Indian River County
2020 Comprehensive Plan

Chapter 3D
Natural Groundwater Aquifer Recharge Sub-Element

Indian River County Community Development Department
Adopted: March 17, 1998

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INTRODUCTION

Aquifers can generally be defined as underground reservoirs of water. Indian River County is underlain by two (2) aquifers. These are the surficial "shallow" aquifer and the Floridan "deep" aquifer. Together, they comprise the primary water supply sources for the County.

As rain falls upon the earth's surface, the force of gravity causes it to percolate downward through porous surface soils to enter the aquifer strata. Because of the variable permeability of different types of soils, the rate of aquifer recharge from rainfall may vary from one location to another. Soils with the greatest permeability have the highest recharge rates and are called prime recharge areas. The presence of overlying confining layers also determines the location and effectiveness of a particular aquifer recharge area.

This sub-element addresses the unique characteristics of each of the aquifers, including: the groundwater that each contains, the recharging of the aquifer, the quality of the water, and the primary consumers of groundwater from each aquifer. Additionally, the document identifies the federal, state, and local agencies which regulate the use of the aquifers and their applicable regulations.

Because of their function as sources of potable water, aquifers are important resources. While aquifers provide water necessary to sustain urban development, they are also threatened by that development. Creation of impervious surfaces, such as roads, parking lots, and buildings, reduces the area available for rainfall percolation and alters the total rate and volume of recharge in that area. Land use, disposal of chemical wastes or other pollutants, urban runoff, and saltwater intrusion can also affect the quality of groundwater.

The quantity of groundwater is influenced by both natural and human causes since excessive withdrawal of water can affect an aquifer, the Natural Groundwater Aquifer Recharge Sub-element is closely related to both the Future Land Use Element and the Conservation Element of the Comprehensive Plan.

Another factor affecting the recharge potential of an area is the rate at which stormwater drains from a recharge area. Inadequately treated stormwater runoff transports non-point source pollution to groundwater in a manner similar to the transport of non-point source pollution to downstream surface waterbodies. Thus, over time an aquifer may become contaminated from pollutants originating from a recharge area. Since both the surficial and Floridan aquifers are the County's sources of drinking water, the presence of contaminants is of particular significance.

DEFINITIONS

Aquifer - a geological formation having at least one (1) horizontal impervious (confining) layer which is capable of yielding a useful amount of water to a well or spring.

Aquifer Recharge Area - a specific area having soils which will permit the percolation of rainfall and other liquids.

Aquifer System - a heterogeneous body consisting of interspersed permeable and less permeable material that acts as a water-yielding hydraulic unit of regional extent.

Artesian well - 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.

Atlantic Coastal Sand Ridge (ACSR) - a prehistoric geologic formation located parallel and proximate to U.S. Highway 1 in Indian River County. The sand ridge is characterized as generally having a combination of the following attributes: (1) The substrate is predominately excessively well drained deep sandy soil or associated moderately well drained soils, being one or more of the following: Paola, St. Lucie, Astatula, Archbold, Pomello, Orsino, and/or Jonathan soil series; (2) The land supports predominately sand pine (Pinus clausa) and associated scrub vegetation; and/or (3) The natural topographic elevation is equal to or greater than twenty-five (25) feet mean sea level (MSL).

Cone of Depression - a depression in the potentiometric surface of a body of ground water that has the shape of an inverted cone and develops around a pumped well.

Confining Bed - a body of relatively impermeable material stratigraphically adjacent to one or more aquifers.

Consumptive Use - any use of water which reduces the supply from which it is being withdrawn or diverted.

Discharge Area - an area of land beneath which there is a net annual transfer of water from the saturated zone to a surface-water body, the land surface or the root zone. The net discharge is physically manifested by an increase of hydraulic heads with depth (i.e., upward ground-water flow to the water table). These zones may be associated with natural areas of discharge such as seeps, springs, caves, wetlands, streams, bays, or playas.

Evaporation - the process by which water is changed from the liquid to the vapor state.

Evapotranspiration - water withdrawn from a land area by evaporation from water surfaces and moist soil and by transpiration from plants.

Floridan Aquifer - a groundwater reservoir comprised of layers of limestone and dolomite of the middle Eocene through Oglicene ages, underlying the Hawthorne Formation of Miocene age. The Floridan Aquifer underlies the entire county at depths ranging from about 250 feet to more than 2,700 feet below sea level.

Impervious surface - substances or surfaces, such as roads, parking lots and buildings, which do not allow the passage of water or other liquids (impermeability).

Irrigation - the process of artificially applying water to plant growth media or directly to living plant material.

Natural Groundwater Recharge Areas for the Surficial Aquifer - the lands along the Atlantic Coastal Sand Ridge and the Ten Mile Ridge where coarse permeable sands are exposed at the surface and rainfall is absorbed by the soil and percolates into the groundwater, as depicted in Figure 3.D.1.

Natural Groundwater Recharge Areas for the Floridan Aquifer - the lands west and northwest of Indian River County which recharge the Floridan aquifer, as depicted in Figure 3.D.1.

Percolation - the downward movement through a permeable layer of earth.

Porosity - the ability of a soil layer to hold water.

Potentiometric Surface - a surface which represents the static head in aquifer. The potentiometric surface is determined by the levels to which water will rise in wells which are tightly cased into the aquifer. The water table and the artesian pressure surface are examples of potentiometric surfaces.

Reclaimed Water - water that meets or exceeds FDEP standards for reuse and that is reused for a beneficial purpose after flowing out of any wastewater treatment facility.

Relic Seawater - water that has been trapped within an aquifer. The source of this water is an ancient sea which inundated the mainland in the geologic past.

Reverse Osmosis (RO) - a method of water treatment in which water under pressure is forced through a membrane which removes a percentage of both organic and inorganic impurities within the water.

Surficial "shallow" Aquifer - a groundwater reservoir encompassing the top stratum of soil in Indian River County that is directly replenished by rainfall. The aquifer extends from the water table to about 200 feet below land surface.

Surficial Aquifer Primary Recharge Overlay District (SAPROD) - the special district, established by Chapter 931 of the County's Land Development Regulations (LDRs), that overlays the Atlantic Coastal Sand Ridge. Specific regulations apply to developments located within the SAPROD.

The SAPROD is depicted is Figure 3.D.20.

Trihalomethanes (THMs)- carcinogenic chemicals found in shallow aquifer groundwater. Total Trihalomethanes (TTHMs) is the sum of the concentrations of the following: bromodichloromethane, dibromodichloromethane, tribromomethane (bromoform), and trichloromethane (chloroform).

Transmissivity - the ability of a pervious surface to transmit water. Higher transmissivity means more water is penetrating into the aquifer.

Water Table - the top of the zone of saturation.

Xeriscape - a water conserving landscape method that incorporates the principles of design, appropriate plant selection, soil improvement, efficient irrigation, mulching, and turf concentration and/or minimization.

Zone of Aeration - the area where both air and moisture are found in the spaces between soil and rock particles. Permeability refers to the ability of a soil layer to transmit or supply water.

Zone of Saturation - the area where the every pore space between rock and soil particles is saturated with water.

The following soil characteristics are defined by the United States Department of Agriculture's (USDA) Natural Resource Conservation Service (NRCS) in the 1987 Soil Survey of Indian River County:

Excessively Well Drained - soils in which water is removed from soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow.

Somewhat Excessively Drained - soils in which water is removed rapidly. Many are sandy and rapidly pervious.

Well Drained - soils through which water is removed readily, but not rapidly and are commonly medium textured.

Moderately Well Drained - soils in which water is removed somewhat slowly during some periods. They commonly have a pervious layer in or directly below the upper part of the soil profile, or periodically receive high rainfall, or both.

Somewhat Poorly Drained - soils in which water is removed slowly enough that the soil is wet for significant periods during the growing season. These soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these elements.

Poorly Drained - soils in which water is removed so slowly that the soil remains saturated for long periods. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very Poorly Drained - soils in which water is removed so slowly from the soil that free water remains at or near the surface during most of the growing season.

NATURAL FEATURES

Topography

Atlantic Coastal Sand Ridge

Indian River County does not have an extreme change in elevation, but there are several important physiographic features located in the county that should be noted. The two (2) ridges that parallel the coast in the eastern part of the county are remnants of offshore bars. The easternmost ridge is known as the Atlantic Coastal Sand Ridge and is approximately one-half (½) mile to one (1) mile west of the Indian River Lagoon (IRL). The ridge has a historic maximum height of approximately 54 feet, but several places along the ridge have been reduced in elevation due to excavation associated with sand mining and development.

Ten Mile Ridge

The second ridge is known locally as the Ten Mile Ridge and is overlain by the Interstate 95 corridor. This ridge pre-dates the Atlantic Coastal Sand Ridge and has a maximum height of approximately 35 feet. Both ridges contribute to the recharge of the surficial aquifer.

Inter-ridge Area

Between the ridges lies a flat shallow depression referred to as the Inter-ridge basin. This natural drainage basin was historically drained by the South Prong of the St. Sebastian River. Today, the southern end of the Inter-ridge basin is traversed by a network of drainage canals, and only a small portion of the basin in the north part of the County is still drained by the St. Sebastian River.

Upper St. John's River Basin

The topography of the County west of Interstate 95 is relatively flat with a rise in elevation near the Indian River-Osceola county line. The area between this rise and Interstate 95 is marshy and poorly

drained with some drainage improvements having been made to benefit area citrus groves, cattle ranches and other agricultural interests. A large portion of western Indian River County is covered by the St. John's Marsh. This marsh flows north, surrounding Blue Cypress Lake, and continues north to form the headwaters of the St. John's River Basin.

Stratigraphy

Indian River County consists of the following strata in descending order:

- The surficial aquifer lies just below the land surface and extends to a depth of approximately 200 feet, and is contained within Pleistocene sands. The surficial aquifer is situated above a confining unit. A 0 to 60 foot thick section of indurated carbonate rock is termed the "shallow rock zone" and overlies a 100 to 150 feet thick section of unconsolidated clastic material termed the "clastic zone".

- The surficial aquifer and the Floridan aquifer systems are separated by a 125 to 200 foot thick, low permeability confining unit known as the Hawthorn Formation.

- The Floridan aquifer includes the Oldsmar, Lake City and Avon Park limestone formations, the Ocala Group, and the Undifferentiated Oligocene Rock layer. It consists of about 2,800 feet of carbonate rocks. The Floridan aquifer is subdivided on the basis of permeability, the Upper Floridan aquifer (about 350-650 feet thick), the middle semiconfining unit (about 20-120 feet thick), and the Lower Floridan aquifer (roughly 2,000 feet thick).

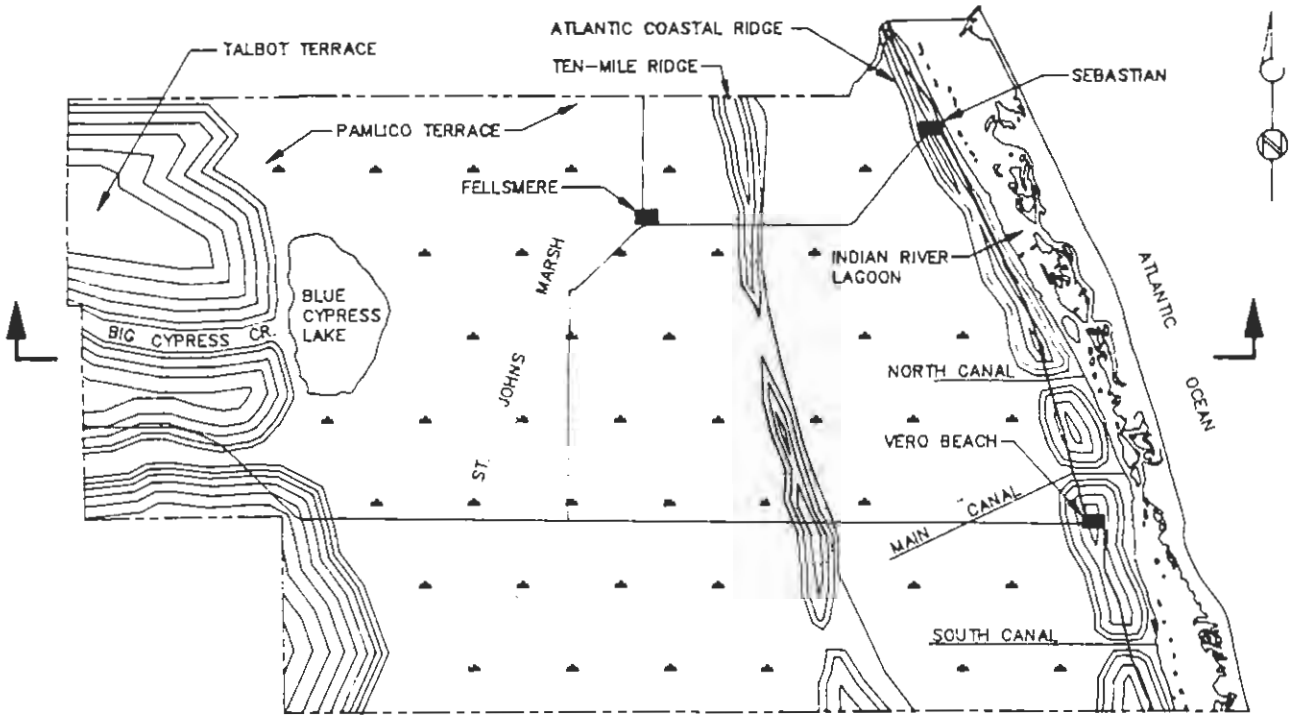
Figures 3.D.1 and 3.D.2 depict the general stratigraphy of Indian River County.

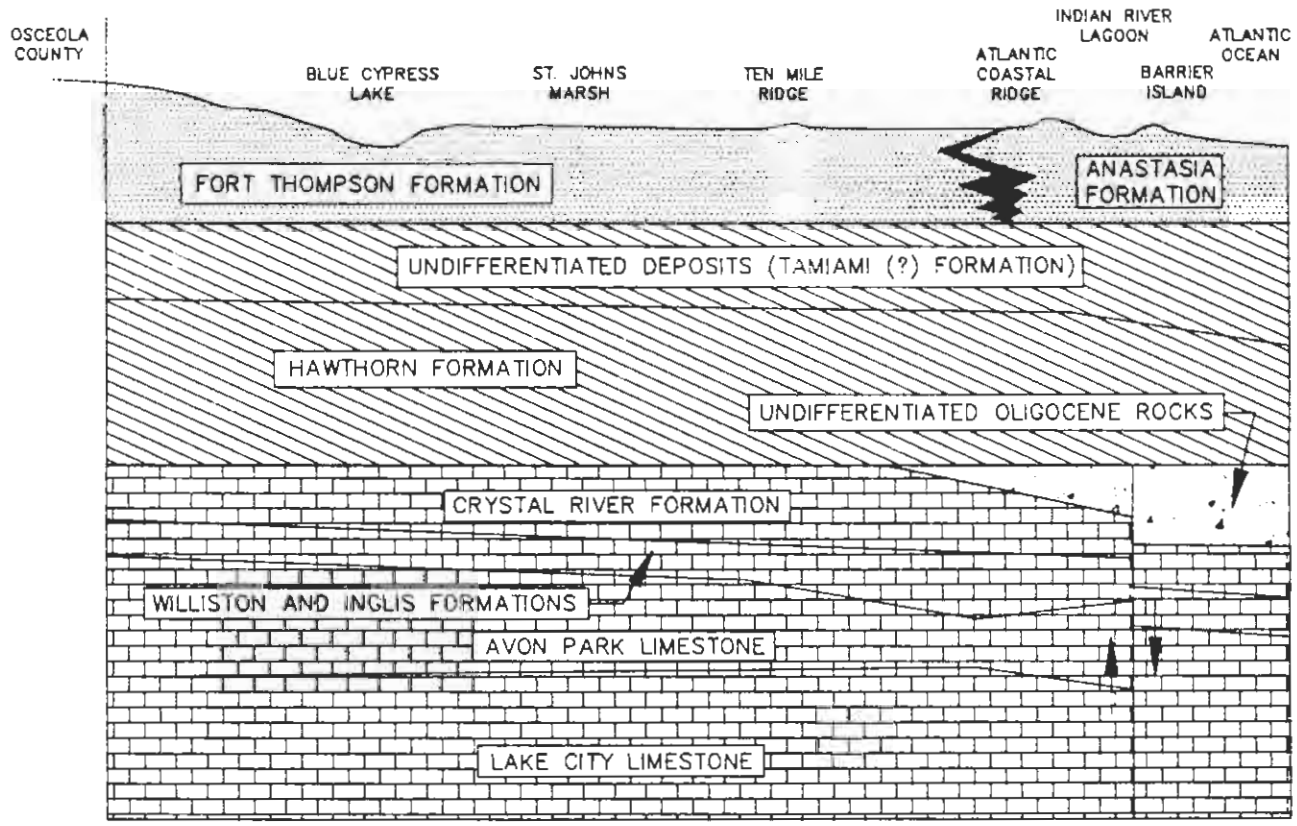
Rainfall

Summer rainfall originates from local showers or thunderstorms that are random in occurrence. Winter rainfall is generally associated with large, cold, frontal-type air masses that move from the northern latitudes southward. These fronts cover large areas so winter rainfall is usually more widespread and less intense than summer rains. Random meteorological events such as n'easters, tropical depressions, tropical storms or hurricanes may add a considerable amount of rainfall to the County's yearly average total rainfall.

