YOUR WATER RESOURCES

ORIGIN
QUALITY
NEEDS
USES

QUANTITY
MOVEMENT
OCCURRENCE
CONSERVATION

FLORIDA
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OUTLINE

INTRODUCTION

Florida has a high average annual rainfall; one of the largest and most prolific ground-water reservoirs in the world; and great quantities of surface water forming more than 30,000 named lakes, innumerable springs, and 12 large stream basins and many smaller ones. Seventeen of the springs each discharge in excess of 65 million gallons per day, and 49 others each discharge in excess of 6 million gallons per day. The spring flow, combined with that of the rivers discharging into the Gulf of Mexico and into the Atlantic Ocean, averages more than 40 billion gallons of water daily.

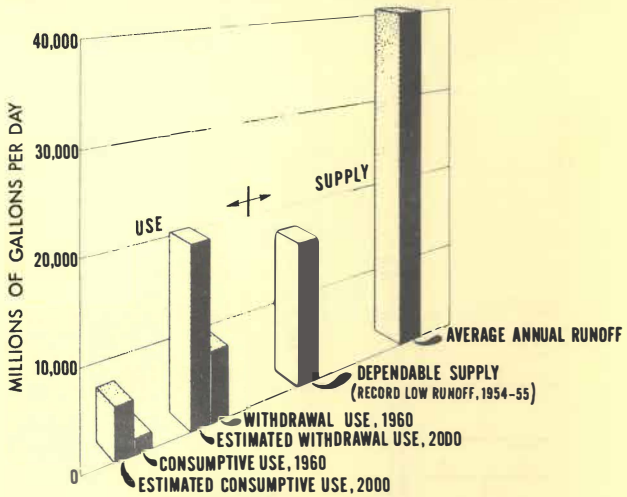
Florida has an adequate source of water for all needs - now and in the future - as long as technology and conservation keep pace with our growing demand. Sound conservation practices can preserve and utilize, with as little waste as possible, our present fresh water supplies and their replenishment. Technological advances will be able to make available for reuse water that has become contaminated and probably in the near future can convert salt water economically into fresh water.

Since there is such an abundance of this most important natural resource, what are the problems? Why the growing concern over it?

The problems associated with our water resources arise from the mismatching of man's needs to the available supply. Therefore, problems of Florida's water resources, for the most part, are not from lack of water but from not having the water arrive at the place at the time it is needed, although flooding, polution, contamination, and heavy mineralization are locally troublesome.

SUMMARY AND CONCLUSIONS

At the present rate of consumption and level of technology, Florida's water resource is not only sufficient to meet all present needs but is sufficient for all expected growth. There exists now large quantities of good ground water which are not being used. Excluding this ground-water surplus, it is estimated we have a surplus runoff in streams of about eight times the amount of water withdrawn in Florida at the present. Much of the water tabulated in withdrawal use has been used many times and the total use is cumulative. However, the runoff is water that is immediately available for additional and increased uses. Industry has been, and will be, attracted by large volumes of good water combined with extensive tracts of available land, good research facilities, and an unexcelled climate, beaches and recreational facilities. This makes Florida an ideal spot for future industrial growth.



SUPPLY and DEMAND of WATER in FLORIDA

Salt water has not been considered thus far in our discussions. This is not because it is unimportant but rather because of the obviously

inexhaustible surface supply existing within 100 miles of any locality in Florida. Salt water, much with only minor concentration of salt, exists at depth under all of Florida below the fresh water and is available in large quantities for many industrial needs.

The anticipated withdrawals in some parts of Florida will exceed the dependable supply of water or the low runoff of 1954-55. Thus it becomes increasingly urgent to form long range plans for water development and management, to obtain the land necessary for the construction of control structures, to provide a statewide zoning plan that will insure the availability of these lands, and to start the construction required to insure the continued availability of water at the time and place it is needed.

The limited problems that have arisen in the use of the State's water resources can be eliminated for the most part by wise development, management, and control. This is the responsibility, not of a few, but of all the people of Florida.

cause some of this loss to be salvaged in the dewatered parts of the ground, for all purposes of planning this water is not available to man. This remaining 40 billion gallons replenishes ground water, sustains lakes, and maintains the stream flow. It is the stream flow off the land that is readily available for future planning and utilization.

The part existing beneath Florida is our water savings account, for beneath the surface lies one of the most extensive and productive ground-water reservoirs in the Nation, called the Floridan aquifer. Several thousand feet of porous limestones make up this principal ground-water reservoir of Florida. This aquifer contains a volume of fresh water estimated to be 800 to 1,000 cubic miles, about 30,000 times the average daily stream discharge of 40 billion gallons. Another way to express this is that the volume of water in this reservoir has been estimated to be 100 times Lake Meade impounded behind Hoover Dam, the Nation's largest manmade lake. There are also several less extensive water-bearing rocks or aquifers that supply areas such as Miami and Pensacola.

HOW ABOUT WASTE WATER?

Waste is a necessary byproduct of our day-to-day living, whether it be from the farm, the cities, or the industries. It is frequently necessary to remove this waste from its source. The degree to which man alters the quality of water depends upon the nature of the soils and water. Some wastes are permitted or caused to be reduced to solids and utilized or destroyed, others react with the soil, and others are released into water courses, with and without treatment. At the present time, water is the most suitable way of diluting and transporting these wastes. As such, a significant amount of contaminated water results; and, while this is a

problem, it is minor compared to the problem that would be created if untreated wastes are introduced into surface streams and fresh-water aquifers.

At the present time, some of the waste water is being treated or decontaminated so that it is reusable, but entirely too much is being introduced untreated into our surface and ground water reservoirs.

Today, most persons recognize that water is life itself, and that it is economically wasteful and morally wrong to pollute our water reservoirs. First priority should be given to plans and action that will reduce the pollution of our water resources.

