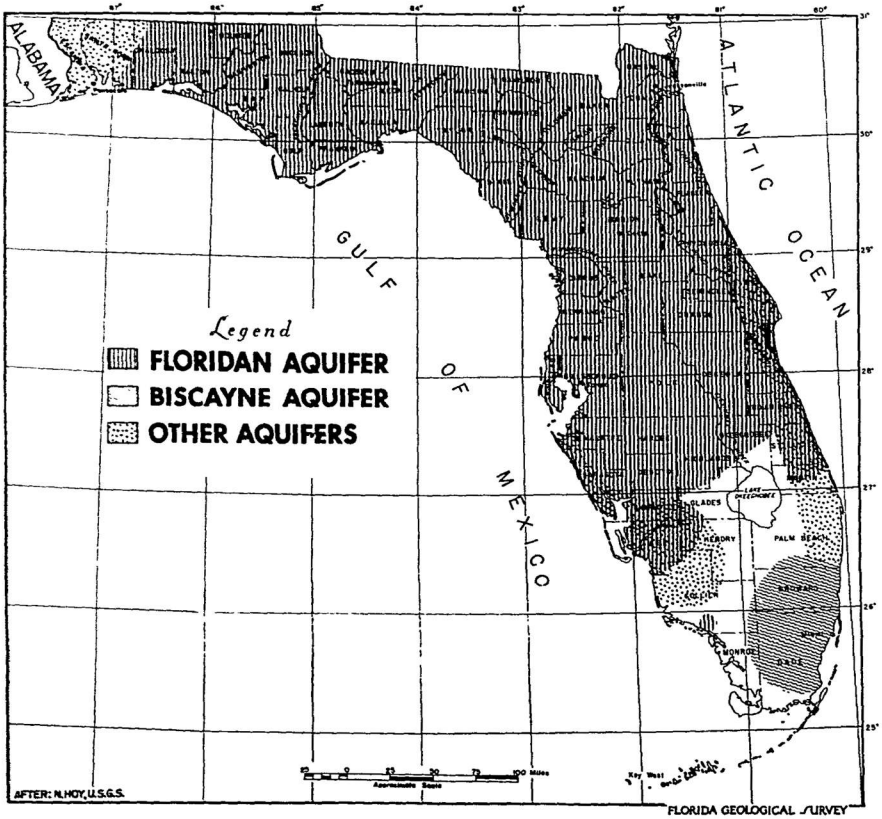


Figure 2. Map showing distribution of fresh-water aquifers.

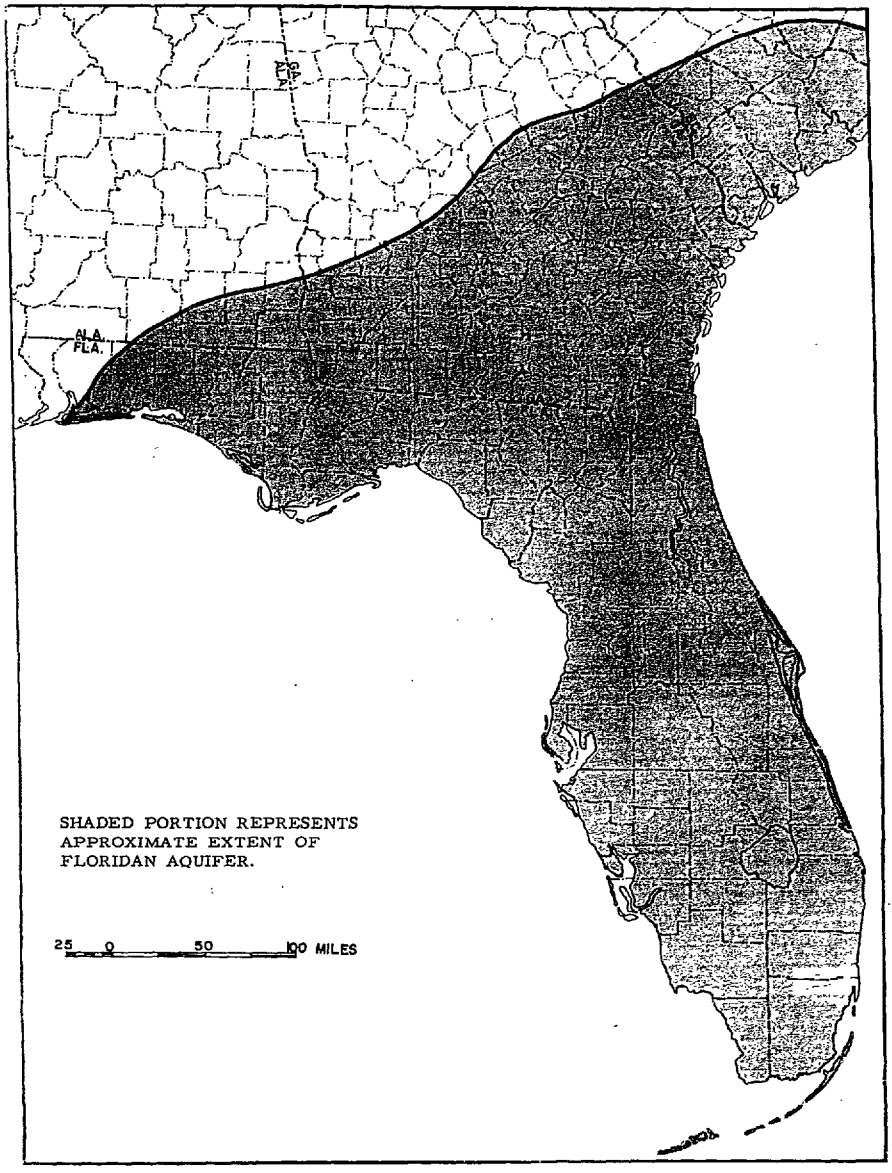


Figure 3. Map showing approximate areal extent of Floridan aquifer.