In Indian River County, rainfall is unevenly distributed throughout the year. Historically, the most rainfall has been recorded in the month of September, followed in order by August, July and June. Nearly 50 percent of the annual rainfall occurs in these four (4) months. For the 20 year period from 1969 to 1988, rainfall averaged 54.4 inches per year. Rainfall can also vary considerably from year to year. The highest and lowest rainfalls recorded during this period were 81.7 inches in 1982, and 39.7 inches in 1980.

FIGURE 3.D.1





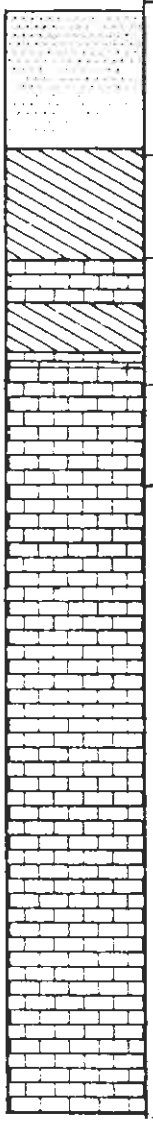
Brown and Caldwell
Consultants
ORLANDO, FLORIDA

STRATIGRAPHIC SECTION THROUGH INDIAN RIVER COUNTY

FIGURE 3.D.2

GENERALIZED STRATIGRAPHIC CROSS-SECTION

[gal/min = gallons per minute]



System	Series	Formation name	Thickness (feet)	Description	Yield of wells		Hydrogeologic unit
	Holocene	Undifferentiated deposits	0-25	Variable mixture of sand, clay, coquina, and organic material	Varies widely but mostly less than 100 gal/min	SURFICIAL AQUIFER SYSTEM	
	Pleistocene	Fort Thompson and Anastasia Formations	100-200	Coquina with variable amounts of sand, silt and organic material	Varies widely, from less than 100 to about 700 gal/min)		Clastic zone
	Pliocene	Tamiami Formation	0-60	Fragmented to cemented coquina and limestone	Generally 100 to 700 gal/min		Shallow rock zone
	Miocene	Hawthorn Formation	70-520	Silty to sandy clay, thin shell and limestone beds, phosphatic	Generally less than 100 gal/min		INTERMEDIATE CONFINING UNIT
	Oligocene	Suwannee Limestone	0-190	Chalky to crystalline limestone	Generally less than 100 gal/min	FLORIDAN AQUIFER SYSTEM	
	Eocene	Ocala Limestone	20-220	Limestone, dolomitic near base in places	Varies widely, from about 100 to more than 700 gal/min		Upper Floridan aquifer
			100-500	Limestone and dolomite	Generally more than 700 gal/min		
		Avon Park Formation	20-120	Dolomite, dolomitic limestone, limestone, and some gypsum	Probably much less than 100 gal/min		Middle semiconfining unit
		Oldsmar Formation	600-700	Limestone and dolomite	Generally 100 to more than 700 gal/min		Lower Floridan aquifer
			About 1,000	Limestone and dolomite	Boulder zone used as receiving unit for injection wells		

Water-bearing characteristics and descriptions of the geologic units in Indian River County

SOURCE: U.S. Geological Survey Water-Resources Investigation Report 88-4073

National Oceanographic and Atmospheric Administration (NOAA) records indicate that rainfall is also unevenly distributed spatially throughout the county. Average yearly rainfall at Fellsmere (about 55 inches) is about three (3) inches more than the average yearly rainfall at Vero Beach (about 52 inches). Annual rainfall for a station at Blue Cypress Lake for the period 1979 through 1985 averaged nearly 49 inches.

Evapotranspiration

Average annual evapotranspiration for the 20 year period from 1969 to 1988 was 45.0 inches. Therefore, approximately 9.4 inches of rainfall percolates to the groundwater table or is transported to surface waterbodies. Peak evapotranspiration occurs in May followed by June, July and April.

Soils

The Atlantic Coastal Sand Ridge and the Ten Mile Ridge are comprised of several different soil types. The soils associated with the Atlantic Coastal Sand Ridge are:

- Astatula-Archbold-St. Lucie
- Immokalee-Myakka-Satellite
- Myakka-Immokalee

The soils associated with the Ten Mile Ridge are:

- Immokalee-Myakka-Satellite
- EauGallie-Oldsmar-Wabasso

Among the different soil types associated with the Atlantic Coastal Sand Ridge and the Ten Mile Ridge, the drainage characteristics vary greatly. The drainage of the Astatula-Archbold-St. Lucie soil series ranges from "moderately well drained" to "excessively well drained." The drainage of the Immokalee-Myakka-Satellite series is "poorly drained" to "somewhat poorly drained." The drainage of the EauGallie-Oldsmar-Wabasso series is described as being "poorly drained." The Myakka-Immokalee series is "poorly drained."

The soil series associated with recharge areas of the Floridan aquifer are as follows:

- Immokalee-Myakka-Satellite
- Myakka-Immokalee
- EauGallie-Myakka-Riviera
- Myakka-Holopaw-Pompano

The drainage of the Immokalee-Myakka-Satellite series is "somewhat poorly drained" to "poorly drained." The Myakka-Immokalee soil series has "poorly drained soils." The drainage of the EauGallie-Myakka-Riviera series is "poorly drained." The Myakka-Holopaw-Pompano series is also

"poorly drained." A map of the general characteristics of soils in Indian River County is depicted in Figure 3.D.3.

EXISTING CONDITIONS

The surficial aquifer system and the underlying Floridan aquifer system are the sources of all ground water used in Indian River County.

Water Usage

According to the SJRWMD, approximately 99.93 million gallons per day (MGD) of groundwater were consumed in various water use categories in 1995. These categories are summarized as follows:

Public supply	11.16 (MGD)
Domestic self supply	6.91
Commercial/industrial	0.16
Recreation	3.00
Agricultural (ground only)	56.34
Estimated abandoned artesian flow wells and Miscellaneous	22.36

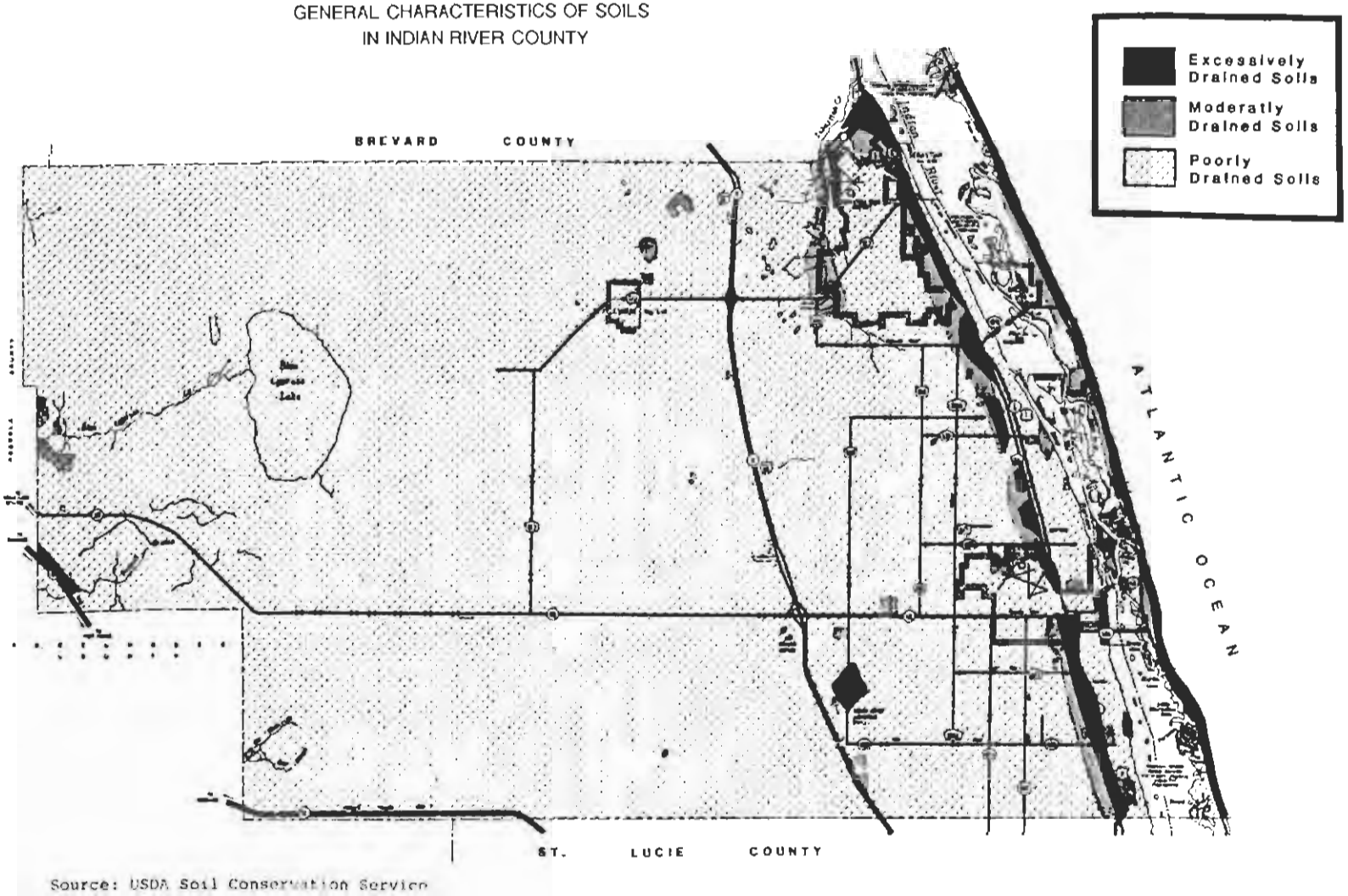
About 43.7 percent of the total area of Indian River County is in agricultural use. As a result, agricultural irrigation comprises the highest groundwater use category in the County, accounting for 56.34 MGD or 56 percent of the total withdrawal. Nearly all of the agricultural water demand and over two-thirds (2/3) of the total water demand for the County is supplied by the Floridan aquifer.

Currently, there are approximately 82,603 acres of irrigated land in the county devoted to citrus production. According to 1996 estimates by the IRCSWCD, agricultural irrigation practices consist of ±40,872 acres of sprayjet irrigation; ±13,918 acres of drip irrigation; and, ±26,322 acres of flood irrigation.

Public Supply figures represent 1995 combined total withdrawals supplied by the Indian River County Utilities Department and the City of Vero Beach Utilities Department. According to the County Utilities Department, over 60,681 County residents obtain water from a public supply source. Abandoned artesian flow wells contribute to an estimated loss of over 22.36 MGD. Notwithstanding, withdrawal figures for abandoned artesian flow wells and domestic self-supply are difficult to quantify and must be estimated.

FIGURE 3.D.3

GENERAL CHARACTERISTICS OF SOILS
IN INDIAN RIVER COUNTY



Source: USDA Soil Conservation Service

Date: 1987

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NORTH

Miles
0 1 2 3 4
SCALE

INDIAN RIVER COUNTY
FLORIDA

SHEET NO.

Surficial Aquifer

Hydrology

Natural recharge to the surficial aquifer occurs when rainfall does not return to the atmosphere by evaporation or evapotranspiration and is not transported from the recharge area directly as overland flow. The intensity, duration and frequency of rainfall are important to the recharge of the surficial aquifer. Depending upon the percolation characteristics of soils and the extent to which the land surface is covered with impervious surfaces, the surficial aquifer is subject to a recharge rate of approximately 12 to 16 inches per year.

The surficial aquifer receives recharge from three (3) different methods. The principal method of recharge is rainfall that percolates into the groundwater through adsorption by soil particles. This method occurs along the Atlantic Coastal Sand Ridge where coarse permeable sands are exposed at the surface. The Ten Mile Ridge also contributes to the recharge to the surficial aquifer. Figure 3.D.4 depicts the recharge areas of the surficial aquifer within the county.

In addition to the recharge which results from rainfall on the Atlantic Coastal Sand Ridge and the Ten Mile Ridge, recharge to the Surficial aquifer also occurs by several other methods. The greatest amount of this recharge occurs when wetlands are present and the water table is at ground level within the inter-ridge area. Rain that falls on these wetlands is a direct recharge to the aquifer. Because of the thick confining layer that separates the surficial and Floridan aquifers, there is little natural interchange of waters between the two (2) aquifers. However, small amounts of water may seep into groundwater from the canal system. Also, some recharge is attributed to water from agricultural irrigation wells which use the Floridan aquifer. The seepage from the drainage canals and from irrigation wells are generalized occurrences throughout the county.

The surficial aquifer is not physically uniform; therefore, characteristics such as density, permeability, and quantity of water produced vary throughout the County. Since the surficial aquifer is interconnected to the surface water systems throughout the county, virtually all recharge to the surficial aquifer is eventually discharged as subsurface flow into the IRL or the St. Johns Marsh.

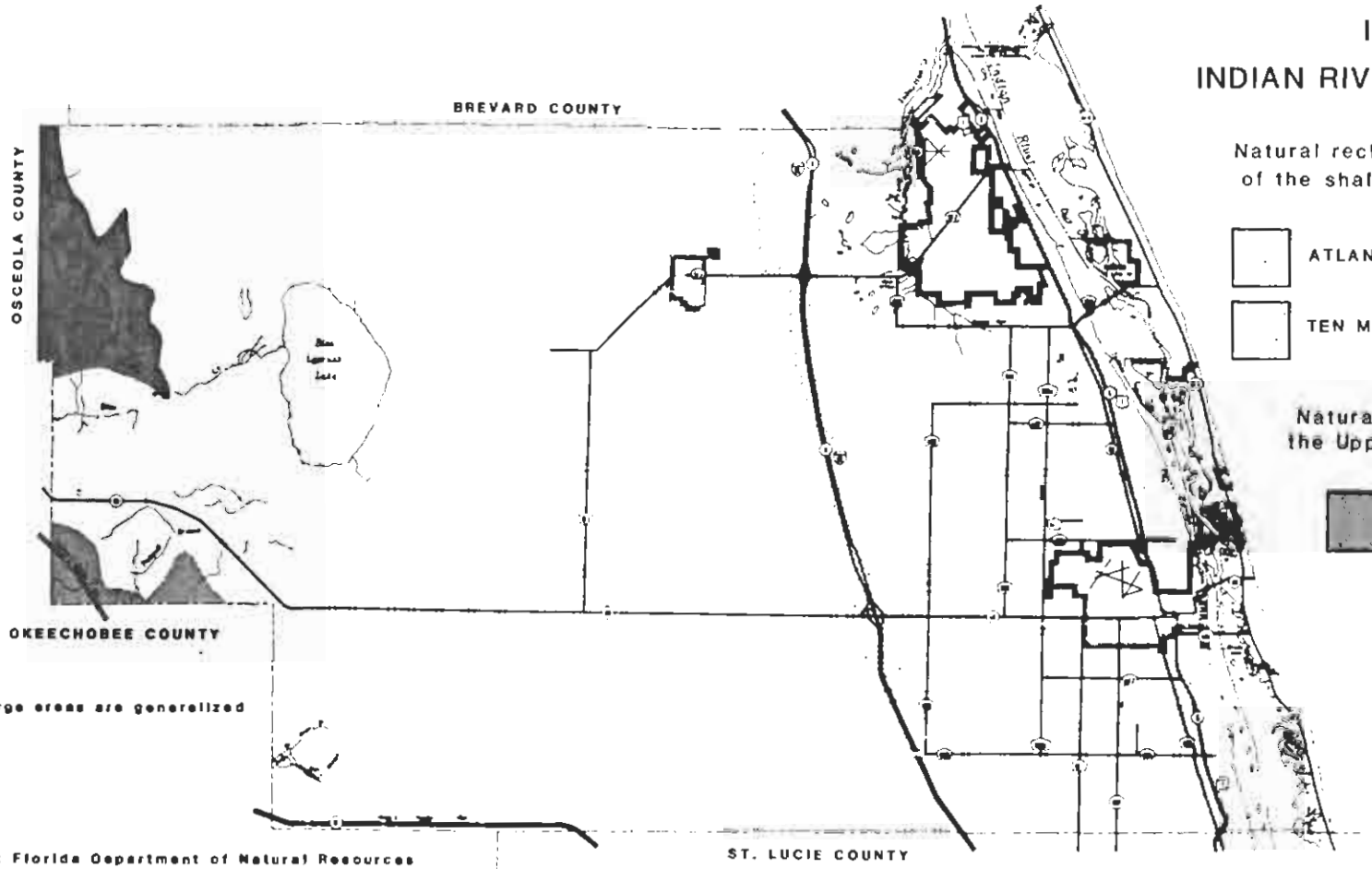
Water Quantity

Flow tests of the surficial aquifer conducted by the United States Geological Survey (USGS) indicate that a section of the county located near the coast, South of the City of Sebastian has the greatest potential for wellfield development. Well test data resulted in flows of 250 to 1,000 (GPM). This area covers approximately 100 square miles of Indian River County.