WHAT CAN BE DONE ABOUT CONTAMINATION?

Man's continued security and well-being depends on how well the land can tolerate both man and his wastes. Most wastes are discharged as liquid solutions into the hydrologic cycle and are mixed with products of the earth's weathering. These contaminants are presently managed in

settling tanks, treatment plants and cesspools, and by the dilution and dispersion in surface streams.

Some wastes are removed through their reaction with the soils and sediments of the earth's crust, but this may result in dangerous concentrations of toxic elements. Wastes such as some detergents cannot be removed and remain in the water. Some nations now prevent the use of these detergents within their boundaries.

Treated wastes are now combined with dilution water and dispersed into the streams and ground to obtain a satisfactory quality. Ultimately more use must be made of the water now wasted, and if water of good quality is to be maintained, it appears that ultimately all wastes may have to be piped to central areas and stored for periods of time necessary to clean the water. Because the piping, controls, and storage reservoirs would be costly, it is necessary to develop some alternate way to reduce the need for dilution water. Research in waste disposal methods is therefore necessary.

WHAT DOES THE WATER CONTAIN?

Rain falling upon the earth is practically pure, containing only a small amount of carbon dioxide and oxygen, dissolved from the atmosphere. Surface water and ground water both take into solution varying amounts of substances with which they come in contact. Surface water usually has larger amounts of acid elements, while ground water usually contains larger amounts of the basic substances. The substances commonly found in greatest abundance dissolved in Florida ground water are hydrogen sulfide, calcium and magnesium sulfates and bicarbonates and sodium chloride. Iron and organic materials are also present, but more commonly in water at the surface and in shallow wells. Sodium is usually restricted to highly mineralized water,

such as waters affected by salt water intrusion. Strontium and fluorine are present in some waters, although usually in small quantities.

CHEMICAL CONSTITUENTS AND WATER USE

Constituent	Effect on Water Quality
IRON	More than 0.3 ppm (parts per million) of dissolved iron will cause staining, discoloration (''red water''), and an unpleasant taste.
HYDROGEN SULFIDE	Gives the water an unpleasant odor and taste, but is readily removed by aeration.
(Calcium, Magnesium) SULFATES	Gives water a bitter taste if concentration is greater than 500 ppm.
(Sodium, Potassium) CHLORIDES	Public supplies must contain less than 250 ppm. Larger amounts give a saline taste and increase the corrosion.
(Fluorine in form of) FLUORIDE	Concentrations of 0.7 to 1.5 ppm are helpful in preventing dental caries. Large concentration may cause mottling of teeth. Concentrations of this element in Florida ranges from a trace to 2.5 ppm with a maximum of 13 ppm.
(Calcium, Magnesium) BICARBONATES	Contributes to hardness of water.
ORGANICS	A source of acidity, color, and bad taste.
NITRATE	Domestic water should contain less than 45 ppm. High concentrations cause ''blue baby disease.''

IS IT GOOD?

In general, Florida water is good. Water suitable for one purpose may be unsuitable for another, and special quality water may not always be found in the area in which it is needed. Artesian water from wells is less subject to contamination from surface sources, but there are isolated coastal areas where the artesian aquifer now contains salty water. This may be due to natural causes or to poor management of municipal supplies where over-pumping has introduced salines and rendered useless the aquifer from which good water was once obtained. Another example of poor management having rendered useless an otherwise good aquifer is the practice of permitting contaminated surface water to be introduced into the aquifer by means of drainage wells.

Drinkable water of high purity and quality is available throughout most of the State from streams, lakes, ponds, and deep wells. Where water from deep wells are highly mineralized, shallow wells provide an adequate supply.

WHAT ARE OUR SURFACE WATER RESOURCES?

Surface water occupies defined channels upon the earth's surface as rivers, brooks, lakes, ponds, swamps, marshes, and variations and combinations

of these. Manmade dams that create additional reservoirs increase the surface water storage. Ditches and canals may be constructed to drain the ponds and swamps to convey the water to the point of use. It is not feasible to quantitatively estimate the total amount of water existing at the surface, but the amount of surface water resources available in manmade reservoirs has been tabulated.

Jim Woodruff Dam on the Apalachicola River at Chattahoochee; Inglis Dam at Inglis on the Withlacoochee River; Talquin Dam on the Ochlocknee River at Bloxham; and Moss Bluff Dam at Moss Bluff on the Oklawaha River, store in excess of 575,000 acre feet of water. An acre foot of water is the amount of water required to cover an acre of land to a depth of 1 foot, and is 325,850 gallons.

With the completion of the large water management project now under development by the Central and Southern Florida Flood Control District, 4½ million acre feet of water can be stored during periods of abundant rainfall in three conservation districts for release during droughts.

In addition, under the U. S. Soil Conservation Service, more than 3,500 small ponds on farms in Florida have been constructed and store in excess of 30,000 acre feet of water in areas where irregular patterns of rainfall make these most useful. Many of these ponds receive no water from streams and are maintained entirely by rainfall.

At least 182 large springs are present in Florida, most of which are fed by waters rising from the porous limestones. Florida has more large springs than any other state. Silver Springs at more than 500 million gallons per day, and Rainbow Springs at about 450 million gallons, are among the larger springs in the world. Silver Springs, alone, discharges enough water to satisfy Florida's municipal and rural domestic needs, if it could be distributed to the place of need.

Florida's streams discharge in excess of 40 billion gallons per day into the Gulf of Mexico and into the Atlantic Ocean.

WHAT ARE OUR GROUND WATER RESOURCES?