This aquifer serves as the source of most of the springs in Florida, some of the largest of which are Silver Springs, Rainbow Springs, and Weekiwachee Spring. Also, the Floridan aquifer is the source of supply to many thousands of wells in the State. Records on part of these wells are filed with the Florida Geological Survey in Tallahassee, or the Ground Water Branch, U. S. Geological Survey, in Tallahassee and Miami. Current ground-water investigations are increasing the number of inventoried wells every day.

Even though the Floridan aquifer underlies most of Florida, it does not yield fresh water throughout its areal and vertical extents. Numerous deep wells drilled into the aquifer throughout the State, many in the exploration for oil and gas, have penetrated salty water at depth. At some localitites along the Atlantic and Gulf coasts and over the southern portion of the State only brackish water is obtainable. In the area that remains, fresh potable ground water, even though underlain by salty water, is endangered only in that unwise development may cause the salty water to move upward in the aquifer and contaminate the fresh water.

Functions of the Floridan Aquifer: This extensive aquifer serves the water-supply need in a twofold capacity. It acts as a giant reservoir, a place for storing the excessive rainfall during the wet season, and therefore fulfilling the need during periods of little or no rainfall. Also, because it is a porous, permeable limestone system, it serves as a system of pipelines transmitting water from the recharge areas to areas far removed throughout its extent, supplying water merely by the drilling of a well.

Piezometric Surface

Water in an artesian aquifer is confined under pressure. This pressure is caused by the weight of water at higher levels in the same zone of saturation and from the weight of overlying beds. The movement of ground water is down the hydraulic gradient. This hydraulic gradient or change in pressure is normally the result of friction losses within the beds through which the water travels and of the release of pressures in discharge areas.

The water level in a well that penetrates the artesian aquifer is an expression of the pressure head in the aquifer at that time and place. Through the measurement of the depth from the ground surface to the water levels in a number of wells that penetrate the aquifer, and by the conversion of these water depths to heights above sea level, a contour map may be prepared to represent the imaginary pressure surface (piezometric surface) of this artesian water body. This type of map is called a piezometric map (fig. 4), and it serves as a basic and necessary tool in understanding the occurrence and behavior of water in an artesian aquifer.

By superimposing a map of the piezometric surface on a contour (topographic) map of the land surface, we see that in more than one-third of Florida the piezometric surface is higher than the land surface. Wells drilled into the artesian aquifer in this area will yield flowing water (fig. 5), except locally where heavy drafts have reduced the piezometric surface below land surface.

Recharge and Discharge

Recharge or replenishment of water to the aquifer occurs in those areas where the piezometric surface lies below the ground surface. This would imply that the aquifer is being recharged (replenished with water) over more than two-thirds of the State. Even though the aquifer may be recharged throughout this area, the amount of local recharge as compared to the discharge permits certain areas to be designated essentially as discharge or recharge areas.

The smooth lines (contours) drawn through the points of equal pressure on the piezometric surface graphically illustrate the highs and lows in this surface (fig. 4). The highs represent those areas in which water is being added to the aquifer in excess of the withdrawal by supply wells or discharge through springs. The areas represented by the valleys and saddles in this surface are essentially discharge areas; that is, the sum total of the water removed from the aquifer in these areas exceeds the total of the water added to the aquifer. This removal of water results in a release or lowering of the pressure head and shows up as lower pressure areas on the piezometric surface.

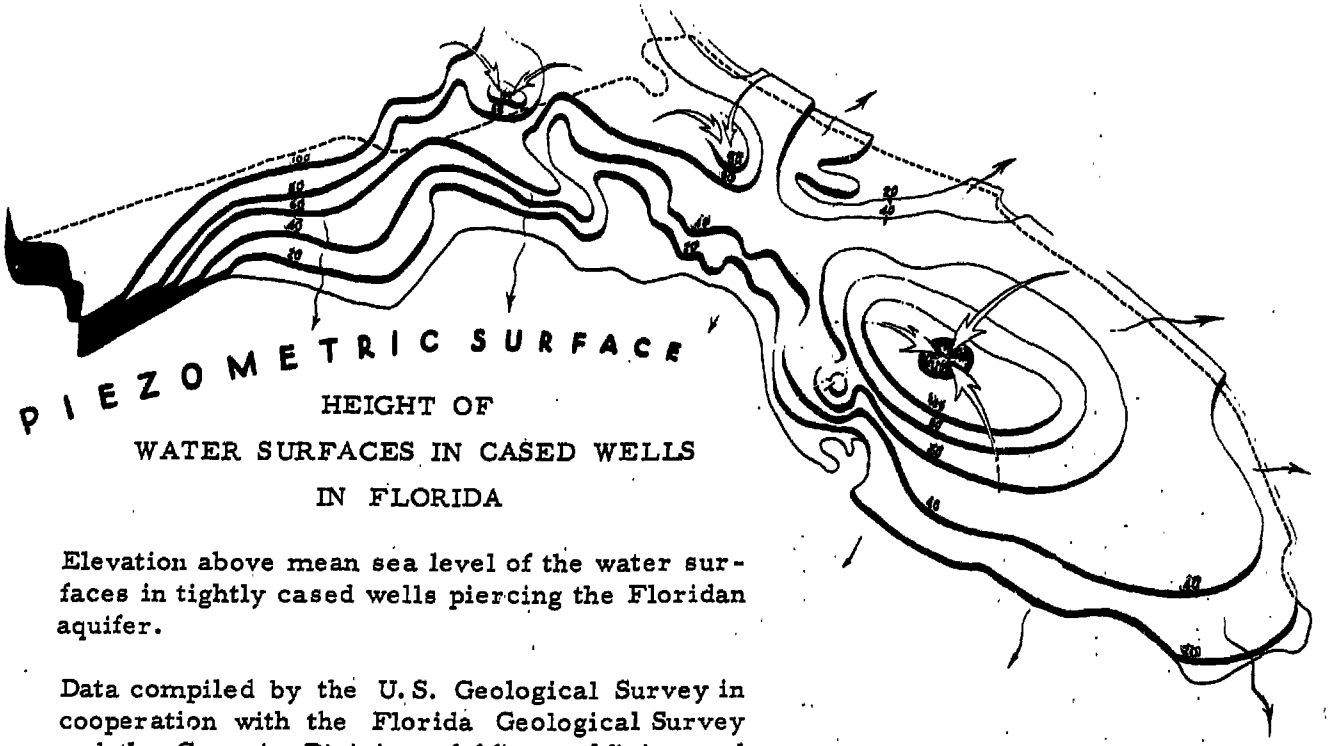


Figure 4. Map showing piezometric surface of the Floridan aquifer.