In the area of the county having the greatest potential well yield, the natural recharge to the surficial aquifer averages 16 inches annually. The natural recharge over this area represents a

FIGURE 3D4

AQUIFER RECHARGE AREAS IN INDIAN RIVER COUNTY



Source: Florida Department of Natural Resources
Indian River County Planning Department
U.S.G.S.

Updated Jan 1996
June 5, 1987

Boyle Engineering Corporation

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NORTH

0 1 2 3 4 5 MILES
SCALE

INDIAN RIVER COUNTY
FLORIDA

volume of water that with temporary changes in storage could sustain a continuous pumping rate of 75 million gallons per day (MGD). According to the USGS, the highest yielding wells of the surficial aquifer system are most likely to be found along the Atlantic Coastal Sand Ridge west of U.S. Highway 1 in the eastern part of the county.

The east central and the far western portions of the county have moderate potential for well field development. Well flow data in these areas were 100 to 250 GPM. The area having the least potential for wellfield development is the central portion of the county. Test results for this area were less than 100 GPM. Figure 3.D.5 displays the locations of high, moderate, and low wellfield potential.

- Public Water Supply Wells

The City of Vero Beach's Utilities department obtains the majority its water from 23 wells that tap the surficial aquifer. In general, groundwater from the surficial aquifer is suitable for domestic use with minimal treatment and generally costs less to use than water from the Floridan aquifer. The locations of the City of Vero Beach's public water supply wells are depicted in Figures 3.D.6 and 3.D.7.

- Domestic Self-Supply

Nearly 95 percent of the estimated 20,000 private wells located throughout the county tap the surficial aquifer. Private wells are utilized by over 36,734 inhabitants. This figure represents almost 38 percent of the County's total population. The average depth for private wells is about 90 feet, and their potential yield varies depending on where they are located in the County. New private wells are permitted by the Department of Health and Rehabilitative Services (DHRS).

Water Quality

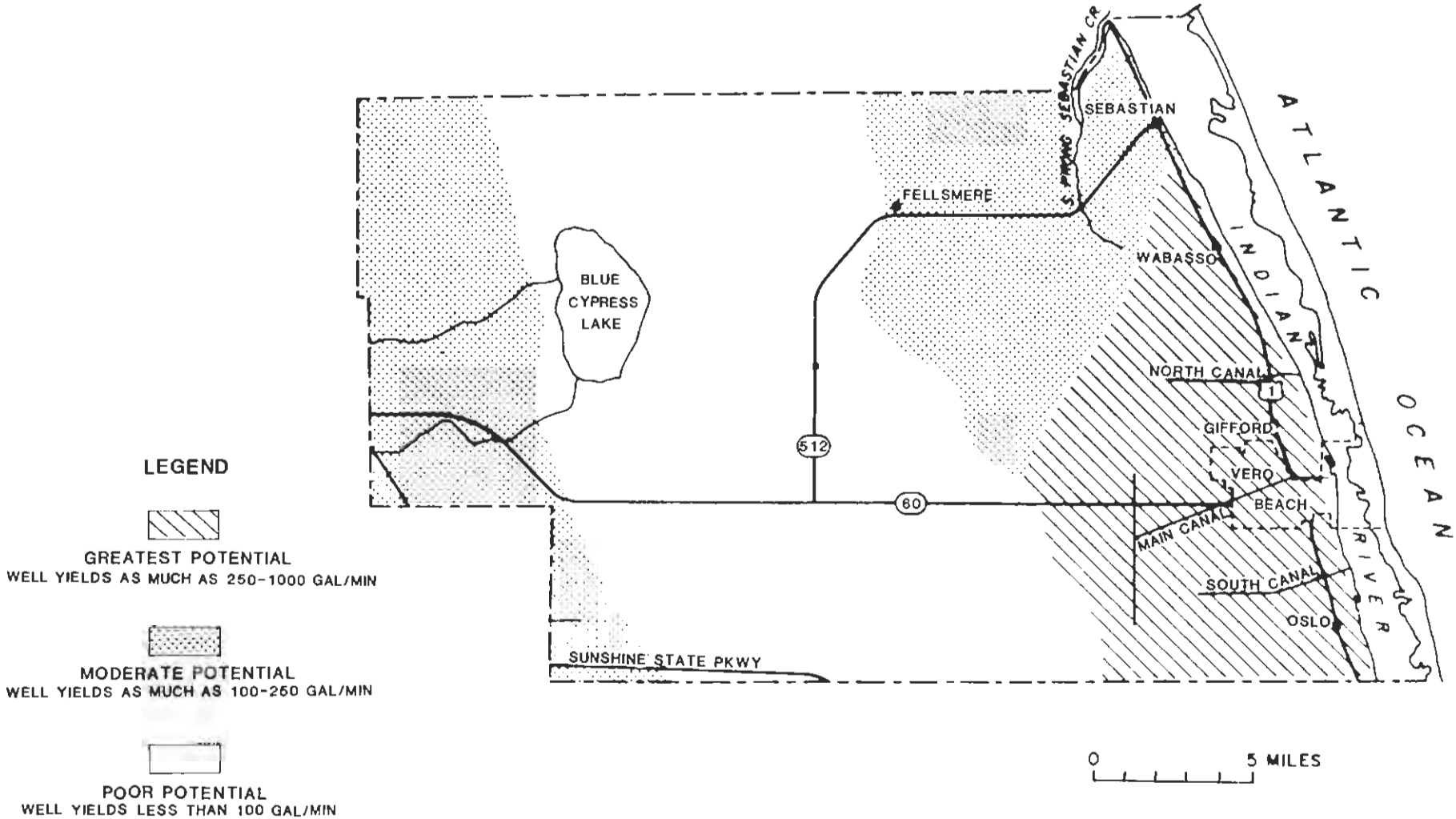
Groundwater often contains organic and inorganic chemical compounds which determine the quality of the water. Water with high concentrations of certain chemical constituents may be unsuitable for human consumption or for specific industrial uses. The general water quality characteristics of the Surficial aquifer are as follows:

- The water of the shallow aquifer may contain high concentrations of calcium (Ca), magnesium (Mg), iron (Fe), and other ingredients. High concentrations of such ingredients produce "hard water".

- Groundwater from the surficial aquifer is commonly treated by one of the following methods: sodium zeolite softening; chlorination; chlorination and aeration; or, lime alum softening.

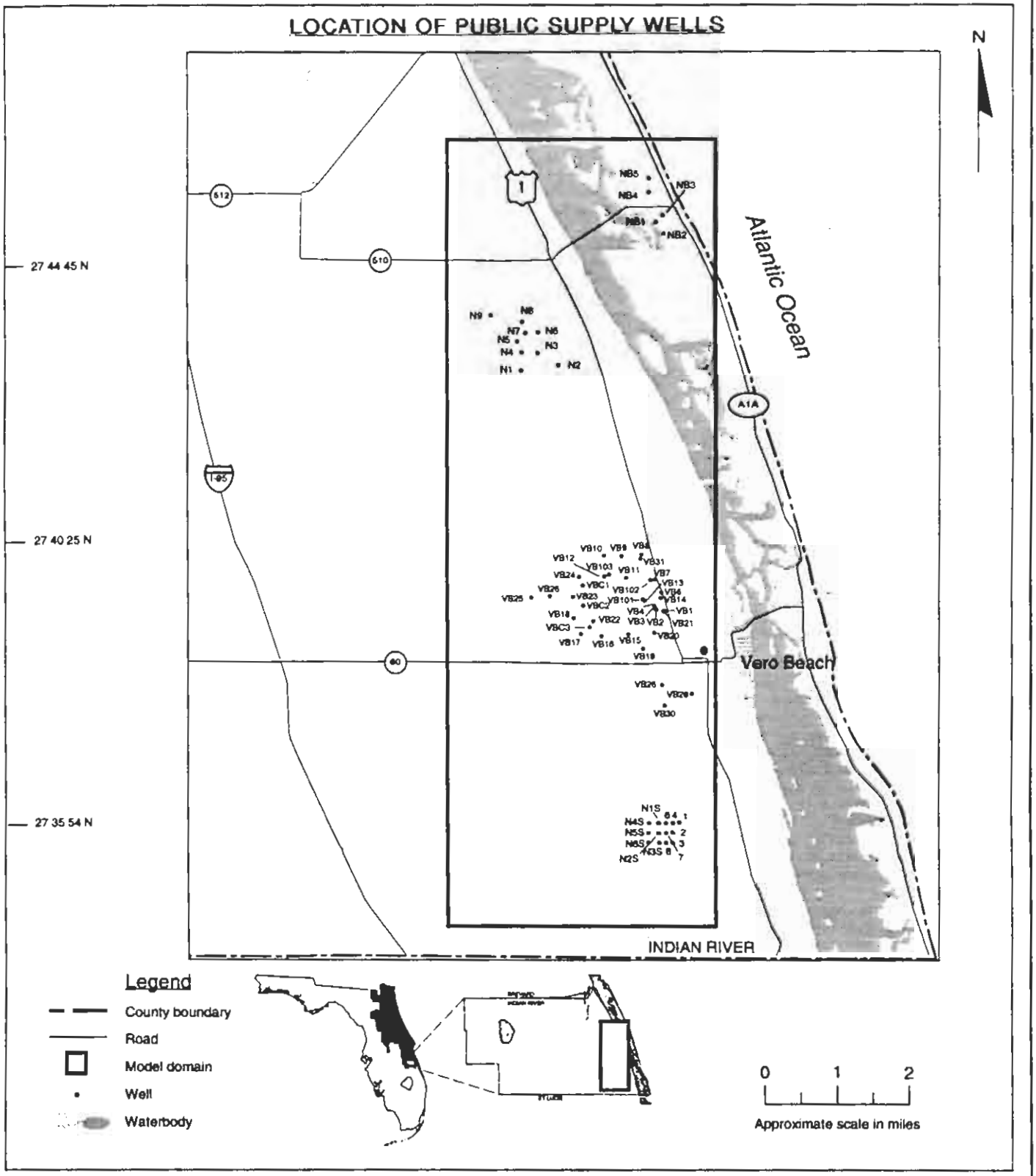
FIGURE 3.D.5

POTENTIAL YIELDS OF WELLS TAPPING THE SHALLOW AQUIFER



SOURCE: Water Resources of Indian River County,Fla., US Geological Survey, 1975

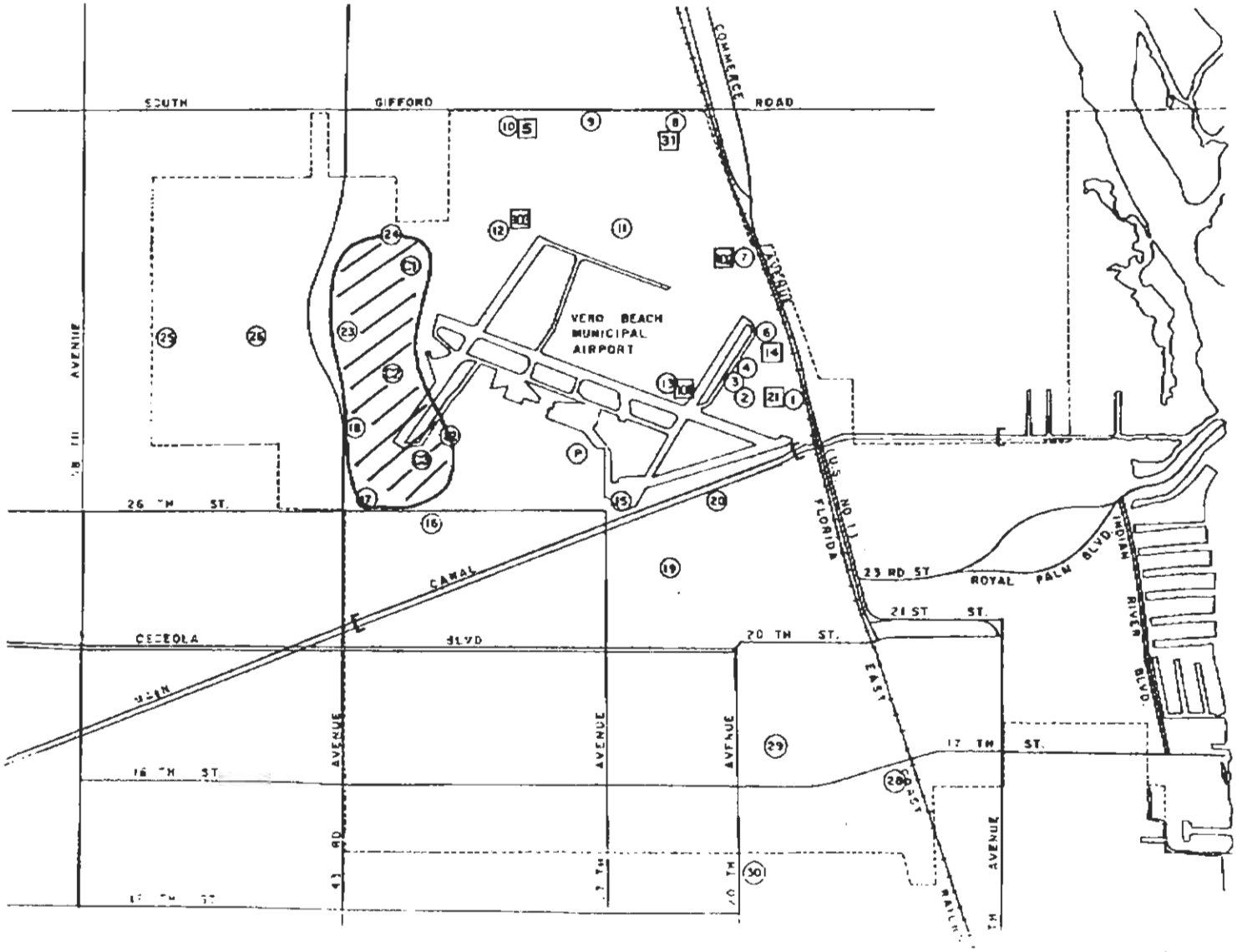
FIGURE 3.D.6



Model domain and well locations. *Wells with the "VB" prefix are located in the City of Vero Beach wellfield. All other wells are part of the Indian River County wellfield.*

FIGUI

EXTENT OF CONTAMINATED AREA IN THE CITY OF VERO BEACH PUBLIC SUPPLY WELLFIELD



- Chloride levels generally average less than 250 milligrams per liter (mg/L), the maximum level allowed by the Florida Department of Environmental Protection (FDEP) for potable water.

- The surficial aquifer is subject to contamination from the Floridan aquifer, herbicides and pesticides, industrial wastes, wastewater discharges, and from other sources.

- Chloride levels exceed 20,000 mg/L just west of the IRL in the Vero Beach area. However, as distance from the IRL increases, the chloride concentrations drop rapidly. Wells in other areas of the county also exhibit similar decreases in chloride concentrations as distance from the IRL increases.

The presence of chlorides, even in trace amounts, limits the use of groundwater by causing it to become nonpotable, toxic to irrigated plants, and corrosive. In fact, fresh water that contains as little as two (2) percent saltwater (greater than 250 mg/L of chloride) does not meet current FDEP standards for drinking water. Also, chloride combines with naturally occurring organic materials in groundwater to form trihalomethanes (THMs). THMs are potentially carcinogenic chemicals. As a result, the Florida Department of Environmental Protection (FDEP) has established 0.1 mg/L as the Maximum Contaminant Level (MCL) for total THMs.