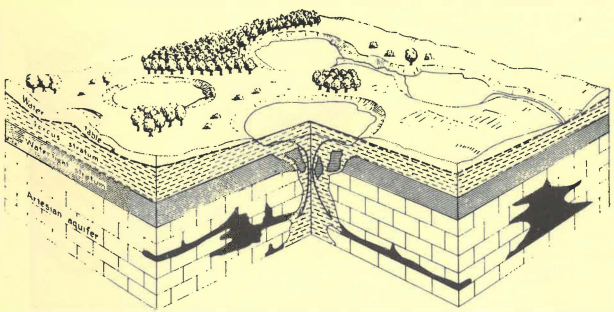
The State is fortunate in having some of the best and most productive ground-water reservoirs in the world. These reservoirs consist of two principal types. The first is the Floridan aquifer, a sequence of limestones, underlying the State, that function as would a pipeline through which water travels under pressure from the intake area to points of discharge. This is an artesian aquifer. The second is a series of shallow ground-water reservoirs, consisting of several types of sediment

in which water occurs under no pressure. The surface of the water in these shallow aquifers is the ground-water table. Aquifers of this latter type are especially important in coastal areas where the deeper artesian water is sometimes heavily mineralized, such as at Miami and Pensacola. About 1.6 billion gallons of water per day are presently being withdrawn through wells from ground-water aquifers.

HOW DOES WATER AFFECT THE LANDSCAPE?

Florida was built by water and the details of its land surface are controlled almost entirely by the erosion and deposition of water. All of the rocks forming the State were deposited in the ocean and gulf or in streambeds and deltas that emptied along the coasts. In these environments, our rocks were formed and some of the land's surface was created as river flood plains, bars, deltas, and as marine plains.

Changing or modifying of the land surface is due principally to the action of running water. This water is derived from a high annual rainfall which, upon reaching the surface, seeks a convenient route down to the sea, picking up and transporting part of the land as it travels, either in dissolved form or as very small grained sediment.

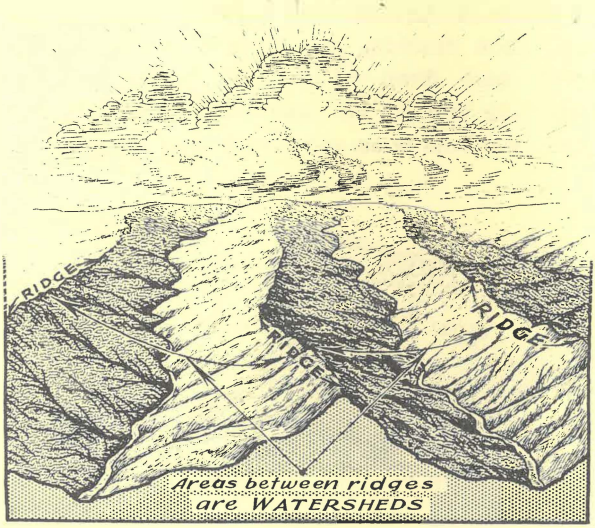


Water that seeps into the ground may also modify the surface. Where the bedrock is composed of soft permeable limestone, there is a continuous but imperceptible dissolving of this limestone by the moving subsurface water. When the rock overlying these dissolved areas will no longer support its own weight, there is a collapse and a subsequent sinking of the land surface. Many of Florida's lakes are formed in this manner.

HOW IS ONE WATERSHED SEPARATED FROM ANOTHER?

A watershed is an area of land bordered by ridges, hills, or highlands called divides that shed or direct the water into a common stream or into several streams that flow into a common body of water.

Florida is divided into approximately 50 well defined watersheds. Although these are natural

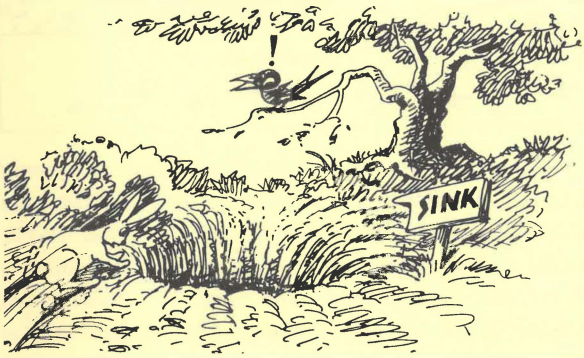


units, they are important political or management entities, as each has specific problems and individual characteristics which may or may not be held in common with another watershed. Problems of flood erosion, drought, contamination, and sedimentation must usually be met within the boundaries of each watershed.

HOW DOES THE LAND INFLUENCE THE SUPPLY?

Because Florida has a very sandy soil and a flat terrain with numerous sinkholes, lakes, and swamps, much of the rain that falls is retained on the ground surface or sinks into the earth. Because of this, the percentage of water that runs off is moderate, compared to some other areas in our nation.

The amount that seeps into the ground or runs off also depends in part on the slope of the land, vegetative cover, type of soil, and agricultural improvements. Soil management by the farmers, growers, and ranchers is an important step in water control and management.



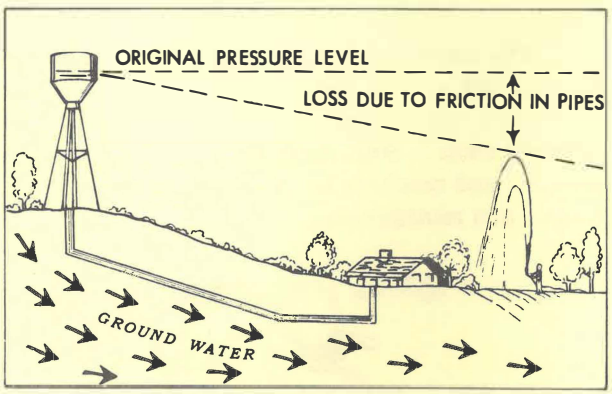
The land regulates, to a large extent, the amount of water that enters the basins. Sloping surfaces are drained faster than flatlands. Sandy lands and limestone areas absorb water more readily

than clay lands and permits storage for dry times. In some areas of Florida there is a layer of dense, organic sand or hardpan, just under the surface which retards the movement of water into the ground.