A map of the piezometric surface enables the detection of the direction of movement of ground water since this movement is normal to the contours. Water in the subsurface moves from the higher pressure areas to the lower pressure areas the same as surface water moves from the higher elevations (hills) to the lower elevations (basins).

MAJOR WATER PROBLEMS

Public interest in the ground water of Florida has increased greatly in recent years because of the important part

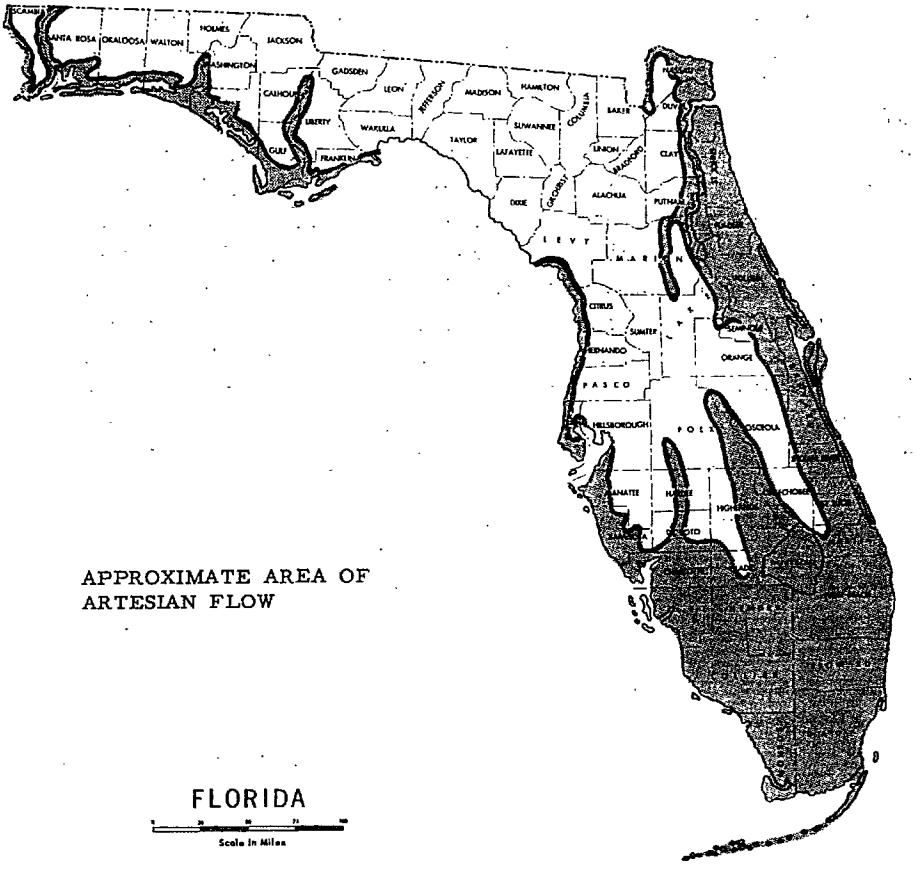


Figure 5. Approximate area of artesian flow.

water is playing in the nation's expanding industrial growth and also because of the problems that have results from unwise ground-water development in our State. The importance of a water problem is based primarily on its detriment to the largest number of people. This report on the investigation of flowing wells in Florida is not intended to include a comprehensive analysis of water problems, but there is a need to restate what constitutes the major water problems of Florida and how they affected the thinking and planning that led to the authorization of this inventory.

In reviewing the problems that plague our ground-water resource it became obvious that the need for the present investigation stemmed not from a single water problem but from the several that embrace our artesian water supply. Two water-problem inventories have been conducted in Florida since the 1953 Legislature passed an act (Chapter 370.051, Florida Statutes, 1953) with state-wide coverage adding to the protection and control of artesian waters. The first of these inventories, requested by the Florida Association of Soil Conservation District Supervisors in 1954, was conducted only in soil conservation districts. The second of these inventories was conducted in 1956 by the Florida Water Resources Study Commission and covered the entire State. The results of both inventories were tabulated by this Study Commission in their report to the 1957 Legislature. These inventories provided information which was used to pinpoint with some degree of accuracy the major problems of Florida.

The above mentioned water-problem inventories readily substantiate that ground-water problems of one locality are rarely unprecedented. Although no two ground-water conditions are exactly alike, widely diverse localities have experienced similar problems and in some cases have solved these problems. Of the three most reported water problems pertaining to wells that were recorded in the Study Commission's report, wasteful flow was reported in 29 counties, reduction of flow in 28, and salt-water intrusion in 20.

MISUSE OF GROUND WATER

A natural resource as readily and economically accessible as Florida's ground water, unfortunately is being wastefully exploited. This exploitation has manifested itself in

declining artesian pressures, in water waste, and in aquifer contamination.

Declining Pressures

The water levels in artesian wells fluctuate continuously. There are many factors causing these changes, but the very large fluctuations caused by rainfall (recharge) and pumping (unnatural discharge) are the most important. The drainage of lowlands and swamps that are suitable for cultivation has contributed substantially to this problem in that it has removed much water that was available for recharge to the aquifer. Heavy withdrawal of water from the aquifer has in specific areas of our State caused a steady decline in the piezometric surface. When a well is pumped or allowed to flow, the water level (or pressure head in the case of flowing wells) falls in and around the well an amount proportionally to the rate of discharge. In most cases this decline in level or pressure has not been injurious to the aquifer. The immediate problem in areas of lowered artesian pressure is the increased cost of lifting the water a greater distance to the surface. In those areas that have flowing wells a decrease in the pressure head results in a decrease of yield.