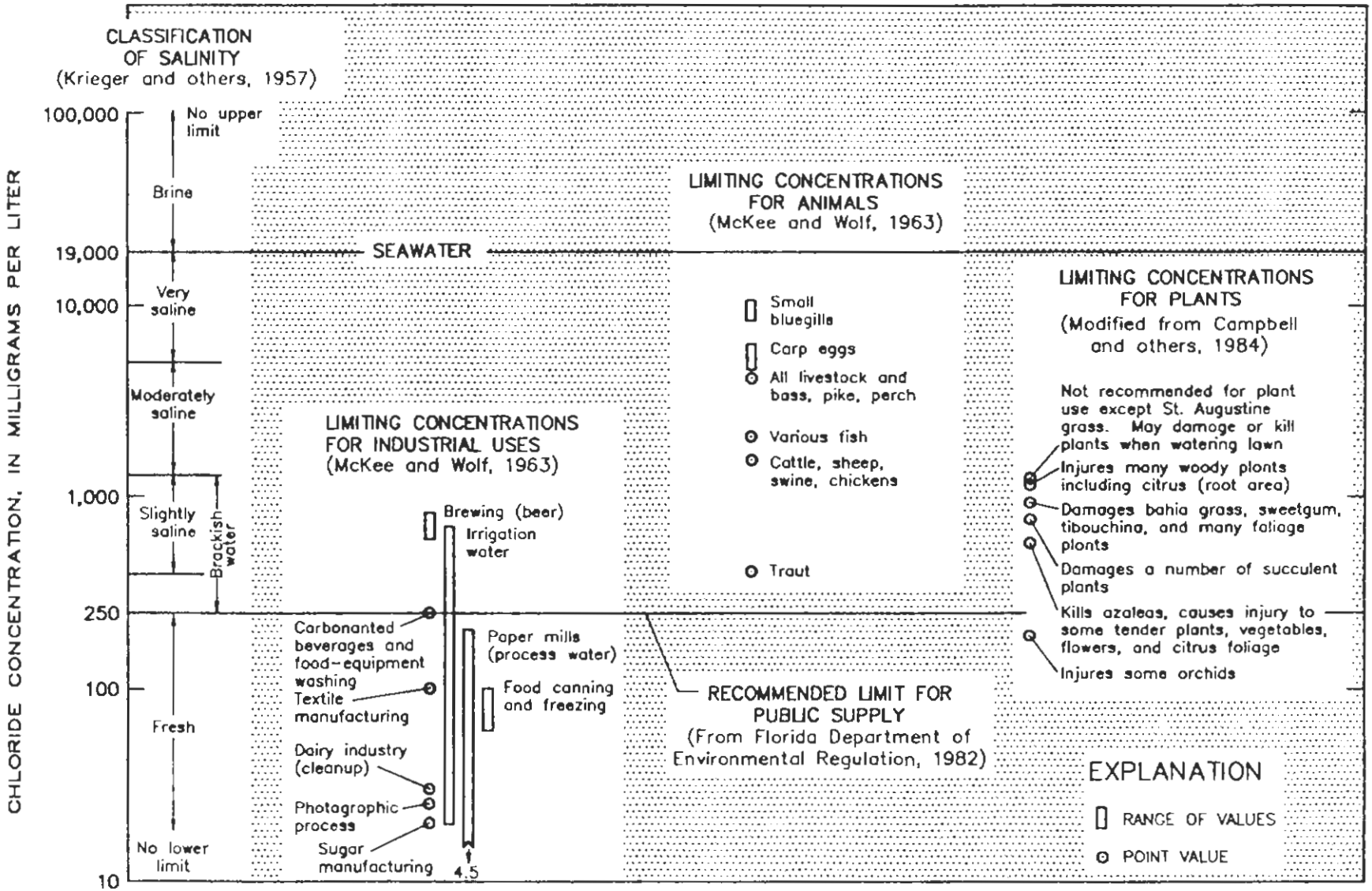
Figure 3.D.8 shows the classification of salinity and the concentration of chloride recommended for plant, animals, public supply and industrial use.

- Saltwater Intrusion

Because it is less dense than saltwater, freshwater floats upon saltwater. Along coastal zones the salt water moves inland as a wedge until balanced by a freshwater head. Although some mixing may occur at the interface of the two, the slow rate of movement of the water and the absence of turbulent flow within the aquifer tend to retard mixing. Lateral or horizontal saltwater intrusion occurs when the equilibrium between the saltwater and freshwater is disturbed. This can be caused either artificially by overpumping or excess drainage, or naturally, through droughts. Because of the different densities between saltwater and freshwater, a relatively small change in the freshwater level within the aquifer can result in a relatively large change in the position of the freshwater/saltwater interface. A cross-section of the high chloride interface is depicted in Figure 3.D.9.

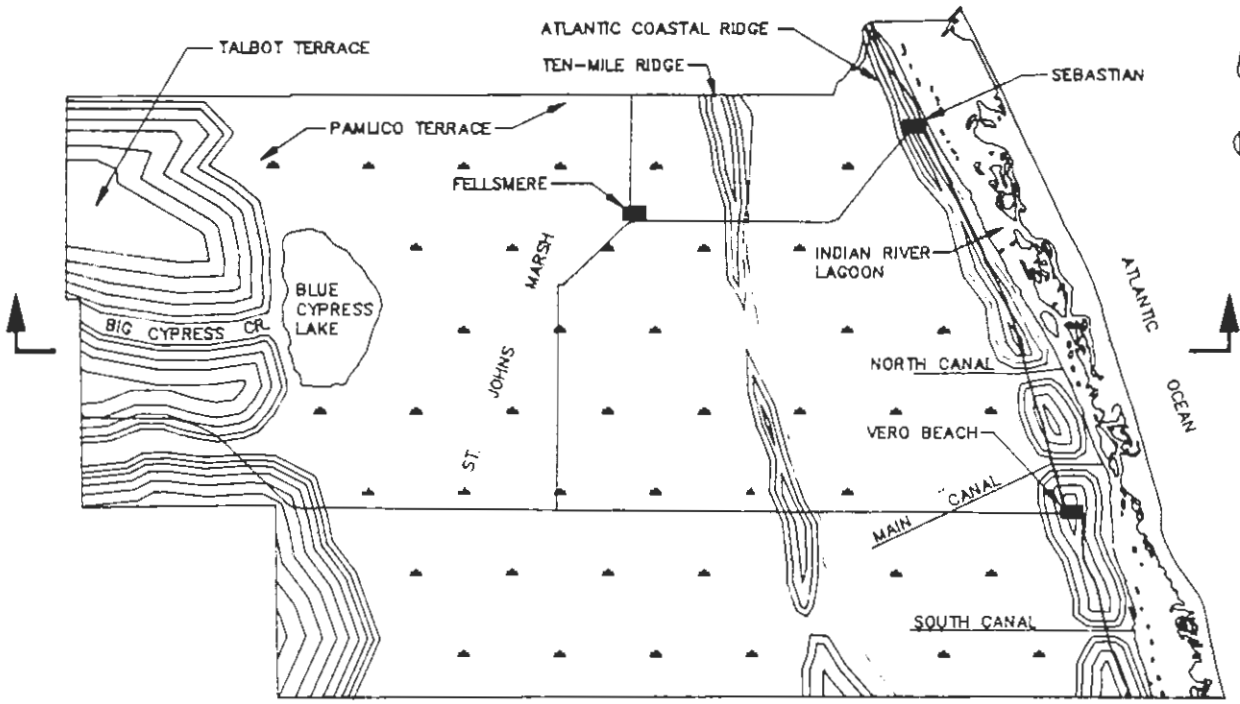
Within Indian River County, groundwater from the surficial aquifer is discharged into either the St. John's River Marsh or the Indian River Lagoon (IRL). The Hawthorne formation (the confining layer) retards saltwater intrusion by slowing the rate of horizontal movement of saltwater. In addition to the Hawthorne formation, the surficial aquifer also contains a relatively impervious layer located in the vicinity of the IRL. This barrier helps to maintain high groundwater levels near the coast by reducing the amount of freshwater discharge from the surficial aquifer. Nevertheless, the surficial aquifer is highly susceptible to saltwater intrusion.

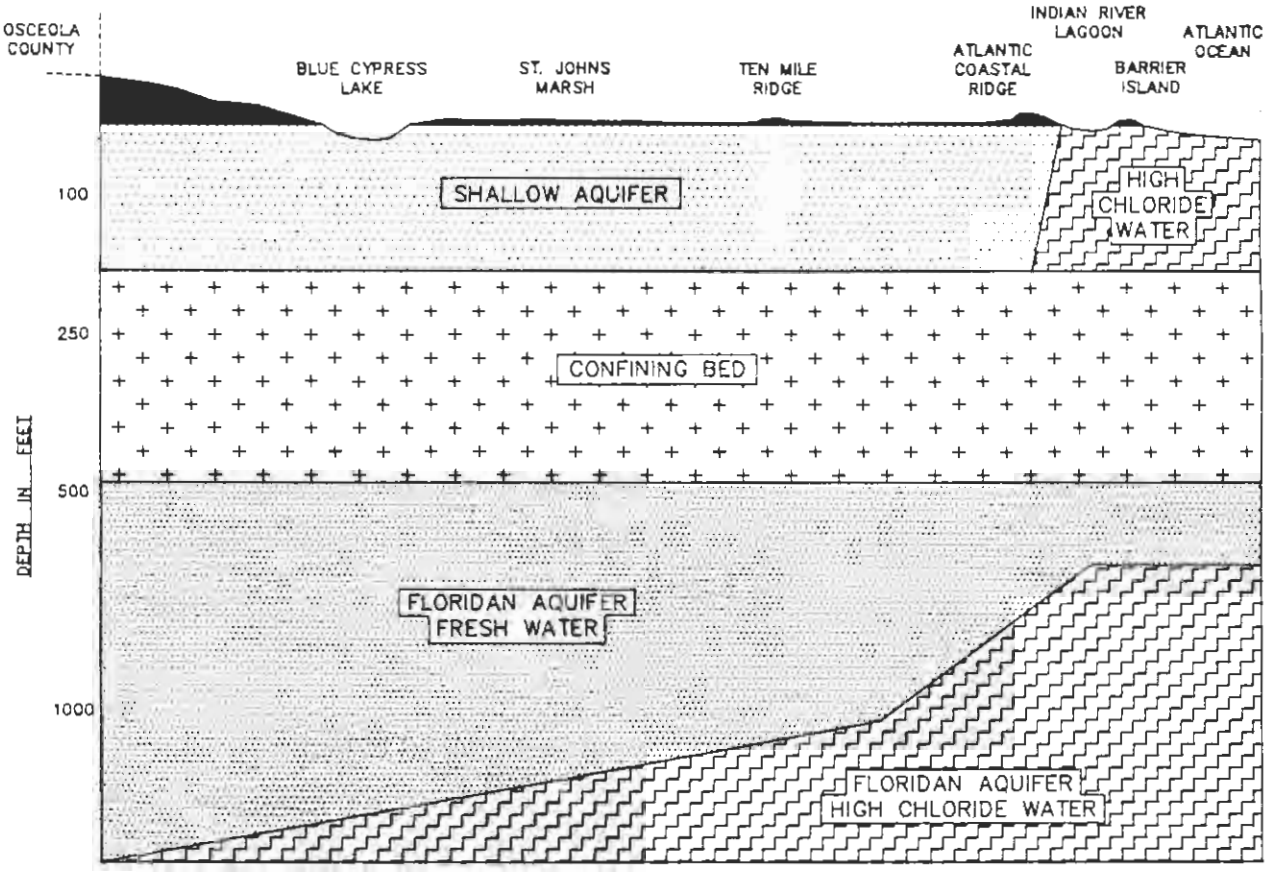
FIGURE 3.D.8



Classification of salinity and limiting concentration of chloride recommended for plants, animals, public supply, and industrial use

FIGURE 3.D.9





NOTE: "HIGH CHLORIDE WATER" HAS A CONCENTRATION IN EXCESS OF 250mg/l CHLORIDE

Brown and Caldwell
Consultants
ORLANDO, FLORIDA

CROSS-SECTION OF INDIAN RIVER COUNTY SHOWING HIGH CLORIDE INTERFACE

Saltwater intrusion is often a direct result of development. As development increases, the need for potable water also increases. Over pumping of groundwater causes saltwater to encroach into the surficial aquifer. As water is pumped from a well, the water table around the well is lowered, forming a cone of depression. This depressed cone causes relic seawater or saline surface waters to flow toward the well from the surrounding area. Initially, saltwater intrusion affects only wells located adjacent to the source of the saltwater. However, over time, the limits of the saltwater intrusion move further inland and affect a larger area. In fact, a (1) foot drawdown in the potentiometric surface results in an upward movement of the saltwater interface of approximately 40 feet. Within a cone of depression, saltwater upconing can be magnified up to 40 times.

Along the coast of Florida, one of the greatest dangers to public water supply wells is to allow the cone of depression to become so large as to induce the saltwater wedge to migrate inland. The obvious method of preventing this type of contamination is to maintain the water table around the withdrawal wells high enough above sea level to prevent the saltwater wedge from moving inland and reaching the wells. The effect of saltwater intrusion on the surficial aquifer is also discussed in the Conservation Element of the Comprehensive Plan.

The St. John's River Water Management District (SJRWMD) conducted a study of surficial aquifer wells in Indian River County to determine the extent of saltwater intrusion. The study looked at two zones within the surficial aquifer. The clastic zone is located approximately 100 to 150 feet below the surface. The rock zone is located approximately 60 to 120 feet below the surface. The results of the SJRWMD study show that, since an earlier study, saltwater had encroached into the mainland portion of the aquifer. However, within each of the two (2) zones, the westward extent of the interface differed.

In the clastic zone of the surficial aquifer, saltwater has encroached under the mainland in two (2) areas. In the northern portion of the county, saltwater has encroached into the Roseland area. This intrusion extends approximately to U.S. Highway 1. Between the Main Relief Canal (MRC) and the South Relief Canal (SRC) of the Indian River Farms Water Control District (IRFWCD), the encroachment extends approximately to U.S. Highway 1. South of the SRC, the westward extent of the intrusion shifts eastward and lies between the IRL and U.S. Highway 1. The limits of the saltwater intrusion within the clastic zone of the surficial aquifer are depicted in Figure 3.D.10.

Within the rock zone of the surficial aquifer, saltwater intrusion is evident in the Sebastian area, east of U.S. Highway 1. There is also intrusion that runs approximately from the IRFWCD's North Relief Canal (NRC) throughout the southern portion of the county. The intrusion extends approximately to U.S. Highway 1. The limits of saltwater intrusion within the rock zone of the surficial aquifer are depicted in Figure 3.D.11.