The lakes and ponds of Florida are storage basins for surface supplies and through which the ground water is being continuously replenished.

HOW DOES GROUND WATER TRAVEL?

The force that causes ground water to move through rock and loose sediment is called water pressure, and is similar to water placed in elevated tanks to supply a city with water moving through pipes. The rock acts like a pipe and areas where water enters the ground are similar to elevated tanks.



Contrary to some popular opinion, ground water is contained in rock pores and cavities and moves through these connected pore and cavity spaces in the rock, rather than being contained in underground lakes and traveling by underground streams. There are areas where solution has created large cavities filled with water, but these are usually disconnected, one from the other, so that a continuous channel does not exist. The porosity of a rock, that is the measurement of void space, determines how much water it will hold. Since the

number and size of pore spaces is so varied, ground water travels at variable rates; and it is impossible to give other than a general estimate of the speed. A general rule would be that the range of groundwater velocity is not more than 5 feet a day to less than 5 feet a year.

WHAT ARE THE CURRENT USES?

The use of Florida's water is as diverse as the many activities in the State. Since these range from permanently removing the water from the natural sources, and thus preventing any future utilization, through a use as casual as boating and fishing, it is necessary to know what use means in terms of its relative effect on our water. For this reason, it is helpful to have terms that recognize the type of use and the effect of this use upon the supply.

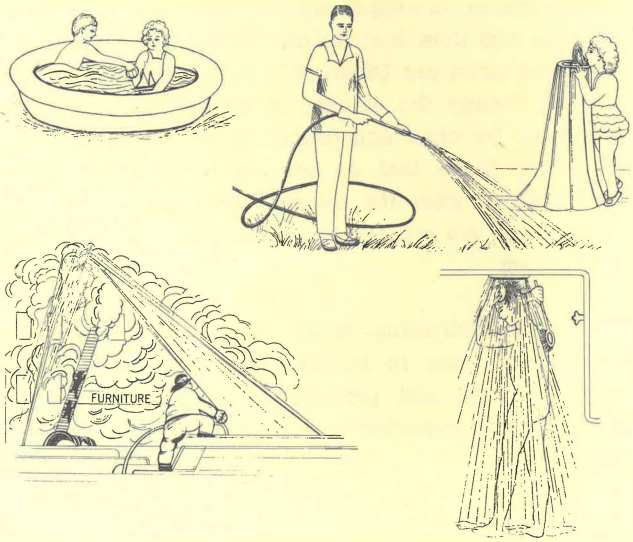
The basic categories of use terms are withdrawal and nonwithdrawal. Withdrawal includes the requirement that water be removed from its source; that is, the ground or lakes and streams. Consumptive and nonconsumptive are the two types of withdrawal use. Consumptive implies a permanent utilization of water such as that which is made so contaminated, is evaporated, or incorporated in some process and thus lost for any future use. Nonconsumptive uses are those of a temporary nature that do not change the amount or quality and which is available for other and further uses. Nonwithdrawal uses are those that do not require that the water be removed from its natural source, and for this reason are not readily available for a quantitative evaluation.

The following table summarizes the major withdrawal uses in Florida in million gallons per day for 1956 and projects it to 1975, when the population is expected to exceed 8 million.

	1956	1975	Percent Increase
Agricultural	1,182	2,500	111
Industrial	2,227	4,650	109
Municipal	390	900	130
Rural	104	150	44
Total (mgd)	3,903	8,200	110

HOW MUCH WATER FOR CITIES AND TOWNS?

Florida's total population in 1960 w 4,952,000. Approximately 68 percent, or 3,370,0(were served by public water facilities. Of thi urban total, 1.5 percent, or 50,000, were served from surface water and the remaining 98.5 percent, or 3,320,000, from ground water. This total urban population utilized 500 million gallons per day of ground water, and 23 million gallons per day of surface water. Essentially, this would be classed as a nonconsumptive use. This amounts to 157 gallons per day for each person living in cities and towns.



Projections to the year 1975 have been based on the following: That the total population in 1975 will be approximately 8 million, of which 80 to 85 percent will be served by public supplies, and the per capita use of 157 gallons per day remains essentially the same. It is anticipated that the total city and town nonconsumptive use will exceed 1 billion gallons per day, and of the total amount used about 17 percent will be consumptive.

WILL INDUSTRY HAVE ALL THE WATER IT NEEDS?

The water requirements for industry are more diverse than those for other uses. Some industries use very large volumes of water while others use practically none. The quality requirements also vary greatly depending upon the type of industry — some requiring water of the highest purity while others can use water of almost any quality.

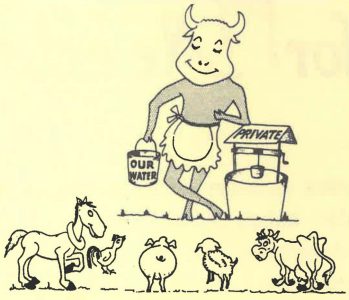
In all uses conservation should be undertaken by reusing water whenever possible, and by reclaiming it where desirable and necessary. However, it is not expected that there will be a shortage of water for industrial use in the foreseeable future,

provided that intelligent plans for water supply are made prior to the location of new industrial sites,or expansion of present plants.

There are four major industrial users of water in Florida: (1) electric power installations use 68 percent of the total withdrawals of which about 4 percent is consumed, the remainder being returned to the reservoirs; (2) pulp, paper and chemical industries use about 19 percent; (3) citrus processing plants use about 4 percent; and (4) the mining industry uses about 9 percent. The last three users consume about 17 percent of the total water withdrawn from the supply.

FROM WHERE WILL WATER FOR LIVESTOCK AND FARM HOMES COME?