The increase or decrease in the amount of water in the aquifer determines the extent to which salty water will encroach or intrude upon fresh water. The density of fresh water being less than that of salt water enables the fresh water to displace the salt water and float as a lens or bubble on the depressed surface of the deeper salty water in the aquifer, much the same way an iceberg floats in the sea. An excessive draft of fresh water ultimately lessens its weight (pressure) to the extent that the displaced salty water is enabled to move into the fresh water domain. In many areas along both the Atlantic and Gulf coasts salt water has encroached or intruded into the fresh-water domain and rendered an otherwise adequate aquifer useless for many or all human needs.

Wasteful Flow

In this report water waste applies only to water expended by wildly flowing wells and negligent irrigation practices.

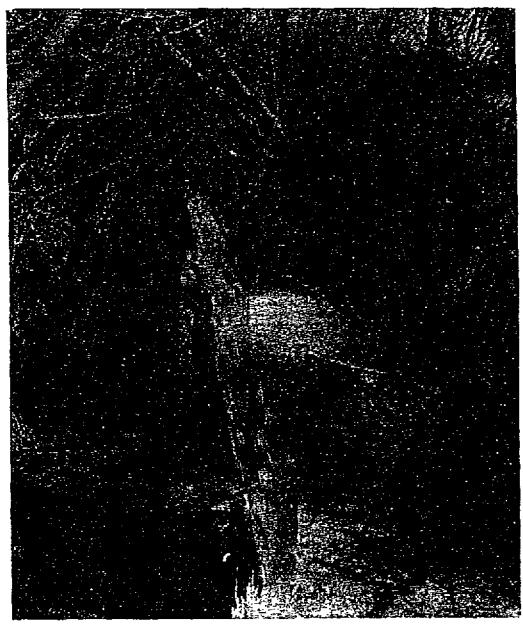
Wells drilled in the principal artesian aquifer over about one-third of the State will yield flowing water. Since the time of the earliest recorded flowing well, in 1885, there have been thousands of wells drilled in these areas of flow. The failure of many citizens to accept the responsibility of proper well use and maintenance allows much water to be consumed without benefiting man. Some wells are allowed to flow continuously with only a very small part of the water gainfully used. Many wells have been abandoned with little or no precautionary measures taken to stop their flow (fig. 6).

There also exists in Florida irrigation practices that, when poorly managed, are undesirable from the standpoint of conservation. In the southwestern part of the State where an adequate supply of water of good quality from artesian wells is available throughout the growing season subirrigation is practical. This consists of applying the water beneath the ground surface rather than upon it, usually by creating and maintaining an artifical water table at some predetermined depth. An artifical water table is built up over the existing water table to a height that will provide adequate moisture in the root zone through capillary action. The water is distributed through a system of main and lateral ditches which are provided with check structures equipped with flashboards to control the water level (fig. 7). Also, these ditches are used for drainage during the rainy season. Poor management is apparent when the desired water level is obtained and the excess water is allowed to flow over the dams and drain away, nonbeneficially used. During the field investigation of this project, it was observed that some of the supply wells for the above mentioned irrigation practices were left flowing even during the nongrowing season.

Contamination

During the geologic past sea level has stood much higher than it is today. One factor controlling the level of the sea is the size of the polar ice caps. When these ice caps were smaller than they are today the water released by melting was sufficient to raise the sea above its present level and inundate large portions of Florida. During these former invasions of the sea salty water permeated the limestone

6-A



6-B

Figure 6. Pictures of two abandoned wells which illustrate where no precautionary measures were taken to stop the flow. Well in picture A is in Osceola County, Florida. Well in picture B is in St. Johns County, Florida.

Figure 7. Sequence of three pictures that show a flowing well and a control structure which are used to create an artificial water table. This property is owned by the Hudson Pulp and Paper Company, Putnam County, Florida.

formations and saline residues were left in the water-bearing formations as the sea retreated from the surface of the land. The fresh water derived from rainfall has entered the aquifer, diluting and flushing out the salty water. Even though this process has been going on for approximately 11,000 years, the process of flushing is still incomplete today, leaving a large area in which water from the Floridan aquifer is too salty for most uses. The principal sources of fresh water in these areas are shallow aquifers of small areal extent.

In these contaminated areas early inhabitants seeking an adequate supply of fresh water for their domestic and irrigation needs found only brackish water in the Floridan aquifer. Because this water was unfit for most uses, many of these early wells were abandoned and some were left flowing. The corrosive characteristic of these saline waters has rotted out some of the casings, permitting leakage beneath the surface. This leakage results in contamination of the potable ground water of the more shallow aquifers, and, consequently, is a waste of these waters.

CURRENT PROGRAM

Inventory of Wells

Wells are man's chief means of obtaining information about the aquifer and its fluid content. The water obtained through wells is derived from either a water-table aquifer or an artesian aquifer. The hydraulic characteristics of each should be thoroughly understood by the investigator, as this knowledge is of inestimable value in his endeavor to collect these data.

The process of data gathering is termed "well inventory" and it is designed to include all the information about the geology of the area, the well, and the water in the well. This information includes: landowner, location of well, topography of area, elevation at the well site, well construction, temperature of the water, the water level, yield and use, water sample for chemical analysis, and other pertinent remarks.

With one exception (the State Board of Health's rule

concerning wells drilled as a public supply) there are no regulations that require water-well drillers to serve notice of their intent to drill or to submit the information collected from wells they drill to any State agency. Many drillers have never felt the need to supply the Florida Geological Survey with geologic samples or hydrologic information from their wells. In the absence of these requirements, the agencies that are interested can turn only to those water-well drillers who voluntarily submit this information. Consequently, a record of only a small percentage of supply wells in Florida are available in State agency files.