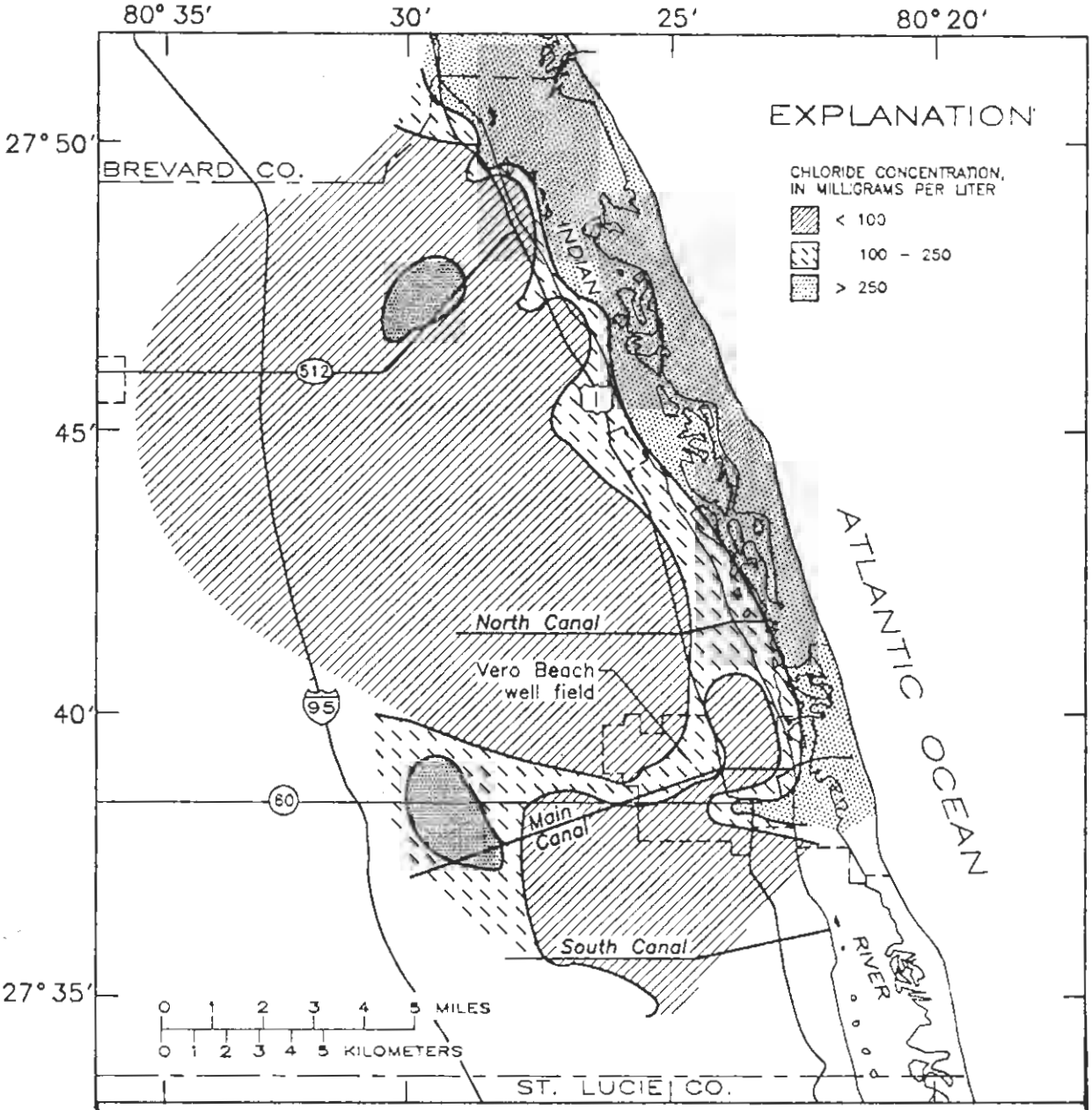


FIGURE 3.D.10

INDIAN RIVER COUNTY

SALTWATER ENCROACHMENT IN THE CLASTIC ZONE OF THE SHALLOW AQUIFER

Source: U.S. Geological Survey

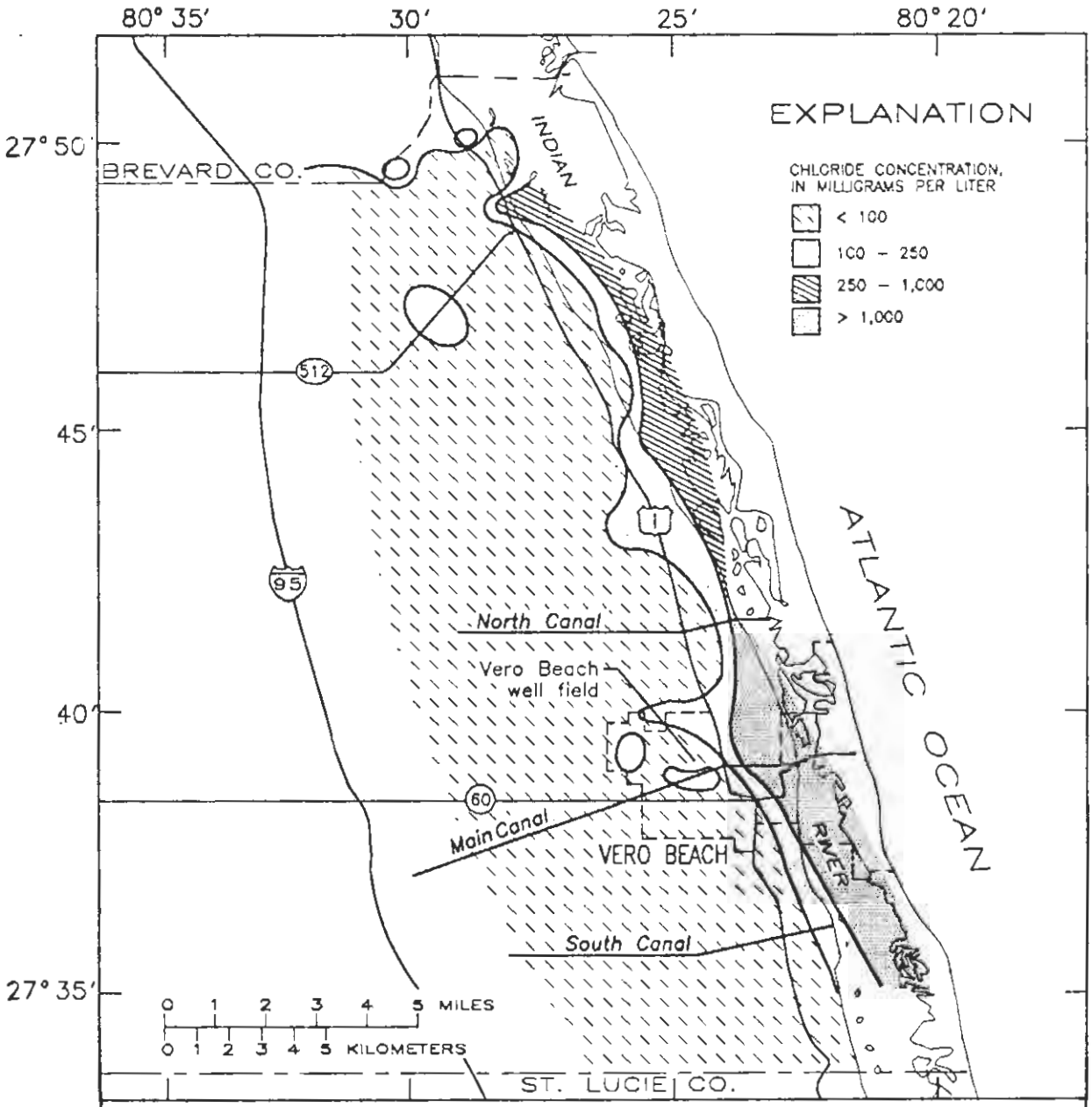


FIGURE 3.D.11

INDIAN RIVER COUNTY

SALTWATER ENCROACHMENT IN THE ROCK UNIT OF THE SHALLOW AQUIFER

Source: U.S.Geological Survey

- Agricultural Contamination

Indian River County has approximately 82,603 acres in active citrus and vegetable cultivation at the present time. This production is primarily concentrated in the central and western portions of the county.

A significant amount of chloride is contributed to the surficial aquifer from agricultural irrigation. Inefficient irrigation practices, such as flood irrigation, transport chloride to the surficial aquifer in two (2) primary ways:

- Water from the Floridan aquifer percolates directly into the shallow aquifer.
- As a result of evaporation, a chloride residue is deposited in the soil. Rainfall dissolves the chloride residue, and it enters the surficial aquifer.

Also, many chemicals associated with agricultural production, such as herbicides, pesticides and fertilizers, are water-soluble and can be transported to groundwater via percolation. However, there is no documented evidence of groundwater contamination from fertilizers, insecticides, or other related chemicals.

- Industrial Contamination

Presently, there are approximately 750 acres land used for industrial purposes within the unincorporated portion of the county. This industrial development is primarily concentrated along U.S. Highway 1 and in several nodes in the unincorporated county. Contamination attributed to leaking underground storage tanks (LUSTs) has been discovered at several sites scattered throughout the County. There is documented evidence of contamination within the western portion of the City of Vero Beach's wellfield. The +400 acre contaminated site is located within the City Limits of Vero Beach, just west of the Municipal Airport in an area east of 43rd Avenue, north of 26th Street and south of 41st Street. According to the City of Vero Beach Water and Sewer Department, five (5) production wells (numbers 17, 18, 22, 23 and 24) are contaminated by trichloro-ethylene and its byproducts. The City operates three (3) cleanup wells (C1, C2 and C3) as part of an ongoing remediation effort. The cleanup program is further discussed in the Analysis section of this sub-element. The extent of the contaminated area in the City of Vero Beach's public supply wellfield is depicted in Figure 3.D.7.

Floridan Aquifer

Hydrology

The entire County is underlain by the Floridan Aquifer. Although the physical character of the aquifer is generally uniform, the hydrology of the Floridan aquifer system is complex. The top of the Floridan Aquifer is oriented towards the southeast and consists of an Oligocene limestone

of relatively low permeability. The Floridan aquifer is, therefore, recharged by rainfall occurring primarily west and northwest of Indian River County. Consequently, the water moves eastward and then eventually discharges into the Atlantic Ocean.

The permeability of the upper zone of the Floridan aquifer generally is higher than that of the lower zone of Floridan aquifer. The upper zone of the Floridan aquifer ranges in depth from 350 to 650 feet below the surface. The natural recharge rate in Indian River County is estimated to be one (1) to two (2) inches annually. The principal recharge area for the Floridan aquifer is located in the Osceola Plain west of Blue Cypress Lake. This portion of the Osceola Plain is not considered a prime aquifer recharge area by the SJRWMD. Prime recharge areas for the Floridan aquifer are located outside the boundaries of Indian River County. The locations of the aquifer recharge areas for the Floridan aquifer, as identified by the SJRWMD, are depicted in Figure 3.D.4. The hydrogeologic sections of the Floridan aquifer are identified in Figures 3.D.1 and 3.D.2.

Water Quantity

The potentiometric surface of the aquifer, the level to which pressurized water within the aquifer would rise if it were not confined, is above the land surface throughout most of Indian River County. An artesian flow well is an example of where the potentiometric surface of the water from the Floridan aquifer is above the land surface.

The potentiometric surface of the Floridan aquifer fluctuates seasonally based on variable amounts of rainfall (recharge) and water usage (withdrawal). During the dry period, usually the months of April and May, there is little recharge of the aquifer. In addition to the absence of recharge, the agricultural usage of the aquifer for irrigation is greatest at that time. During the summer and fall months, the recharge of the aquifer is the greatest, and the irrigation needs are usually minimal. Between the wet season and the dry season, the potentiometric surface of the aquifer may fluctuate as much as 15 feet.

The evidence regarding the overall status of the potentiometric surface of the Floridan aquifer within the county is inconclusive. Although some observations indicate that the water level is dropping, other observations do not suggest a downward trend. Notwithstanding, data are not available to adequately substantiate the quantity of water contained in the Floridan aquifer.

- Potential Yield

Considerable variation in yield may be found in nearby wells of equal depth. Measured flow rates of wells that tap the Floridan aquifer system range from 30 to 2,000 GPM with a median of 650 GPM. An aquifer simulation was performed for a potential well at the South County Reverse Osmosis Water Plant (ROWTP). The simulation tested 4 to 11 wells (the 3 existing wells and 1 to 8 new wells), each discharging at a rate of 1200 to 1400 GPM. Results of the

modeling indicate that a sustained yield of 22 MGD could be obtained from the Floridan Aquifer at this site.

- Public Water Supply Wells

Within the county, the preferred method of treating groundwater from the Floridan aquifer is reverse osmosis (RO). Reverse osmosis is a physical method of forcing the groundwater through membranes which separate chloride and other impurities from the potable water. The South County facility currently utilizes four (4) production wells with a total pumping capacity of 5,600 GPM or 8.06 MGD. The North Beach facility utilizes three (3) production wells with a total pumping capacity of 1,500 GPM or 2.16 MGD. The Potable Water section of the comprehensive plan also describes water treatment methods for both the surficial and Floridan aquifers.

According to the Indian River County Utilities Department Master Plan, raw water quality concerns for the County's facilities include: chlorides, sodium, calcium and magnesium, and dissolved organic carbon. The presence of calcium and magnesium determine the hardness of the water. Chloride and dissolved organic carbon affect THM and disinfection by-product (DBP) formation. Figure 3.D.6 shows the locations of the public supply wells utilized by the Indian River County Utilities Department.

Production wells at the North Beach facility exhibit elevated levels of chloride, sodium and total hardness. Well #2 is of particular concern since chloride levels exceed 1,700 mg/L. Since Well #2 produces water with a chloride concentration twice that of the other wells at the facility, it has been relegated to a standby status. Due to the proximity of Well #2 to the other production wells, it is assured that local aquifer faulting or connate-upcoming is the probable cause for the elevated levels of chlorides. However, there is no conclusive evidence to prove this speculation. Raw water quality parameters for the South County and North Beach production wells are contained in Tables 3.D.1 and 3.D.2.

Compared to the North Beach facility, production wells at the South County facility contain lower levels of TDS and chlorides. The improved water quality can be attributed to a greater depth to the freshwater/saltwater interface in the aquifer. Also, the South County facility utilizes an upper production zone which is less influenced by connate waters. Pumping from the wellfield has lowered the potentiometric head by approximately ten (10) feet; however, water quality has remained constant. Remaining service lives for the four (4) production wells at the South County facility are estimated to be greater than 10 years (Brown and Caldwell, 1993).

TABLE 3.D.1
FLORIDAN AQUIFER RAW WATER QUALITY PARAMETERS

PARAMETER (mg/L)	SOUTH COUNTY ROWTP	NORTH BEACH ROWTP	NORTH BEACH ROWTP (Well 2)	NORTH COUNTY ROWTP	FDEP Standards (Maximum)
Chlorides	263	760	1,735	270	250
Calcium	38	112	128	34	NR
Magnesium	48	43	113	40	NR
Sodium	144	N/A	N/A	135	NR
Potassium	11	16	29	16	NR
Sulfate	142	87	87	64	250
Bicarbonate	158	170	195	182	NR
T.O.C.	0.54	N/A	N/A	N/A	NR
TDS	750	1,575	3,435	690	500

Units expressed in milligrams per liter (mg/L)

T.O.C. Total Organic Carbon
TDS Total Dissolved Solids
N/A unknown
NR not regulated

Source: Indian River County Utilities Department Master Plan (Brown and Caldwell, 1993)

TABLE 3.D.2
FLORIDAN AQUIFER PUBLIC WATER SUPPLY WELLS

SOUTH COUNTY REVERSE OSMOSIS TREATMENT PLANT

WELL NUMBER	CASING DIAMETER (inches)	CASING DEPTH (feet)	TOTAL DEPTH (feet)	MAXIMUM CAPACITY (GPM)	PRESSURE (PSI)
1	12	383	700	1,400	60
2	12	381	740	1,400	60
3	12	385	701	1,400	60
4	14	412	710	1,400	60

DESIGN CAPACITY: 8.5 MGD
CURRENT DEMAND: 4.0 MGD

NORTH BEACH REVERSE OSMOSIS TREATMENT PLANT

WELL NUMBER	CASING DIAMETER (inches)	CASING DEPTH (feet)	TOTAL DEPTH (feet)	MAXIMUM CAPACITY (GPM)	PRESSURE (PSI)
1	16	300	995	500	65
2	16	300	960	500	65
3	16	310	945	500	65

DESIGN CAPACITY: 1.0 MGD
CURRENT DEMAND: 0.4 MGD

Source: Indian River County Utilities Department Master Plan
(Brown and Caldwell, 1993)

- Agricultural Irrigation Methods

As previously mentioned, agricultural irrigation comprises the highest water use category in the County. Groundwater withdrawals for irrigation in 1995 amounted to 63.20 MGD, nearly all of which was supplied by the Floridan aquifer.

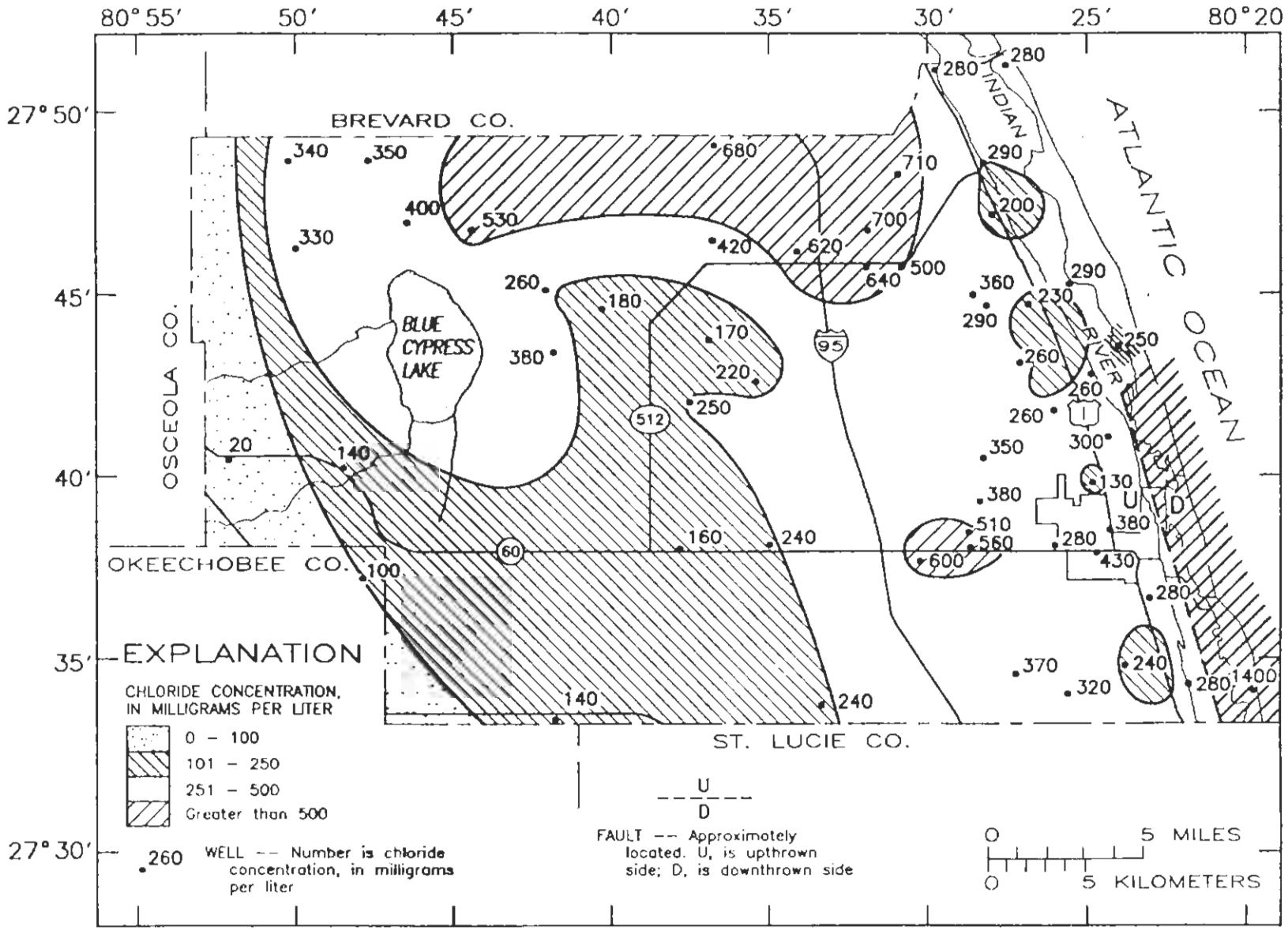
According to 1996 estimates by the Indian River County Soil and Water Conservation District (IRCSWCD), sprayjet irrigation is utilized on ±40,872 acres or 49 percent of the total area irrigated, whereas drip irrigation is used to irrigate ±13,918 acres or 17 percent of the total area irrigated. Both low-flow methods combined account for ±54,790 acres or 66 percent of the total acreage irrigated. Flood irrigation accounts for ±26,322 acres of land irrigation or 32 percent of total acreage irrigated. Approximately 1,492 acres, less than one (1) percent, is considered non-irrigated agricultural land.