Practically all farm water supplies in Florida are obtained from privately developed wells. In some areas these wells flow naturally, while in others pumping is necessary to furnish an adequate supply. In 1960 the approximate rural population was 1,582,000 and the use of ground water was at a rate of 86 million gallons per day. Thus, a daily requirement for farms with running water is estimated at 54 gallons per day for each person. This is classed as nonconsumptive use.

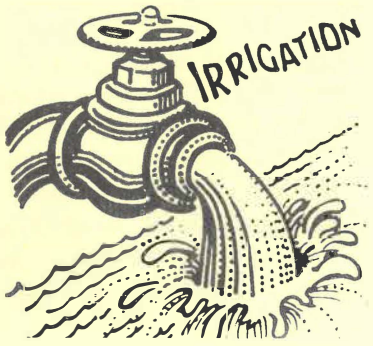


In 1960 the total use of water by livestock was estimated to be 23 million gallons per day, with 6.5 million gallons per day derived from surface water and 16 million gallons per day from ground water. The daily requirements are 12 gallons each for horses and beef cattle, 25 gallons each day for dairy cattle, and about 2 gallons each for small stock.

Projections to the year 1975 indicate moderate increases in the total water used, but farm home and livestock use of water is not increasing as rapidly as that of the other major water consumers.

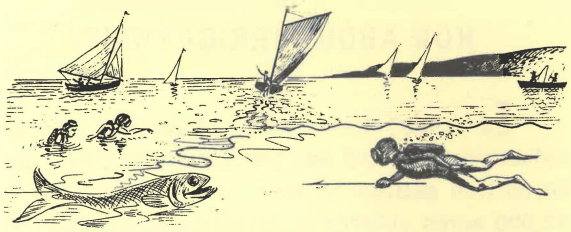
HOW ABOUT IRRIGATION?

In 1956 there were 16,584,000 acres of productive farm land and pasture in Florida. About 660 million gallons of water a day were used upon 742,000 acres subject to irrigation practices. Even though a large amount of water is supplied by rain falling upon crops and groves, this is not necessarily enough; nor does the rainy season always correspond to the growing season. For these reasons, it is necessary to supply additional water from nearby surface reservoirs or from wells. About 41 percent of the irrigation water is from wells, some of which flow naturally. The remaining water is derived from lakes and streams. It is estimated that 2,500 million gallons of water will be needed daily in 1975 to supply the irrigation needs of Florida's growing agriculture.



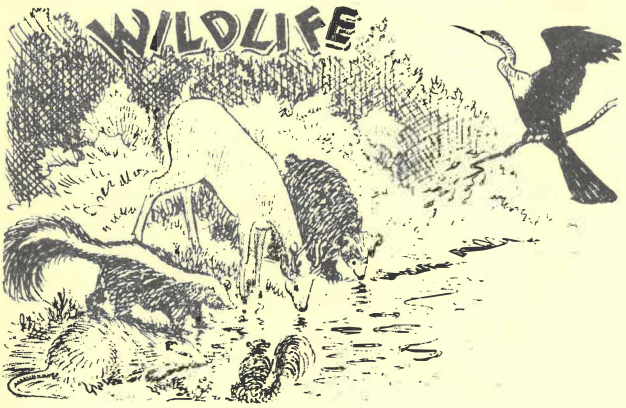
HOW ABOUT THE NEEDS FOR RECREATION AND WILDLIFE?

Florida, by virtue of its relatively large uninhabited areas, climate, and fresh and salt water facilities, is attractive to those seeking outdoor recreation. Primarily because of these abundant, available opportunities, Floridians take part in more outdoor recreational activities per capita than the average American.



The use of water for outdoor recreation has become so vast that it is difficult to assess with accuracy, but the present demand by the 5 million permanent residents and the 13 million annual visitors is expected to steadily increase in the years ahead. In the next 10 years our population will swell to about 8 million and the number of tourists is expected to increase to about 19 million annually. The recreational activities will increase with personal income and leisure time.

The water in its natural environment is not only needed for man's direct recreational need, but indirectly as well in the support of wildlife. Water used for fresh-water recreation, hunting, and wildlife is classified, for the most part, as nonwithdrawal. This means that the water involved cannot be evaluated quantitatively, but the money spent by the public in water recreation is a vast segment of the economy of Florida.



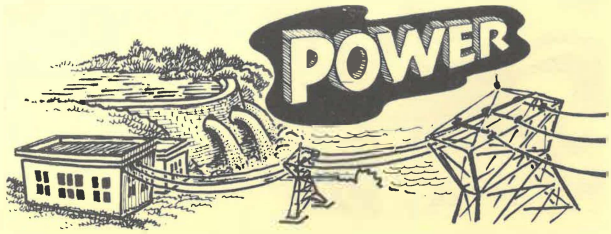
The chief threats to our recreational use of water are pollution and inadequate public access to recreational areas.

WHAT ARE THE PROSPECTS FOR USING WATER FOR POWER?

Because of the low relief and flat terrain that is natural to Florida, and the resulting sluggish streams, there are very few sites available for the development of dams suitable for power production. At the present time only three hydroelectric power dams are operated in Florida: Jim Woodruff Dam on the Apalachicola River at Chattahoochee, Inglis Dam at Inglis on the Withlacoochee River, and Talquin Dam on the Ochlockonee River at Bloxham. The Jim Woodruff Dam is the largest of the three; and it is designed to produce an average of 212 million kilowatt hours of electricity, but that only during times when the head pool has an effective head above the tail pool, rarely present during flooding.