Since Chapter 373.021-373.061, Florida Statutes, 1957, provides for the final disposition of all artesian wells in violation of this law it was necessary to establish the existence of any wells not used or maintained in accordance with the law. This included the recording of their location for future reference, and establishing who was the owner or person controlling the real estate upon which the well is located.

A knowledge of the topography (land configuration) in the vicinity of the well and the elevation at the well site is necessary for a complete and accurate geo-hydrologic interpretation of the data collected.

It is necessary that complete information on the well construction be recorded for future use. The field investigator records the type (dug, drilled, etc.), the total depth, the amount and size of casing used, and supplies a diagram of the well on the back of the well schedule. The aquifer yielding the water flowing from each well is an important part of the basic data to be considered in a study of the water-resource problem. For this, the total depth of the well was measured and used as a datum to locate the source of water. The diameter of a well is part of the data used in determining the yield and in concluding the steps necessary to correct any violation of the law.

The temperature is an additional aid in determining the aquifer from which the water is derived, and the level of the water in the well, or pressure head in flowing wells, is useful in checking the piezometric surface.

The rate of discharge, or yield, is needed for each well

in the consideration of the total amount of water wasted through inadequately controlled flowing wells. As some freely flowing wells are exempt under the law, it was necessary to know the use to which the water is assigned.

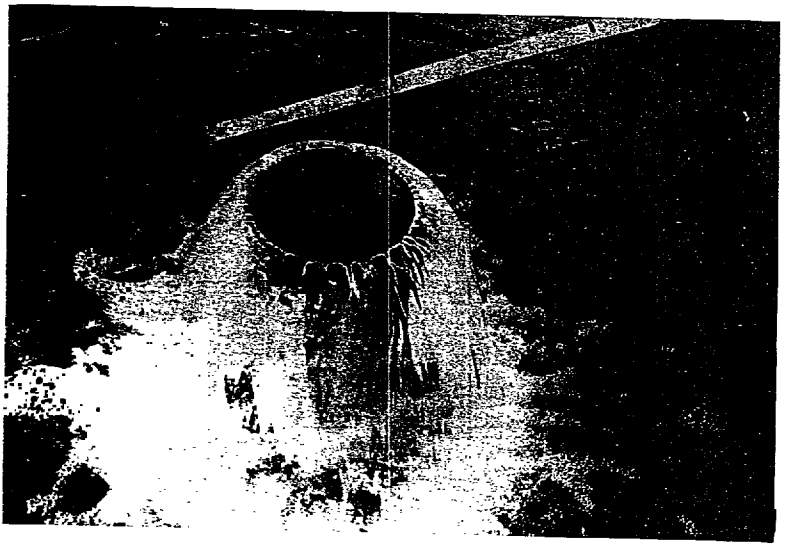
A sample of water was collected from each well inventoried and the chloride content in parts per million was determined. The hydrologist uses the chloride content as an indicator in detecting salt-water intrusion. The quality of fresh water is important since the State Board of Health has placed an upper chloride limit of 250 parts per million on water used for public supply. Also, the farmer must know the chloride content of his irrigation water to control the concentration of deleterious salts in his soils or to use as a guide in selecting a crop that would not be damaged by the water.

In addition to the standard basic data collected at each well the field investigator must record those miscellaneous conditions and facts that would be pertinent in the final analysis of the investigation.

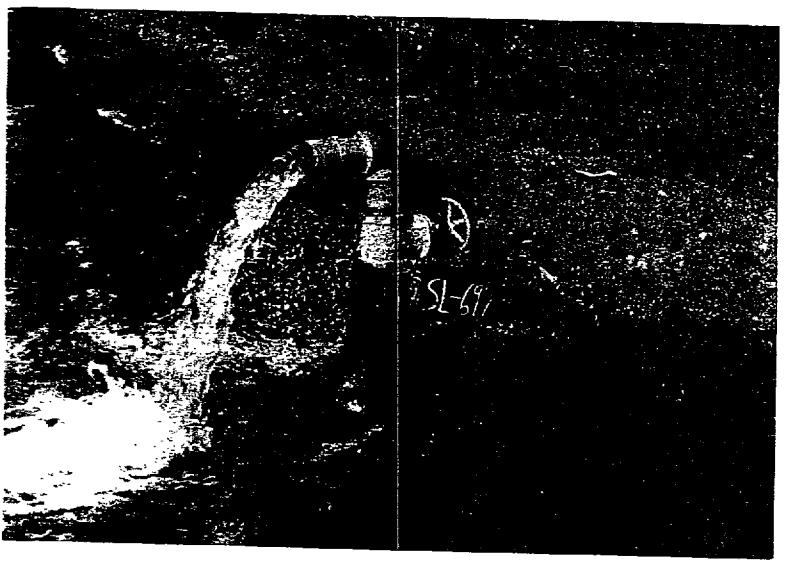
Presentation of Data

Since the beginning of the data collecting program in September, 1955, information on over 4,000 wells in 45 counties has been collected with over 1,800 of these wells being classified as wild. (For this discussion a well that is allowed to flow continuously is considered wild. These data have been amassed primarily from the area of artesian flow (fig. 5); however, a few wells not in the area of flow were inventoried in order that its limits could be determined.