Water Quality

With the exception of the Sebastian Lens, the water quality of the Floridan aquifer is characterized by concentrations of chlorides and total suspended solids (TSSs) in excess of FDEP standards. However, the concentration of chlorides is not constant throughout the county. Data from the Indian River Lagoon Joint Reconnaissance Report indicate that chloride concentrations of the Floridan aquifer groundwater average between 300 and 400 mg/L in the eastern portion of the County.

Groundwater with high chloride concentrations is usually associated with the upward movement of saltwater from the lower portion of the aquifer. This upward movement is often associated with uncontrolled flowing wells or locally heavy withdrawals.

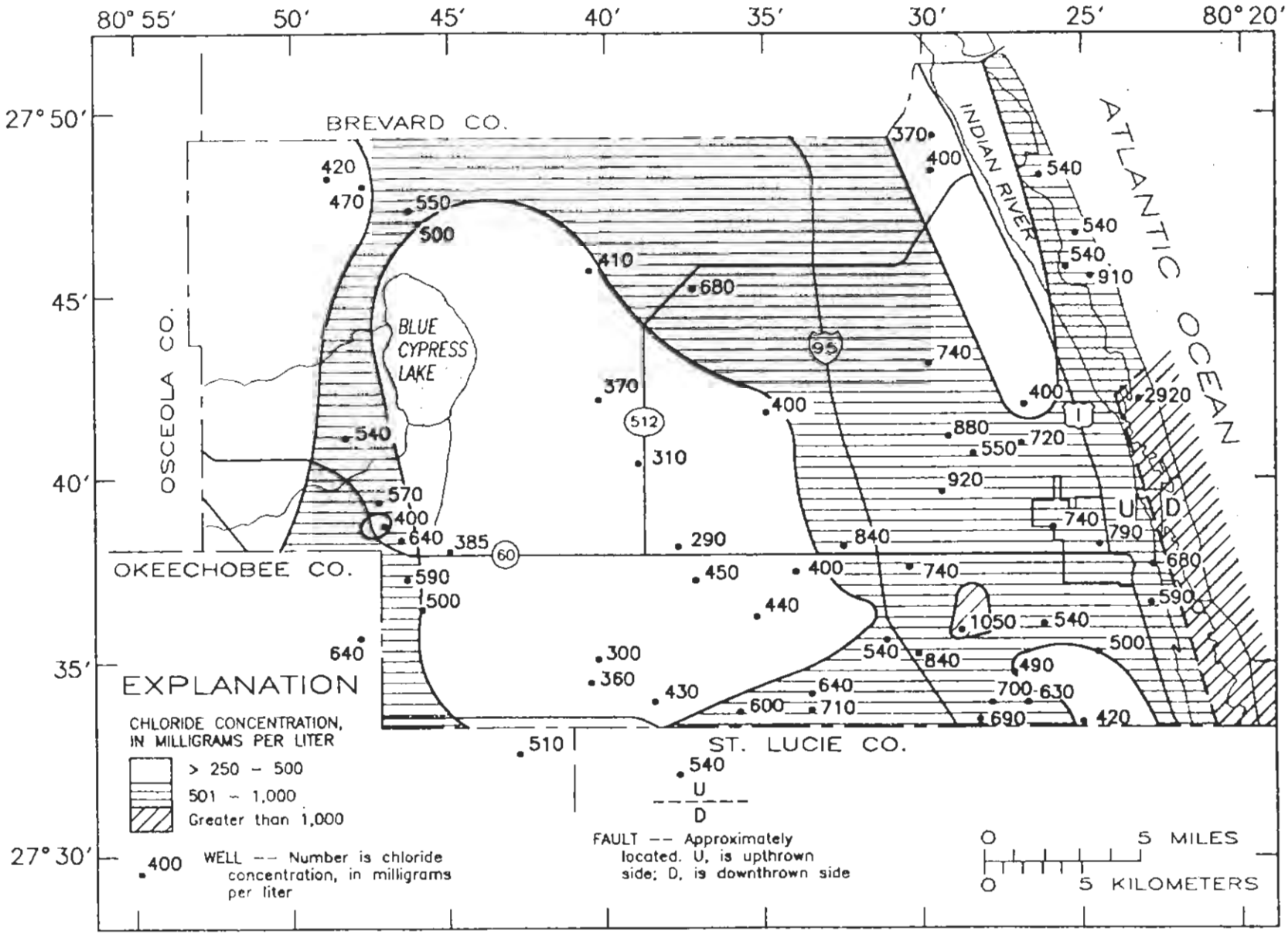
A 1988 USGS report indicates that water from the lower zone of the Floridan aquifer generally contains chlorides and dissolved solids in concentrations that exceed 250 mg/L and 500 mg/L, respectively. However, water from the upper zone of the Floridan aquifer generally contains less than 250 mg/L of chlorides in much of the southwestern part of the county and along some areas of the Atlantic Coastal Sand Ridge. High freshwater heads in the Floridan aquifer system (generally 10 to 30 feet above land surface) were, as of 1985, preventing saltwater in the Indian River Lagoon, the Atlantic Ocean, and the saline aquifers that underlie the freshwater from migrating into the Floridan aquifer. The high heads also prevent contaminants on the land surface from moving downward into the Floridan aquifer system. Throughout most of the county, there is no conclusive evidence to indicate that chloride concentrations of wells that tap the Floridan aquifer system have changed significantly. Chloride concentrations in the upper zone and the lower zone of the Floridan aquifer are depicted in Figures 3.D.12 and 3.D.13.



Chloride concentration in water from wells that tap the Upper Floridan aquifer

SOURCE: U.S. Geological Survey Water-Resources Investigation Report 88-4073

FIGURE 3.D.13



Chloride concentrations in water from wells that tap the Upper and Lower Floridan aquifer

- Saltwater Intrusion

Saltwater penetrates the Floridan aquifer through lateral intrusion from the Atlantic Ocean. Also, relic seawater is trapped in the upper zone of the Floridan aquifer. Figure 3.D.14 depicts the location of saltwater encroachment and the relic seawater.

A saltwater front occurs when saltwater encroaches inland from the Atlantic Ocean. The only saltwater front present in the County is located on Orchid Island in the vicinity of Wabasso Beach. In addition to saltwater intrusion, relic seawater is present under the southeast portion of the county, both on the mainland and on the barrier island. Relic seawater is saltwater that was entrapped in the rocks during deposition or during a past geologic age when the sea inundated the Florida peninsula. This seawater is not being recharged with water from the Atlantic Ocean.

- The Sebastian Freshwater Lens

The Sebastian Freshwater Lens is a naturally occurring pocket of potable water within the Floridan aquifer located in the northeast corner of Indian River County and the southeast corner of Brevard County. It extends from Floridana Beach on the north to Wabasso Beach on the south. On the east, it is bordered by the Atlantic Ocean and extends approximately two (2) miles west of the west shore of the IRL. Figure 3.D.15 depicts the location of the Sebastian Freshwater Lens.

Although the Sebastian Freshwater Lens is completely surrounded by groundwater with chloride concentrations greater than 250 mg/L, it contains water with chloride concentrations less than 250 mg/L. The Sebastian Freshwater Lens is composed of two separate, relatively impermeable water-bearing zones within the Floridan aquifer. The first, called the upper zone, is less than 500 feet below National Geodetic Vertical Datum (NGVD). The second, called the lower zone, is between 500 to 800 feet below NGVD. Figure 3.D.16 depicts the generalized profile and geological formations of the barrier island at the Sebastian Inlet.

The upper zone is the source of water for most of the wells within the Sebastian Freshwater Lens area. Within this zone, the pocket of potable water consists of three (3) separate lobes. The middle lobe and north lobe are located in Brevard County. The south lobe, the largest of the three, extends from Mathers Cove in Brevard County to News Cut in Indian River County. Each of the three (3) lobes is confined to the barrier island and represents the extent of the freshwater. Figure 3.D.17 shows chloride concentrations in the upper zone of the Sebastian Freshwater Lens.

The areal extent of the freshwater of the upper zone is steadily declining. The largest ongoing decline in the potentiometric surface is occurring in the Wabasso Beach area. This decrease in the amount of available potable water in the Sebastian Freshwater Lens is a result of increased chloride concentrations and has occurred concurrently with the increased use of the freshwater for human consumption, irrigation, and heat pumps.

FIGURE 3.D.14

INDIAN RIVER COUNTY

LOCATION OF SALTWATER FRONTS

AND

RELIC SEAWATER IN FLORIDAN AQUIFER

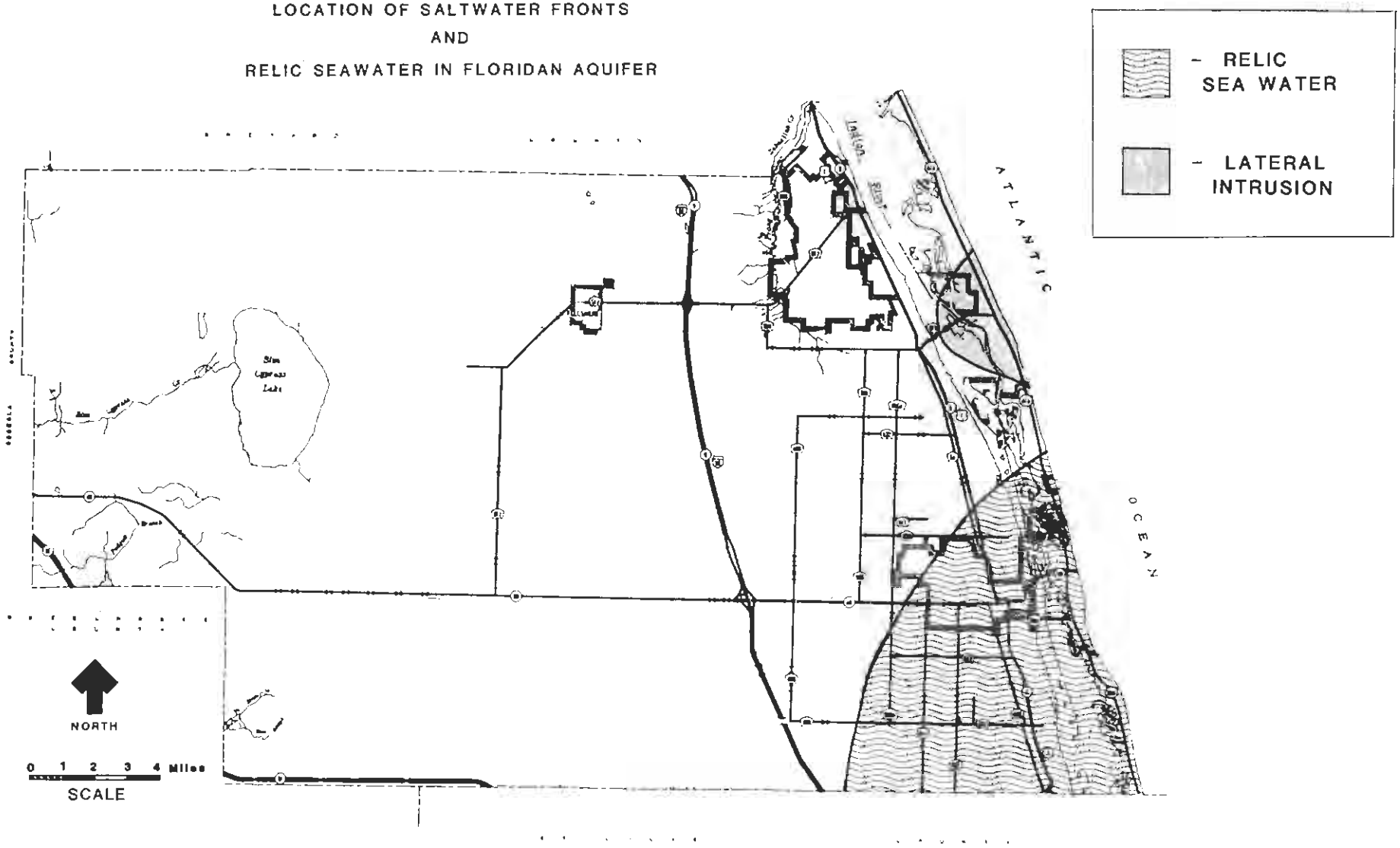
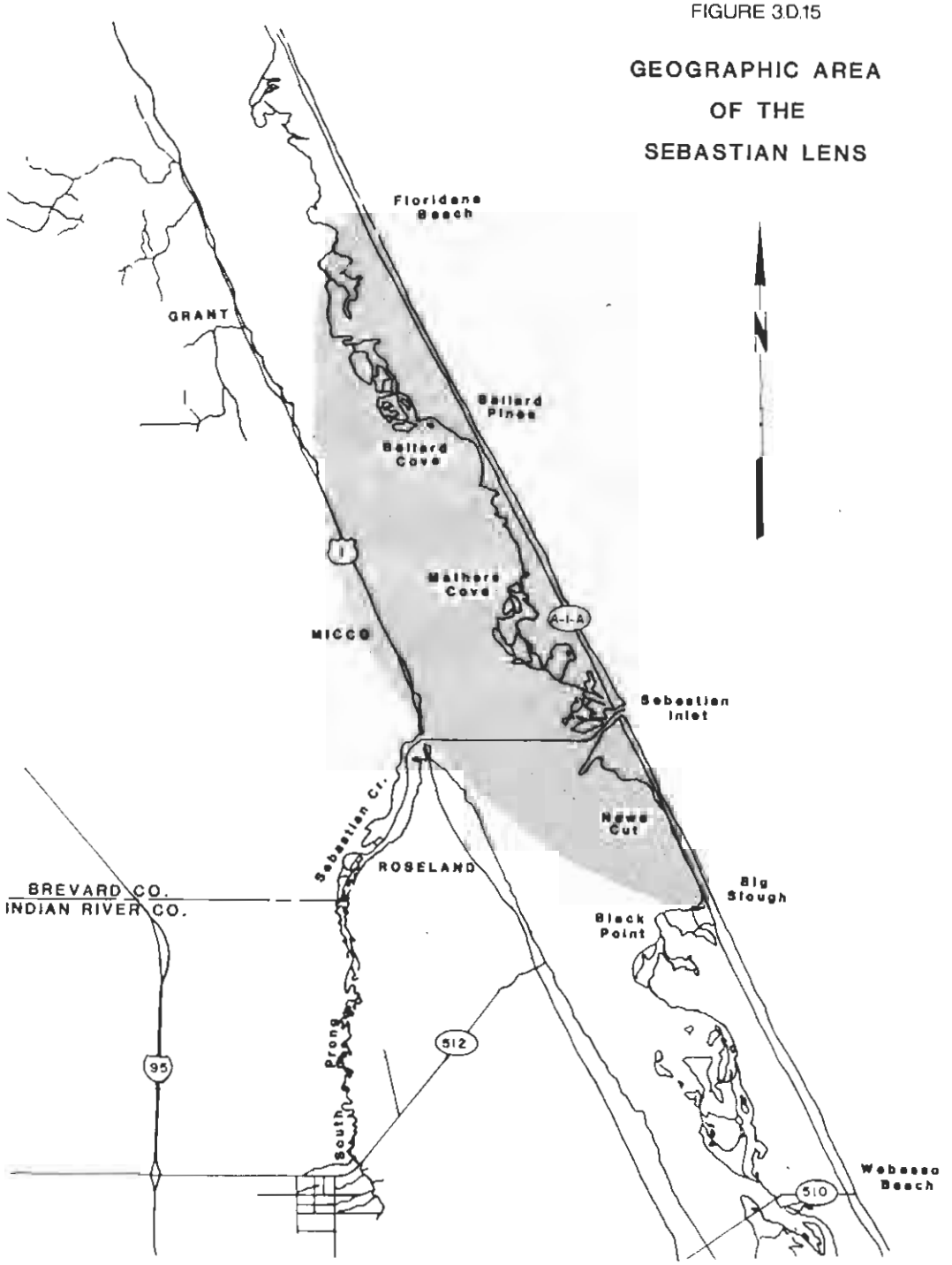