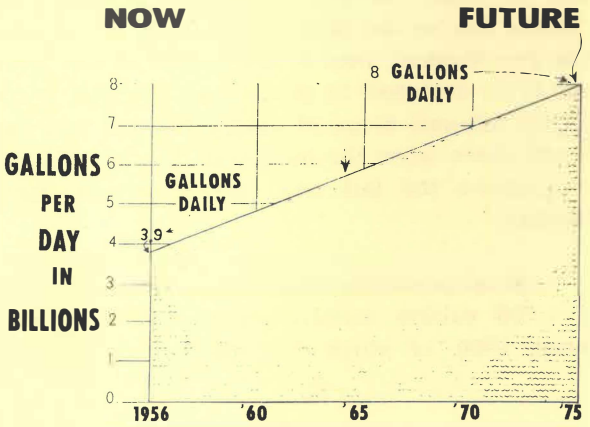
Steam-generation installations used in excess of 1,700 million gallons per day of fresh water during 1960, of which only about 4 percent was

obtained from ground water. This use is nonconsumptive withdrawal and is returned directly to its source with no quality change.



HOW MUCH WATER WILL WE USE IN THE FUTURE?

The need for pure, fresh surface and ground water will increase tremendously in the future. In the next 10 years the requirements will nearly double. The total withdrawal use of fresh water excluding that used for water power, amounts to about 1,100 gallons per day per person in Florida. This is a total withdrawal use of 5.5 billion gallons a day in 1963. By 1975 this total will exceed 8 billion gallons a day. This does not include nonwithdrawal uses such as recreation, navigation, and electric power generation. The needs for recreation will increase at a rate greater than the uses illustrated above. The primary reason for



this is that as our standard of living increases and work weeks become shorter the time available for recreation increases. Recreational needs must be met as a prime economic need of the State.

HOW DO WE LOSE WATER?

Only a relatively small amount of water may be considered to be permanently lost for any future reuse. However, water may be lost in the sense that misuse renders it unavailable for some length of time. Examples of this temporary loss are: The contamination of streams that ruin them for recreation, fish, and wildlife; the contamination of ground water by drainage wells; overpumping ground-water supply wells, allowing salt-water contamination; and sea level canals that provide ready avenues for salt water to enter the aquifers. In areas of artesian flow, open casings, leaking valves, valves left open needlessly, leaking casings, and wasteful irrigation practices remove excessive amounts of water from ground-water storage.

Water is considered to have been consumed, and therefore no longer available to meet the needs at the point of use, if it is evaporated or combined in a product or made so contaminated or polluted that it is useless.

CAN WE HAVE TOO MUCH WATER?

To anyone who has been in a flood or seen the aftermath of a flood, it is obvious that we can have too much water at times. Since most of Florida is within 60 miles of the sea and less than 35 feet above sea level, drainage is often inadequate during the wet season. Not only do some sections of the State suffer from seasonal stream flooding but also from a high water table

and raised lake levels accompanied by waterlogged soils and temporary ponds. Flooding in Florida is frequent and normal because of the flatlands, the concentration of much of the annual rainfall over short periods, and the absence of protective water-control facilities.

HOW DO WE PREVENT FLOOD DAMAGE?

The first plain above a river is called a floodplain because it is periodically flooded. This floodplain varies in width from an extremely narrow beach to a very broad plain. Man in his eagerness to be near water will often build upon the floodplain and subject himself to the periodic problem of high water. To lessen this problem along many major rivers, there have been constructed levees to hold the water back and channels cut wider and deeper to aid in faster removal of excess water.

This same eagerness to be near water applies to lakes. The level of water in the lakes fluctuates with rainfall, much the same as rivers do. There are many examples of man encroaching too low in the lake basins when the water is low; and when the level recovers to a normal or above normal state, the problem of inundation of property is upon him.

Flood prevention activity is not confined to rivers or lakes entirely. There are primary measures that should be taken prior to high water. Very frequently, what man does to the soil, and vegetation it produces, has a large bearing on how much water soaks into the ground and how rapidly water runs off to collect in lakes and streams. Large flood control districts have been created to aid in control of this excess in very large areas. The Central and Southern Florida Flood Control District is an example of this type of organization. A type of control that has not been practiced much in Florida and is perhaps the least expensive preventive measure is the zoning against building too close

to lakes and streams. Some counties are now applying this approach, but there is a great need for a state zoning authority to anticipate the needs of Florida for lands to be dedicated to water control and management, waterways, and recreational development. The purchase of land now for these purposes will be comparatively lower in cost than in the future.

WHO PAYS FOR FLOOD DAMAGE?

The uplands areas of stream basins are frequently utilized by rural and agricultural elements of our society. In these areas the basic approach is proper land use and treatment, such as good forestry and agricultural practices to preserve the land. There are governmental agencies such as the Soil Conservation Service that stand ready to assist the land owner in the conservation program.

Lower in the stream basins where the waterways become navigable, the engineering structures and channel improvements that are necessary for flood prevention and control are costly and beyond the individual's means for installation. They require group action, technical planning, and corporate or governmental financing. In this area, the U. S. Army Corps of Engineers determines the feasibility, plans and designs the control structures, supervises the construction, and in some cases operates the facility.

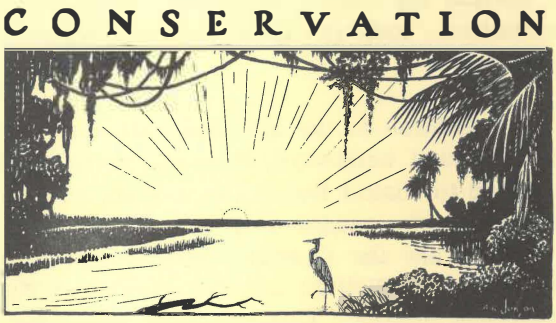
In addition to the agencies that control and manage natural waterways, there are agencies that are set up to control flooding by constructing large conservation (impoundment) areas. Such agencies in Florida are the Central and Southern Florida Flood Control District and the Southwest Water Management District. These districts have specific boundaries and exercise taxing power within these boundaries to help pay for the construction of flood control structures.