It would not be practical to include herein a well table similar to the one included in the report to the 1957 Legislature. With this in mind, three tables of a more concise form have been included for the convenience of presenting the information. Table 1 is a tabulation of the data pertaining to all the wells inventoried. Column 1 is an alphabetical listing of counties in which wells were inventoried. Column 2 lists the total number of wells inventoried in each county. The third column lists the chloride content in parts per



8-A



8-B

Figure 8. Sequence of three pictures depicting examples of continuous flow as tabulated in column 4, table 1. Picture A shows a large diameter well with no control device for shutting off the water. It is located in Okeechobee County. Picture B shows a well with a properly operating valve that is left on all or most all the time. It is located in St. Lucie County. Picture C shows a well with an inoperative control device. It is located in Manatee County, Florida.

million of the well water in four categories ranging from 0 to 1,000+. Under column 4 are wells that flow continuously. These are further subdivided into: 4a) open casing - no control device for shutting off the water; 4b) operative control device - properly operating valves that are left open all or most all the time. It also includes those wells that have been equipped with a discharge pipe, usually somewhat smaller in diameter than the well casing but with no valve with which to shut off the water; 4c) inoperative control device - broken valves or valves so corroded that they no longer will close completely. Also included are wells with

leaking casing, either caused by natural corrosive action or improper maintenance, such as rusted out fittings. Figure 8 is a sequence of three pictures depicting examples of wells classified in column 4, table 1. Column 5 lists those wells that are kept in good operating order and closed when the water is not needed. The last column includes the few miscellaneous categories that could not be included elsewhere in the table. The largest group of wells included in this column are the nonflowing artesian wells.

Table 2 differs from table 1 in that it pertains only to continuously flowing wells. These are the wells listed in column 4 of table 1. Table 2 also lists for each county the composite discharge in gallons per minute. This amounts to over 107 million gallons per day. While this may not be as much as the flow from any of several large springs in the State, it does represent a large quantity of water that is not being beneficially used. It represents wasted pressure which is needed to reduce the cost of acquiring beneficially used water.

Table 3 is the tabulation of the total number of wells per county in each of six categories based on use. These categories are: 1) domestic - privately owned supplies used for household needs; 2) stock - includes wells for both range and farm stock; 3) irrigation - includes both citrus and truck farm wells; 4) ponds - includes fish ponds, swimming pools, and scenic pools supplied directly by wells; 5) none - wells at abandoned home sites and farms, abandoned sawmill sites, etc.; 6) public and industrial - wells directly supplying drinking fountains, scenic water displays, public and industrial water systems. Those wells inventoried as continuously flowing are listed in red and those wells inventoried as properly controlled are listed in black. At the end of table 3 is a composite total for each category of use.

The summary at the end of table 3 clearly points out that stock wells are the most numerous in the continuous flow category. These wells do not represent the largest group yield because of their generally smaller diameters.

The second largest number of wild wells are those that

are abandoned or have no use. They are usually in very poor condition and many have deteriorated to the point where they boil like a spring (fig. 9).

Irrigation wells are the third largest offender in number but this group ranks first in total yield because of the large draughts needed to irrigate the bit farms. The subirrigation systems mentioned earlier in the report require little care; therefore, many of the wells are left unattended for long periods of time and the valves end up so corroded they cannot be completely closed.

The three remaining groups represent very little of the total yield. They are essentially self-explanatory and need no elaboration.

Figure 9. Picture of a well that is so deteriorated it appears to be a spring. It is located in Lee County, Florida.

CONCLUSIONS AND RECOMMENDATIONS

This investigation has been conducted as the factfinding phase of the program leading to the enforcement of the 1957 Florida Statute 373.021-373.061. It has produced information relating to the number of wild wells, their general physical condition, and the quality and quantity of the water issuing from these wells. It was not possible to inventory all of the wild wells. As time and conditions change, new wells are drilled, maintenance practices are relaxed, and good wells end up as bad wells. Also, the process of establishing the existence of a wild well and then locating it are time consuming. For these and other reasons it has been found that to keep this type of investigation current, an inventory has to be checked and rechecked frequently. However, for the time the inventory has been in progress it is felt a large part of the wild wells have been located and investigated. This, therefore, leads to the conclusion that even though all of the wild wells were not inventoried, the information gained thus far is indicative of the general conditions that do exist in relation to the continuously flowing wells.

The Florida Geological Survey is the principal agency of the State engaged in geological and hydrological research. Much of this research is in the form of field investigations, such as the location and inventory of wild wells. It involves considerable contact with the general public, and it was found that the cooperative relation with the public suffers when an investigation leading to statutory enforcement of a conservation measure is conducted by the agency also responsible for the enforcement of that statute. The law concerning the care and disposition of artesian wells has been found inadequate in this respect, as it authorizes the Florida Geological Survey, essentially a research organization, to be responsible for the enforcement of this statute. It has been found that the detriment to the water resources of Florida by continuously flowing wells lies not only in the quantity of water wasted, but also in the contamination caused by water of undesirable quality being allowed to flow uncontrolled. THEREFORE, IT IS RECOMMENDED that the 1959 Session

of the Legislature consider the following recommendations and proposed revisions to sections 373.021 and 373.051, Florida Statutes, 1957.

NOTE: The Florida Legislature acting in the 1953 Session enacted the authority of this investigation. This authority appears in the Florida Statutes, 1953, as Chapter 370.051-370.055. Legislation pertaining to Florida's water policy subsequently has been consolidated by the Attorney General with the above mentioned act incorporated as Chapter 373.021-373.061, Florida Statutes, 1957.

A BILL
TO BE ENTITLED

AN ACT RELATING TO THE STATE BOARD OF CONSERVATION; AMENDING SUBSECTION (1) OF SECTION 373.021, AND SUBSECTIONS (1) AND (2) OF SECTION 373.051, FLORIDA STATUTES, TO TRANSFER SUPERVISORY POWER OVER ARTESIAN WELLS FROM REPRESENTATIVES OF STATE GEOLOGICAL SURVEY TO WATER RESOURCES DEPARTMENT.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF FLORIDA:

Section 1. Subsection (1) of Section 373.021, Florida Statutes, is amended to read:

373.021 Definitions, 373.031-373.061, artesian wells. -- (1) An artesian well is defined as an artificial hole in the ground from which water supplies may be obtained and which penetrates any water bearing rock, the water in which is raised to the surface by natural flow, or which rises to an elevation above the top of the water bearing bed. Artesian wells are defined further to include all holes, drilled as a source of water, that penetrate any water bearing beds that are a part of the artesian water system of Florida, as

determined by representatives of the Florida geological survey or water resources department.