FIGURE 3.D.15

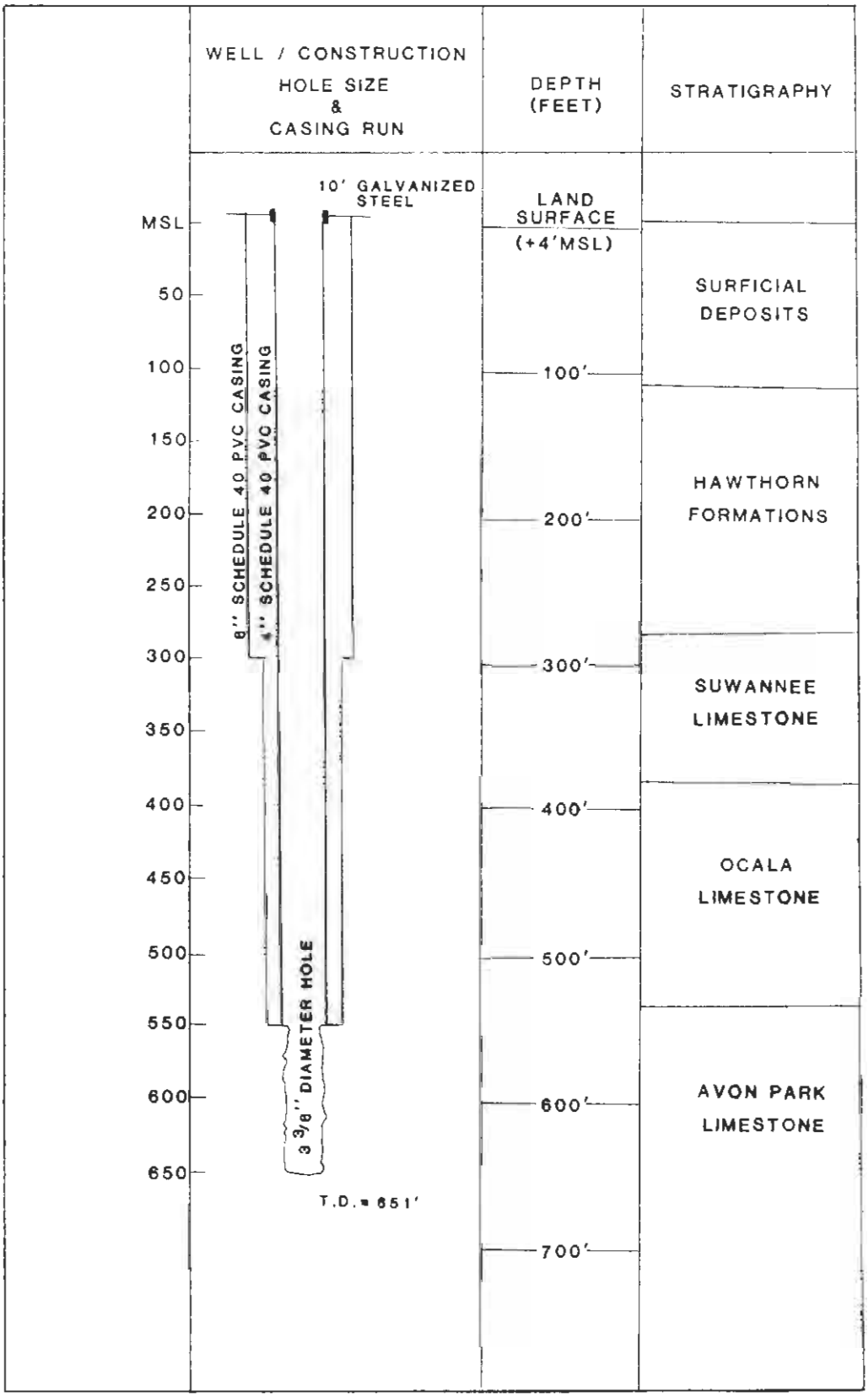
GEOGRAPHIC AREA OF THE SEBASTIAN LENS



SOURCE: St. Johns River Water Management District

FIGURE 3D16

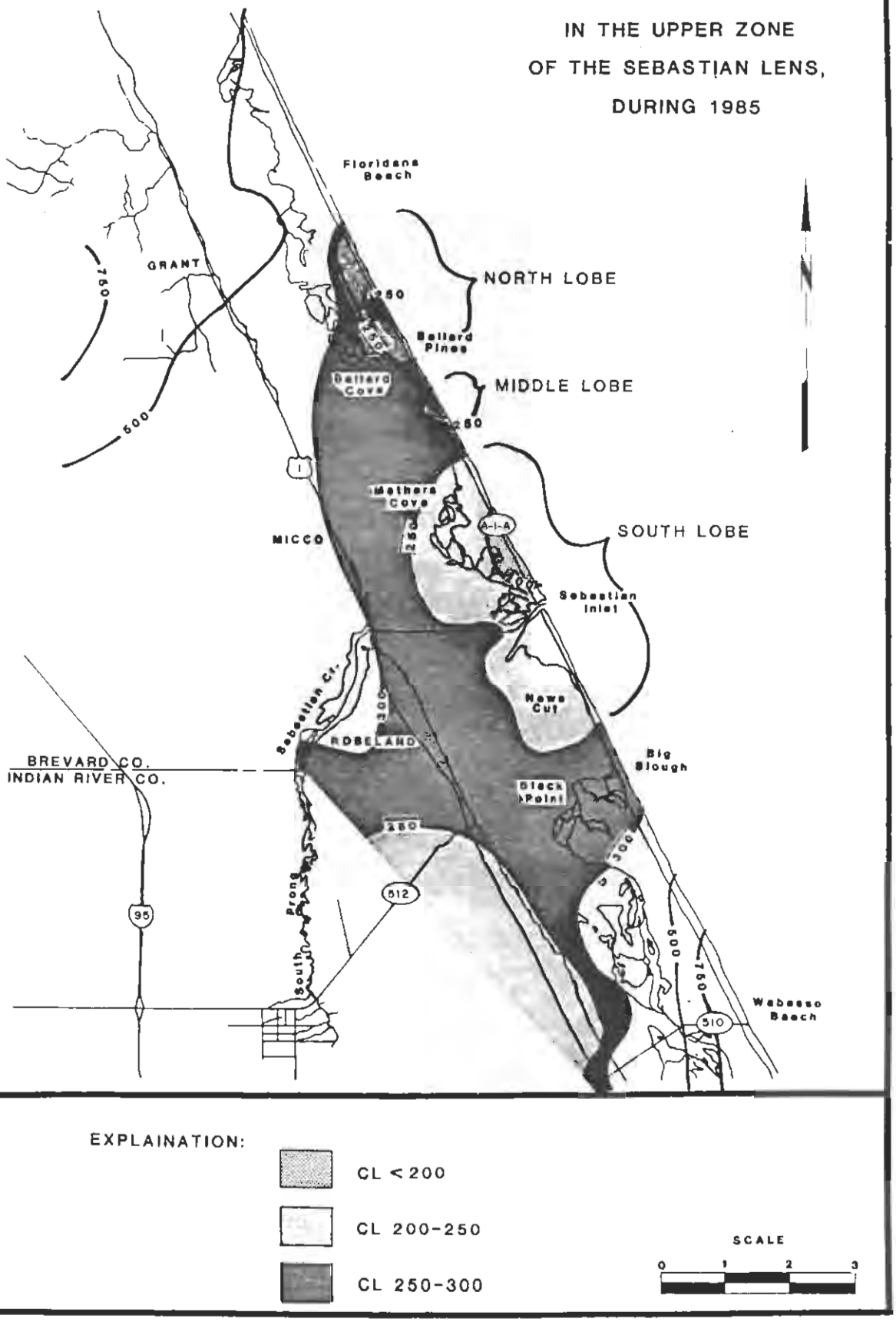
GENERALIZED PROFILE
AND
GEOLOGIC FORMATIONS
OF THE
SEBASTIAN LENS



SOURCE: St Johns River Water Management District

FIGURE 3.D.17

CHLORIDE CONCENTRATION IN THE UPPER ZONE OF THE SEBASTIAN LENS, DURING 1985



SOURCE: St. Johns River Water Management District

Data regarding the lower zone are not as extensive as that for the upper zone. Therefore, the areal extent of the freshwater within the zone cannot be adequately defined. However, some information does exist which provides an indication of the limits of the freshwater. In 1985, the lower zone of the Sebastian Lens covered an area ranging from Floridana Beach in Brevard County to south of the Sebastian Inlet in Indian River County. Figure 3.D.18 depicts the areal extent of the freshwater of the lower zone in 1985.

GOVERNMENT INITIATIVES

The Federal Government, State of Florida, St. Johns River Water Management District (SJRWMD) and Indian River County have enacted non-regulatory programs as well as regulations to ensure groundwater resources remain a source of potable water.

Federal Regulations

In 1986, the Federal Safe Drinking Water Act (Pl 93-523) was amended to strengthen protection of public water system wellfields and aquifers.

State of Florida

Department of Environmental Protection

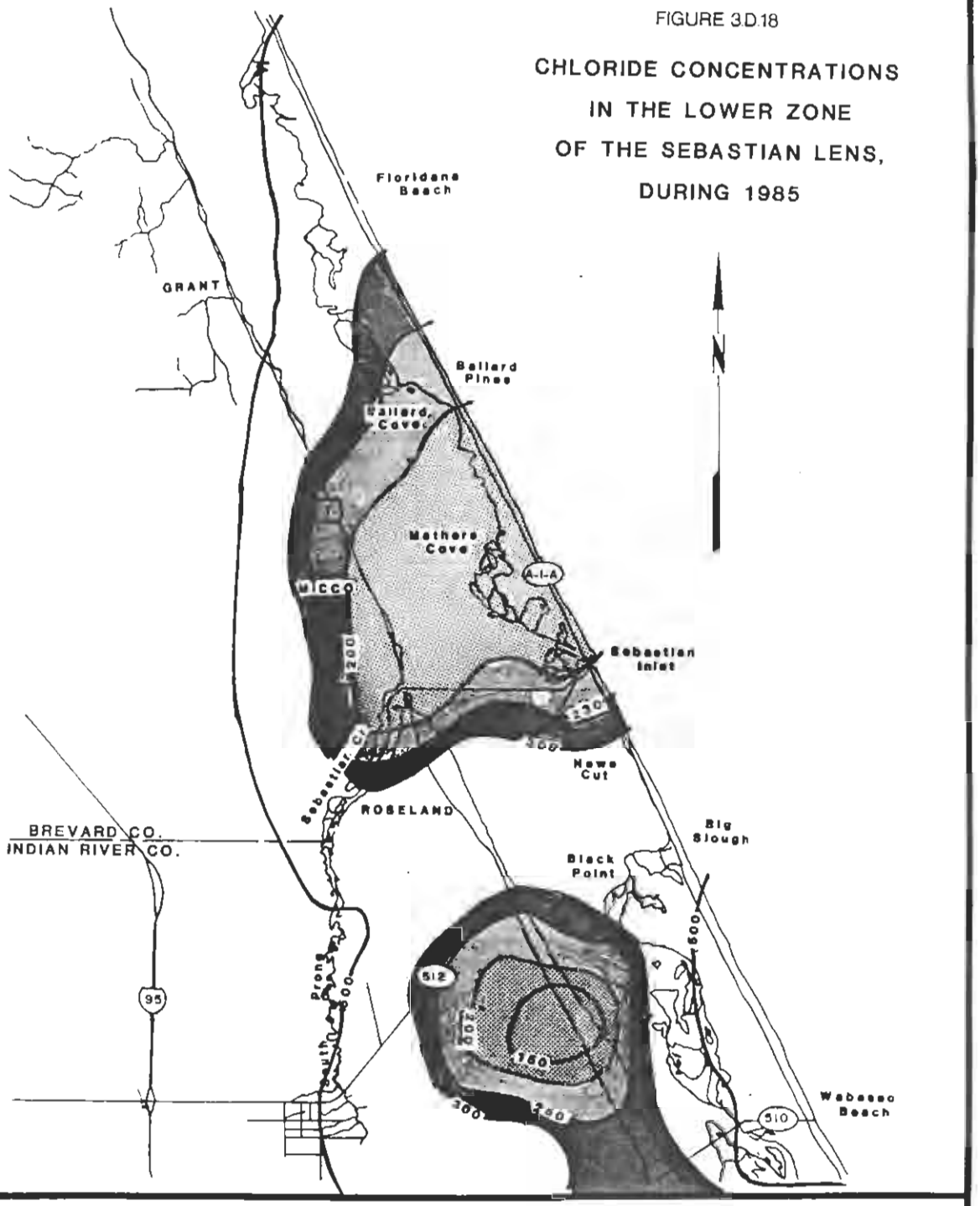
- Regulations

As per the Safe Drinking Water Act of 1986, the EPA delegated the authority to enforce drinking water standards to the State of Florida. The State's regulations for primary standards are included in Chapter 17-550, F.A.C. The State also regulates secondary maximum contaminant levels (SMCLs) as enforceable standards. Enforcement of the aforementioned regulations is the responsibility of the Florida Department of Environmental Protection (FDEP). The State of Florida generally enforces the Federal Government's requirements for most contaminants. The following contaminants, however, are subject to more stringent FDEP standards:

- The FDEP regulates Ethylene dibromide (EBD) at 0.00002 mg/L while the EPA standard is 0.00005 mg/L;
- The FDEP regulates sodium at 160 mg/L. Sodium is not regulated by the EPA; and
- The FDEP regulates the following volatile organic compounds (VOCs) at levels more stringent than EPA standards; trichlorothane, carbon tetrachloride, 1,2-dichloroethane, and benzene.

FIGURE 3.D.18

CHLORIDE CONCENTRATIONS IN THE LOWER ZONE OF THE SEBASTIAN LENS, DURING 1985



SOURCE: St. Johns River Water Management District

- The MCL for Total Coliform (TC) bacteria in groundwater is 4 per 100 milliliters (mL).

The following secondary MCLs are also regulated as enforceable standards: color is 15 color units; foaming agents is 0.5 mg/L, odor is 3 (odor threshold number). The secondary MCL for total dissolved solids (TDS) is 500 mg/L. This standard may be exceeded if no other MCL is exceeded.

A complete listing of contaminants regulated by the FDEP is contained in Table 3.D.3.

St. Johns River Water Management District

The task of identifying the nature and extent of groundwater resources available within the state has been delegated to the regional water management districts by the FDEP.

- Regulations

Figure 3.D.8 depicts the portion of the County that has been identified as an "area of special well location and construction criteria" by the FDEP and adopted by rule in accordance with Section 373.09, F.S. and Chapter 62-524, FAC. According to SJRWMD regulations, new private potable water wells are prohibited if the subject property lies within the delineated area and a water distribution line is within 500 feet of the subject property. If public water is not available, the SJRWMD requires new potable water wells to be located outside of the delineated area, and on land least subject to inundation. Prior to being permitted, wells in the delineated area must be tested by the DHRS. If well contamination is present, a filter or similar device must be installed to protect users from the contaminant. Also, the SJRWMD may require additional protection measures if warranted. The general boundaries of the area of special well construction are is depicted in Figure 3.D.19.

- Water Conservation

As per Chapter 62-40.412, the SJRWMD restricts inefficient irrigation practices; requires the installation of water conserving domestic fixtures; and, prohibits landscape irrigation between 10 a.m. and 4 p.m. Also, the SJRWMD is considering a regulation to require all heat pump units to have return wells and operate in a closed system. Changes to the SJRWMD Water Conservation Plan and the current Consumptive Use Permit (CUP) regulations are currently pending.