There also exist agencies that are set up to plan for and carry through the construction of canals that are used to improve navigation. These canals also serve as important links in the total flood control picture.

HOW CAN WE PROTECT AND CONSERVE OUR WATER RESOURCES?

We can best protect and conserve our water resources by developing a comprehensive statewide long range water plan. This plan should be based on a complete understanding of the natural and manmade controls that regulate the storage, movement, and quality of water conditional to the availability and need for water, fairly apportioned among the users.

Ground-water management must be statewide but surface-water management is a watershed problem and must be approached within each watershed. A coordinated district action is required and usually a soil conservation program is included. The construction of terraces to reduce slope wash, the encouragement of good soil tilling and mulching practices, the planting of protective vegetative cover, all work toward soil and water conservation.



The Watershed Protection and Flood Prevention Act (U. S. Public Laws 566 and 1018) provides for management and use of water by upper watershed

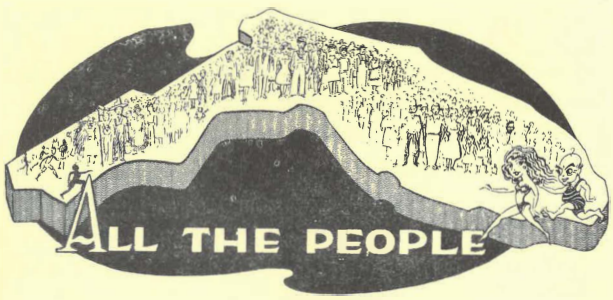
control structures. Flood control and agricultural benefits can be combined with improvements for industrial and municipal supplies, wildlife management, and recreational facilities with these sharing in the costs of construction according to the value and degree of the benefits.

WHO OWNS THE WATER IN FLORIDA?

Florida follows the general rule of riparian rights, which essentially guarantees that each riparian proprietor is entitled to make use of any water resources on his land, provided his use does not unreasonably affect the rights of adjacent riparian owners. This right implies "reasonable use," but this term has never been clearly defined by legislative or judicial authority in Florida.

In 1955 the Legislature of the State of Florida declared that the "waters in the state are a natural resource," and that "the ownership, control of development and use of waters for all beneficial purposes is within the jurisdiction of the state which in the exercise of its powers may establish measures to effectuate the proper and comprehensive utilization and protection of the waters."

Such implementation of this policy must be within the framework of judicial opinion relative to the riparian doctrine. Irrigation is necessary



in Florida. The construction of surface reservoirs and the use of waste waters for this purpose should be encouraged. But irrigation is not possible without the loss of water through evaporation, and large losses might exceed the "reasonable use" provision of the riparian doctrine.

The laws of Florida should anticipate the relative rights of human needs, stock requirements, irrigation, industrial, and recreational uses, and should adopt means to fairly apportion such rights to the extent to which they are most reasonably capable. In this way, waste and unreasonable use of water should be prevented.

The Department of Water Resources was created in 1957 for the purpose of implementing the water policy of Florida. This department primarily exercises control over and manages our water resources, formulating reasonable rules and regulations to implement the policy. The Florida Geological Survey is designated by the Legislature as the primary state agency for the collection of data on water resources, and joins the U. S. Geological Survey, state universities, Salt Water Fish Commission, and the State Game and Fresh Water Fish Commission to provide specialized data on water resources relating to specialized fields of responsibility.

WHAT IS A WELL AND HOW DOES IT WORK?

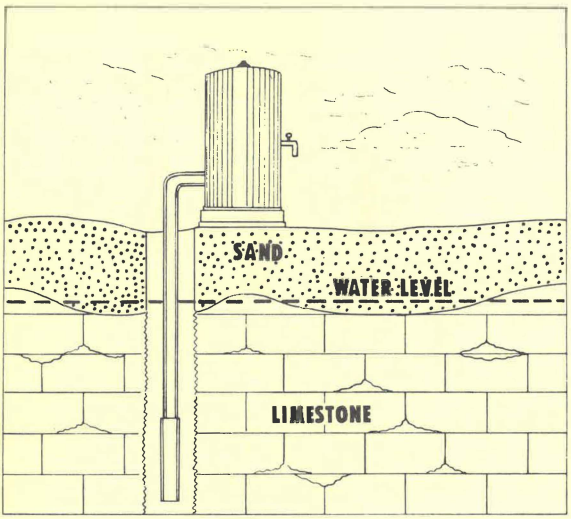
A water well is simply a hole dug or bored into the ground for the purpose of getting water. If it is to be productive, it must be deep enough so that water stands in the bottom. Wells drilled or dug into sand and clay would probably cave in and fill up if something was not used to keep the sides from sluffing. To prevent this, casing (pipe) is used, and well screens (strainers) fitted to the base of the casing serve to make it possible for

water to enter the well and at the same time keep the very small sand and clay particles out.

Wells that are drilled into bedrock are usually cased only through the sluffing section, as the rock portion of the hole stands open and yields water without the use of casing and well screens.

Of course, pumps are needed in most wells to lift the water, that has entered the well bore, the surface.

The level of water in wells fluctuates with seasonal variation in rainfall the same as does the level of surface bodies of water. There are times when wells are said to go dry. This may mean only that the water level in the well has been lowered below the intake pipe of the pump, and increasing the length of this intake pipe will often correct the trouble, although sometimes the well must be deepened.