Section 2. Subsections (1) and (2) of Section 373.051, Florida Statutes, are amended to read:

373.051 Procedure where artesian wells not capped. --
(1) The water resources department through its duly authorized agents shall have access to all wells in the state with the consent of the owner.
(2) Should any well be not provided with a valve as required in 373.031, or should any well be allowed to flow in violation of 373.041, then and in such event the water resources department through its duly authorized agents shall, upon being informed of such fact, give notice to the owner to correct such defect, and if the same be not corrected within ten (10) days thereafter, shall have authority to install the necessary valve or cap upon such well and control the flow therefrom in accord with the provisions of 373.031 and 373.041.

The beginning of a comprehensive water resources law was authorized by the 1957 Legislature. This law was set up to preserve the existing rights of water users and to provide at state level an organization to administer the water resources policy of Florida. This organization is called the Department of Water Resources. IT IS RECOMMENDED that the well inventory program as presently conducted be terminated at the end of the 1959 fiscal year and that adequate funds be made available to the Department of Water Resources to begin the enforcement of Sections 373.021-373.051, Florida Statutes.

The factfinding well-inventory program was initiated in the fall of 1955 with two geologists employed to conduct the work. To more quickly facilitate this investigation of wild wells, the 1957 Legislature authorized the expansion of the well inventory program to include two additional geologists. IT IS RECOMMENDED that at the conclusion of the 1959 fiscal year three of the four geologists be transferred to the permanent staff of the Florida Geological Survey to continue in the regular duties thereof, and to participate in the expanding geo-hydrologic resources studies that are conducted

by the Florida Geological Survey, and that the fourth geologist be transferred to the Department of Water Resources to assist in the enforcement of Florida Statute 373.041, 1957.

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Table 1. Tabulation of Total Number of Wells, Their Flow, Chloride Content, and Well Completion Data

(1)	(2)	(3) Chloride content (parts per million)					(4) Continuous flow			(5)	(6)
								Control device			
County	No. of wells inv'd.	0-250	251-500	501-1000	1000+	No information	Open Casing (a)	Operative (b)	Inoperative (c)	Properly maintained	Other
Bay	18	16	0	0	0	2	3	6	0	9	0
Brevard	162	4	12	61	47	38	23	74	58	7	0
Calhoun	6	6	0	0	0	0	1	4	1	0	0
Charlotte	219	26	17	79	82	15	14	26	41	130	8
Clay	46	34	0	0	0	12	3	21	16	6	0
Collier	2	0	0	0	2	0	0	0	2	0	0
De Soto	378	292	8	0	0	78	51	16	71	134	106
Duval	33	33	0	0	0	0	2	20	8	3	0
Escambia	22	18	0	0	0	4	17	5	0	0	0
Flagler	27	0	0	4	6	17	7	13	2	2	3
Franklin	22	18	0	1	1	2	1	17	1	3	0
Glades	40	6	8	4	2	20	3	14	9	14	0
Gulf	3	2	0	0	1	0	1	1	1	0	0
Hardee	200	170	0	0	0	30	10	9	7	12	162
Hendry	50	5	4	19	21	1	7	17	13	13	0
Hernando	1	0	0	1	0	0	0	0	0	1	0
Highlands	124	106	0	0	0	18	0	17	14	39	54
Hillsborough	32	11	6	3	9	4	4	12	3	13	0
Holmes	12	12	0	0	0	0	1	7	0	4	0
Indian River	45	8	16	18	0	3	8	15	22	0	0
Lake	96	30	9	10	12	35	11	10	3	22	50
Lee	378	19	45	237	58	19	16	64	86	198	14
Levy	4	3	0	0	0	1	0	1	1	1	1
Liberty	3	3	0	0	0	0	0	1	1	1	0
Manatee	58	46	9	3	0	0	3	16	31	8	0
Marion	15	14	1	0	0	0	2	11	0	2	0
Martin	78	1	13	17	31	16	4	12	10	52	0
Nassau	29	29	0	0	0	0	7	18	3	1	0
Okaloosa	5	4	1	0	0	0	0	3	0	2	0
Okeechobee	77	23	9	4	3	38	11	10	8	48	0
Orange	20	4	6	5	0	5	0	3	15	0	2
Osceola	81	38	8	11	1	23	12	41	8	20	0
Palm Beach	4	0	0	0	4	0	0	3	0	1	0
Pinellas	12	6	0	2	1	3	1	2	0	8	1
Polk	20	20	0	0	0	0	2	3	2	7	6
Putnam	116	92	8	1	1	14	8	79	16	13	0
St. Johns	62	31	10	3	4	14	22	23	15	2	0
St. Lucie	717	44	277	315	48	33	6	89	72	550	0
Santa Rosa	3	1	1	0	0	1	0	1	0	2	0
Sarasota	247	139	68	50	16	14	23	28	47	149	0
Seminole	169	45	25	52	43	4	14	71	84	0	0
Volusia	265	67	59	29	63	47	42	35	39	124	25
Wakulla	7	7	0	0	0	0	0	5	0	2	0
Walton	100	55	27	14	1	3	2	11	0	87	0
Washington	2	2	0	0	0	0	0	1	1	0	0

Table 2. Tabulation of Total Number of Continuously Flowing Wells, Chloride Content and Well Completion Data

(1)	(2)	(3)	(4) Chloride content (ppm)					(5) Condition of wells		
									Control device	
County	No. of inventoried wells flowing continuously	Total yield (ppm)	0-250	251-500	501 1000	1000+	No information	Open casing (a)	Operative (b)	Inoperative (c)
Bay	9	116	8	0	0	0	1	3	6	0
Brevard	155	13,528	3	12	60	46	34	23	74	58
Calhoun	6	59	6	0	0	0	0	1	4	1
Charlotte	81	3,343	12	7	29	32	1	14	26	41
Clay	40	1,352	30	0	0	0	10	3	21	16
Collier	2	3	0	0	0	2	0	0	0	2
De Soto	138	3,221	123	7	0	0	8	51	16	71
Duval	30	666	30	0	0	0	0	2	20	8
Escambia	22	588	22	0	0	0	0	17	5	0
Flagler	22	1,697	0	0	4	7	11	7	13	2
Franklin	19	435	17	0	1	1	0	1	17	1
Glades	26	1,249	1	8	3	2	12	3	14	9
Gulf	3	40	2	0	0	1	0	1	1	1
Hardee	26	804	26	0	0	0	0	10	9	7
Hendry	37	1,904	4	2	15	15	1	7	17	13
Hernando	0	0	0	0	0	0	0	0	0	0
Highlands	31	462	31	0	0	0	0	0	17	14
Hillsborough	19	527	7	3	3	2	4	4	12	3
Holmes	8	58	8	0	0	0	0	1	7	0
Indian River	45	3,399	8	16	17	0	4	8	15	22
Lake	24	283	11	3	1	7	2	11	10	3
Lee	166	7,033	11	24	110	14	7	16	64	86
Levy	2	20	2	0	0	0	0	0	1	1
Liberty	2	12	2	0	0	0	0	0	1	1
Manatee	50	2,621	38	9	3	0	0	3	16	31
Marion	13	61	12	1	0	0	0	2	11	0
Martin	26	2,273	0	3	8	10	5	4	12	10
Nassau	28	564	28	0	0	0	0	7	18	3
Okaloosa	5	153	4	1	0	0	0	1	3	1
Okeechobee	29	2,893	11	6	3	1	8	11	10	8
Orange	18	399	4	5	5	0	4	0	4	14
Osceola	61	1,406	32	8	9	1	11	12	41	8
Palm Beach	3	12+	0	0	0	3	0	0	3	0
Pinellas	3	13	2	0	1	0	0	1	2	0
Polk	8	119	7	0	0	0	1	0	6	2
Putnam	103	3,067	84	6	2	0	11	8	79	16
St. Johns	60	3,167	30	9	3	4	14	23	22	15
St. Lucie	167	14,548	5	78	65	12	7	6	89	72
Santa Rosa	1	350	0	1	0	0	0	0	1	0
Sarasota	98	3,031	46	13	30	9	0	23	28	47
Seminole	161	3,107	44	25	49	40	3	8	39	114
Volusia	116	920	36	21	14	33	12	42	35	39
Wakulla	5	97	5	0	0	0	0	0	5	0
Walton	13	322	12	0	1	0	0	2	11	0
Washington	2	17	2	0	0	0	0	0	1	1
TOTALS	1,883	79,939	852	173	182	103	71	144	397	340

Table 3. Principal Uses of Wells

County	Domestic		Stock		Irrigation		Pond		None		Mun.-Ind.	
Bay	8	5	1	0	0	0	0	1	0	3	0	0
Brevard	1	4	2	68	3	21	0	10	1	41	0	11
Calhoun	0	5	0	0	0	0	0	0	0	1	0	0
Charlotte	34	1	21	52	70	11	1	1	10	16	2	0
Clay	4	4	0	29	1	0	0	2	1	4	0	1
Collier	0	0	0	0	0	0	0	0	0	2	0	0
De Soto	10	0	24	61	190	69	1	0	11	7	4	1
Duval	1	3	0	18	0	0	0	3	1	5	1	1
Escambia	0	11	0	0	0	0	0	4	0	7	0	0
Flagler	0	0	3	6	0	1	0	3	1	12	1	0
Franklin	2	10	0	0	0	0	0	0	0	8	1	1
Glades	4	3	6	20	2	0	0	0	1	3	1	0
Gulf	0	1	0	0	0	0	0	0	0	2	0	0
Hardee	6	0	18	21	145	2	0	1	4	2	1	0
Hendry	0	0	3	19	10	2	0	1	0	15	0	0
Hernando	0	0	0	0	0	0	0	0	0	0	1	0
Highlands	37	3	10	24	39	0	0	0	4	4	3	0
Hillsborough	2	2	3	11	6	2	1	0	0	4	1	0
Holmes	3	2	0	2	0	0	0	2	0	2	1	0
Indian River	0	0	0	19	0	6	0	5	0	14	0	1
Lake	38	3	3	5	4	1	4	1	21	14	2	0
Lee	4	4	7	72	191	57	0	5	8	27	2	1
Levy	0	0	0	0	0	0	0	2	2	0	0	0
Liberty	1	0	0	1	0	0	0	0	0	1	0	0
Manatee	0	0	0	4	7	31	0	3	1	11	0	1
Marion	1	12	0	0	0	0	0	0	1	1	0	0
Martin	0	0	16	13	31	4	1	3	2	6	2	0
Nassau	0	5	0	5	0	0	0	2	1	15	0	1
Okaloosa	0	2	0	0	0	0	0	0	0	2	0	1
Okeechobee	2	0	10	15	32	8	2	0	1	5	1	1
Orange	0	0	1	10	0	3	0	0	1	3	0	2
Osceola	1	2	17	53	2	0	0	0	0	5	0	1
Palm Beach	0	0	0	1	0	0	0	0	1	0	0	2
Pinellas	4	0	0	0	3	0	0	0	1	3	1	0
Polk	1	0	7	3	0	0	2	4	0	1	2	0
Putnam	7	9	0	21	0	13	0	13	6	29	0	18
St. Johns	0	1	1	18	0	6	0	2	1	30	0	3
St. Lucie	2	3	53	70	448	45	4	20	5	18	2	11
Santa Rosa	2	0	0	0	0	1	0	0	0	0	0	0
Sarasota	10	0	36	48	88	19	1	0	11	31	3	0
Seminole	0	14	8	22	0	90	0	4	0	31	0	0
Volusia	74	22	17	15	25	22	3	12	27	44	3	1
Wakulla	2	4	0	0	0	0	0	0	0	0	0	1
Walton	73	8	5	2	0	0	1	1	1	2	7	0
Washington	0	2	0	0	0	0	0	0	0	0	0	0
Total	334	145	272	728	1333	414	21	105	125	431	42	60

Black columns represent properly controlled wells.
Red columns represent continuously flowing (wild) wells.

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