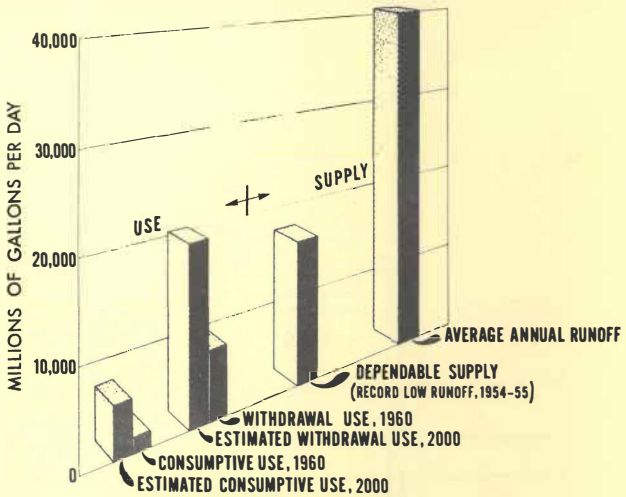
inexhaustible surface supply existing within 100 miles of any locality in Florida. Salt water, much with only minor concentration of salt, exists at depth under all of Florida below the fresh water and is available in large quantities for many industrial needs.

The anticipated withdrawals in some parts of Florida will exceed the dependable supply of water or the low runoff of 1954-55. Thus it becomes increasingly urgent to form long range plans for water development and management, to obtain the land necessary for the construction of control structures, to provide a statewide zoning plan that will insure the availability of these lands, and to start the construction required to insure the continued availability of water at the time and place it is needed.

The limited problems that have arisen in the use of the State's water resources can be eliminated for the most part by wise development, management, and control. This is the responsibility, not of a few, but of all the people of Florida.

SUMMARY AND CONCLUSIONS

At the present rate of consumption and level of technology, Florida's water resource is not only sufficient to meet all present needs but is sufficient for all expected growth. There exists now large quantities of good ground water which are not being used. Excluding this ground-water surplus, it is estimated we have a surplus runoff in streams of about eight times the amount of water withdrawn in Florida at the present. Much of the water tabulated in withdrawal use has been used many times and the total use is cumulative. However, the runoff is water that is immediately available for additional and increased uses. Industry has been, and will be, attracted by large volumes of good water combined with extensive tracts of available land, good research facilities, and an unexcelled climate, beaches and recreational facilities. This makes Florida an ideal spot for future industrial growth.



SUPPLY and DEMAND of WATER in FLORIDA

Salt water has not been considered thus far in our discussions. This is not because it is unimportant but rather because of the obviously

SOURCES OF INFORMATION

The water resource facts for Florida are developed by a number of State and Federal agencies. Inquiries may be addressed to the following:

Basic data -

Division of Geology,
State Board of Conservation
P.O. Box 631
Tallahassee, Florida

Water Resources Divison
U.S. Geological Survey

Ground Water Branch
P.O. Box 2315 MS
Tallahassee, Florida

Surface Water Branch
Federal Building
Ocala, Florida

Quality of Water Branch
Federal Building
Ocala, Florida

Beaches and shores - erosion and preservation

Division of Beaches and Shores
State Board of Conservation
107 West Gaines Street
Tallahassee, Florida

Climate and meteorology

Department of Meteorology
Florida State University
Tallahassee, Florida

U. S. Weather Bureau
Washington 25, D. C.

Control and management - including flood control and water management districts

Divison of Water Resources and Conservation
State Board of Conservation
107 West Gaines Street
Tallahassee, Florida

Control and use of salt water fish and marine life

Division of Salt Water Fisheries
State Board of Conservation
107 West Gaines Street
Tallahassee, Florida

Control and use of water for game and fresh water fish

Game and Fresh Water Fish Commission
646 West Tennessee Street
Tallahassee, Florida

Development of large watersheds, harbors, and other waterways for navigation, power, flood control and water management

U. S. Department of the Army
Corps of Engineers
Mobile and Jacksonville Districts
Mobile, Alabama, and Jacksonville, Florida

Development of small watersheds for flood control, water resource development and management, good water, and soil conservation practices

U. S. Soil Conservation Service
P. O. Box 162
Gainesville, Florida

Evapotranspiration rates, soil moisture, irrigation problems

Agriculture Experiment Station
University of Florida
Gainesville, Florida

Oceanography

Oceanographic Institute
Florida State University
Tallahassee, Florida

Public water supply and treatment; sewage and industrial waste treatment and disposal - sanitation

State Board of Health
P. O. Box 210
Jacksonville, Florida

Water chemistry and treatment

Department of Chemistry
University of Florida
Gainesville, Florida

Waterways, including navigation districts

Division of Waterways Development
State Board of Conservation
107 West Gaines Street
Tallahassee, Florida

Unit	EQUIVALENT				
	Gallons per day	Cubic feet per day	Gallons per minute	Acre feet per day	Cubic feet per second
1 gallon per day	ONE	.1337	.0006944	.000003069	.000001548
1 cubic foot per day	7.4805	ONE	.005195	.00002296	.00001157
1 gallon per minute	1,440	192.50	ONE	.00442	.00223
1 acre foot per day	325,850	43,560	226.28	ONE	.5042
1 cubic foot per second	646,323	86,400	448.83	1.9835	ONE

Unit	Cubic inches	Gallons	Cubic feet	Cubic yards	
1 cubic inch	ONE	.004329	.0005787	.00002143	
1 gallon	231	ONE	.13368	.00495	
1 cubic foot	1728	7.4805	ONE	.03704	
1 cubic yard	46,656	201.974	27	ONE	

Unit	Square inches	Square feet	Square yards	Acres	Square miles
1 square inch	ONE	.00694	.0007716	---	---
1 square foot	144	ONE	.1111	.00002296	---
1 square yard	1296	9	ONE	.0002066	---
1 acre	6,272,640	43,560		ONE	
1 square mile	---	27,878,400	3,097,600	640	ONE

FLORIDA GEOLOGICAL SURVEY
P. O. Drawer 631
Tallahassee, Florida 32302

"There is no substance in nature so protean in form, so incessant in circulation, or so multifarious in its functions as water. Now aciform, now liquid, now solid; now in the ocean, now in the atmosphere, now percolating the earth's crust, now coursing its surface and hurrying again to the ocean."

– David Page, 1866.