- Non-regulatory programs

The SJRWMD and the County contribute to a joint cost-share program to ~~repair~~ or plug abandoned artesian flow wells. Over 220 abandoned flow wells have been repaired or plugged since the joint cost share program was initiated in 1993. The location of known abandoned artesian flow wells is depicted in Figure 3.D.19.

TABLE 3.D.3

LIST OF CONTAMINANTS REGULATED BY
FLORIDA DEPT. OF ENVIRONMENTAL PROTECTION (FDEP)

State of Florida

Classifications and parameters	Units	NPDWR,[a] MCL	NPDWR,[b] MCLG	Proposed,[c] MCL	Proposed,[d] MCLG	SMCL[e]
SDWA-86[f]						
IOC[g]						
Aluminum[h]	mg/L	NR	NR	NP	NP	NR
Antimony	mg/L	0.006	0.006	NP	NP	NR
Arsenic	mg/L	0.05	0.05	NP	NP	NR
Asbestos	Fibers/L	7E6	7E6	NP	NP	NR
Barium	mg/L	1	1.5	5	5	NR
Beryllium	mg/L	0.004	0.004	NP	NP	NR
Cadmium	mg/L	0.005	0.005	NP	NP	NR
Chromium	mg/L	0.10	0.10	NP	NP	NR
Copper	mg/L	TT	1.3	NP	NP	1
Cyanide	mg/L	0.2	0.2	NP	NP	NR
Fluoride	mg/L	4.0	4.0	NP	NP	2.0
Lead	mg/L	TT	Zero	NP	NP	NR
Mercury	mg/L	0.002	0.002	NP	NP	NR
Molybdenum[h]	mg/L	NR	NR	NP	NP	NR
Nickel	mg/L	0.1	0.1	NP	NP	NR
Nitrate and nitrite	mg/L as N	10	10	NP	NP	NR
Selenium	mg/L	0.05	0.05	NP	NP	NR
Silver[h]	mg/L	0.05	NR	NP	NP	0.1
Sodium[h]	mg/L	NR	NR	NP	NP	NR
Sulfate	mg/L	NR	NR	400	400	250
Thallium	mg/L	0.005	0.002	NP	NP	NR
Vanadium[h]	mg/L	NR	NR	NP	NP	NR
Zinc[h]	mg/L	NR	NR	NP	NP	5
OC[i]						
Acrylamide	mg/L	TT	Zero	NP	NP	NR
Adipates	mg/L	0.5	0.5	NP	NP	NR
Alachlor	mg/L	0.002	Zero	NP	NP	NR
Aldicarb	mg/L	0.003	0.003	NP	NP	NR
Atrazine	mg/L	NR	NR	0.003	0.003	NR
Carbofuran	mg/L	0.04	0.04	NP	NP	NR
Chlordane	mg/L	0.002	Zero	NP	NP	NR
Dalapon	mg/L	0.2	0.2	NP	NP	NR
Dibromochloropropane	mg/L	0.0002	Zero	NP	NP	NR
Dibromomethane[h]	mg/L	NR	NR	NP	NP	NR

TABLE 3.D.3

State of Florida - Continued

Classifications and parameters	Units	NPDWR,[a] MCL	NPDWR,[b] MCLG	Proposed,[c] MCL	Proposed,[d] MCLG	SMCL[e]
Dinoseb	mg/L	0.007	0.007	NP	NP	NR
Diquat	mg/L	0.02	0.02	NP	NP	NR
Endothall	mg/L	0.1	0.1	NP	NP	NR
Endrin	mg/L	0.002	0.002	NP	NP	NR
Epichlorohydria	mg/L	TT	Zero	NP	NP	NR
Ethylene dibromide	mg/L	0.00005	Zero	NP	NP	NR
Glyphosate	mg/L	0.7	0.7	NP	NP	NR
Hexachlorobenzene	mg/L	0.001	Zero	NP	NP	0.008
Hexachlorocyclopentadiene	mg/L	0.05	0.05	NP	NP	NR
Lindane	mg/L	0.002	0.0002	NP	NP	NR
Methoxychlor	mg/L	0.04	0.04	NP	NP	NR
PAHs	mg/L	0.0002	Zero	NP	NP	NR
PCBs	mg/L	0.0005	Zero	NP	Zero	NR
Pentachlorophenol	mg/L	NR	NR	0.2	0.2	0.03
Pichlorum	mg/L	0.5	0.5	NP	NP	NR
Phthalates	mg/L	0.006	Zero	NP	NP	NR
Simaxine	mg/L	0.004	0.004	NP	NP	NR
Toxaphene	mg/L	0.003	Zero	NP	NP	NR
Vydate	mg/L	0.2	0.2	NP	NP	NR
2,4-D	mg/L	0.07	0.07	NP	NP	NR
2,3,7,8-TCDD	mg/L	3E8	Zero	NP	NP	NR
2,4,5-TP	mg/L	0.05	0.05	NP	NP	NR
1,1,2-trichloroethane	mg/L	0.005	0.003	NP	NP	NR
VOC [j]						
Benzene	mg/L	0.005	Zero	NP	NP	NR
Carbon tetrachloride	mg/L	0.005	Zero	NP	NP	NR
Cis-1,2-dichloroethylene	mg/L	0.07	0.07	NP	NP	NR
Chlorobenzene	mg/L	0.1	0.1	NP	NP	NR
Dichlorobenzene	mg/L	0.6	0.6	NP	NP	0.005
Methylene chloride	mg/L	0.005	Zero	NP	NP	NR
Tetrachloroethylene	mg/L	0.005	Zero	NP	NP	NR
Toluene	mg/L	1	1	NP	NP	NR
Trans-1,2-dichloroethylene	mg/L	0.1	0.1	NP	NP	NR
Trichlorobenzene	mg/L	0.07	0.07	NP	NP	NR
Trichloroethylene	mg/L	0.005	Zero	NP	NP	NR

TABLE 3.D.3

State of Florida - Continued

Classifications and parameters	Units	NPDWR,[a] MCL	NPDWR,[b] MCLG	Proposed,[c] MCL	Proposed,[d] MCLG	SMCL[e]
Vinyl chloride	mg/L	0.002	Zero	NP	NP	NR
Xylene (total)	mg/L	10	10	NP	NP	0.02
1,2-dichloroethane	mg/L	0.005	Zero	NP	NP	NR
1,1-dichloroethylene	mg/L	0.007	0.007	NP	NP	NR
1,2-dichloropropane	mg/L	0.005	Zero	NP	NP	NR
1,1,1-trichloroethane	mg/L	0.20	0.20	NP	NP	NR
RADs[k]						
Beta particle and photon radioactivity	pCi/L	NR	NR	4-MREMS	Zero	NR
Gross alpha particle activity	pCi/L	15	NR	NP	NP	NR
Radium 226 and 228 (each)	pCi/L	5	NR	20	Zero	NR
Radon	pCi/L	NR	NR	300	Zero	NR
Uranium	pCi/L	NR	NR	30	20 to 40	NR
Micros[l]						
Giardia lamblia	Organisms	TT	Zero	NP	NP	NR
Legionella	Organisms	TT	Zero	NP	NP	NR
Standard plate count	Organisms	TT	Zero	NP	NP	NR
Total coliforms	Col/100 mL	NP	NP	≤ 1	Zero	NR
Turbidity-GW	NTU	1	Zero	NP	NP	NR
Viruses	Number	NR	NR	NP	NP	NR
THM[m]						
Total THM	mg/L	0.1	NR	NP	NP	NR
Substitutes January 1988[n]						
Aldicarb sulfone	mg/L	NR	NR	0.04	0.04	NR
Aldicarb sulfoxide	mg/L	NR	NR	0.01	0.01	NR
Ethylbenzene	mg/L	0.7	0.7	NP	NP	0.03
Heptachlor	mg/L	0.0004	Zero	NP	NP	NR
Heptachlor epoxide	mg/L	0.0002	Zero	NP	NP	NR
Nitrite	mg/L	1	1	NP	NP	NR
Styrene	mg/L	0.1	0.1	NP	NP	0.01
SMCL						
Chloride	mg/L	NR	NR	NP	NP	250
Color	CU	NR	NR	NP	NP	15
Copper	mg/L	NR	NR	NP	NP	1

TABLE 3.D.3

State of Florida - Continued

Classifications and parameters	Units	NPDWR,[a] MCL	NPDWR,[b] MCLG	Proposed,[c] MCL	Proposed,[d] MCLG	SMCL[e]
Corrosivity	LI	NR	NR	NP	NP	NC
Fluoride	mg/L	NR	NR	NP	NP	2
Foaming agents	mg/L	NR	NR	NP	NP	0.5
Iron	mg/L	NR	NR	NP	NP	0.3
Manganese	mg/L	NR	NR	NP	NP	0.05
Odor	TON	NR	NR	NP	NP	3
pH	Units	NR	NR	NP	NP	6.5 to 8.5
Sulfate	mg/L	NR	NR	NP	NP	250
TDS	mg/L	NR	NR	NP	NP	500
Zinc	mg/L	NR	NR	NP	NP	5

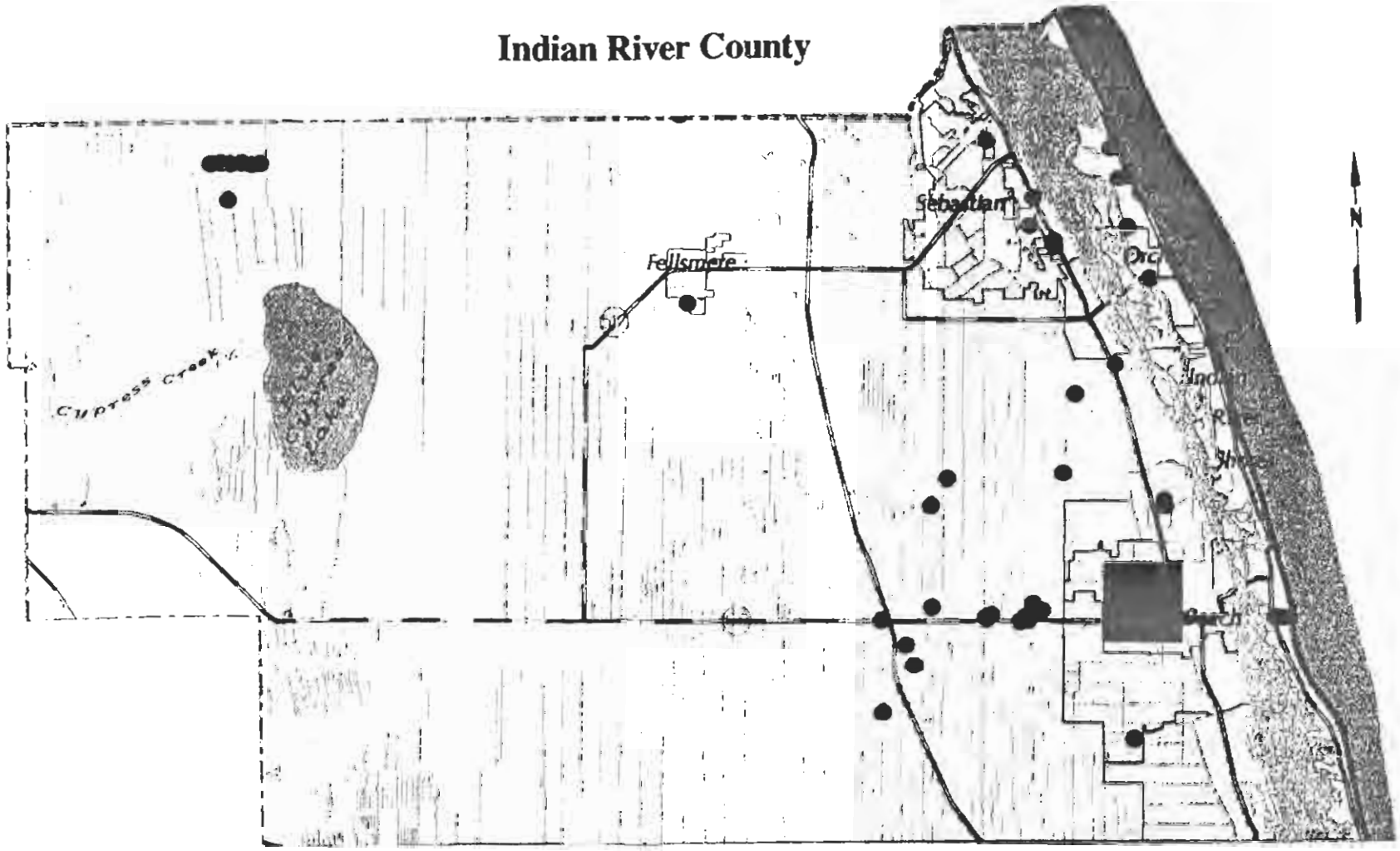
[a] National Primary Drinking Water Regulation Contaminant Level currently promulgated.
[b] National Primary Drinking Water Regulation Contaminant Level Goal currently promulgated.
[c] Proposed National Primary Drinking Water Regulation Contaminant Level currently published and undergoing review and comment.
[d] proposed National Primary DDrinking Water Regulaüon Contaminant Level Goal currently published and undergoing review and comment.
[e] Secondary Maximum Contaminant Level.
[f] Original list of 83 contaminants to be regulated--referenced within the 1986 Amendments to the Safe Drinking Water Act.
[g] Inorganic contaminants.
[h] Inorganic contaminants.
[i] Organic contaminants.
[j] Volatile organic contaminants.
[k] Radiological contaminants.
[m] Microbiological contaminants.
[n] Contaminants substituted for original list contaminants in January 1988

Notes:
CU = color units
LI = Langlier Index
mg/L = milligrams per liter
NA = not available
NC = noncorrosive
NP = not proposed
NR = not regulated
NTU = nephelometric turbidity units
pCi/L = picocuries per liter
TON = total odor number
TT = treatment technique
umhos/cm^2 = micromhos per square centimeter

FIGURE 3.D.19

Ground Water Quality

Indian River County



Area with special well construction criteria

Water

1990 Census-based urbanized area

Abandoned artesian wells

The SJRWMD has a cost-share program to implement alternative water supply strategies. Under this program, funding for 1997 has been awarded to Berry Groves, Inc. to construct a stormwater reservoir for agricultural irrigation. The County also received funding to construct the North County Reverse Osmosis Treatment Plant.

Indian River County

- Regulations

Provisions specifically relating to the protection of groundwater resources contained in the Code of Indian River County include the following: a Wellfield and Aquifer Protection ordinance (LDR Chapter 931); the Excavation and Mining ordinance (LDR Chapter 934); and a Landscape ordinance (LDR Chapter 926).

Following are regulations contained in LDR Chapter 931:

- The Community Development Department is responsible for maintaining up-to-date regulated area maps of existing and future public water supply wells and their zones of protection [931.04].

- Non-residential land uses which store, use, handle or produce any regulated substance are prohibited from locating in regulated areas unless expressly exempt [931.05(1)].

- Minimum setbacks requirements (from a public water supply well) are applicable to the following land uses and structures:

  200 feet - on-site disposal systems;
  300 feet - stormwater retention/detention areas;
  500 feet - wastewater treatment plant discharges, landfills and/or collection centers, feed lots or concentrated animal facilities, storage tanks for fuel or other regulated substances; and
  1,000 feet - any mining and/or excavation of waterways or drainage facilities which intersect the groundwater table [931.05(2)].

- The Surficial Aquifer Primary Recharge Overlay District (SAPROD) overlays the Atlantic Coastal Sand Ridge. Auto salvage/junk yards and landfills are prohibited from locating in the SAPROD. Additionally, any land use which generates hazardous waste must have a nondomestic waste disposal system approved by the Department of Health and Rehabilitative Services (DHRS) [931.08(2)(a)].

- Excavation incidental to development that results in an average elevation less than 25 MSL is not permitted in the SAPROD unless approved by the SJRWMD [931.08(2)(b)].

- Stormwater management facilities are not allowed to penetrate the water table in the SAPROD [931.08(2)(c)].

- Abandoned artesian flow wells must be plugged in conjunction with site development [931.09(1)].

The generalized location of the SAPROD is displayed in Figure 3.D.20.

The following regulations are provided in LDR Chapter 934:

- Dewatering is prohibited within 1,000 feet of a platted subdivision not serviced by public water [934.04(7)(6)].

- A maximum excavation depth of 25 feet above mean sea level (MSL) is required for mining operations located on the Atlantic Coastal Sand Ridge and exempt from SJRMWD permitting thresholds [934.07(2)(d)].

The following regulations are contained in LDR Chapter 926:

- A minimum of 50 percent of all new landscape material is required to be "moderately" to "very" drought tolerant [926.06(2)].

- An underground irrigation system is required for all new development, unless specifically exempt. Listed below are the requirements for irrigation systems as per LDR Section 926.11(2)(b): First, a low-volume distribution system appropriate for the landscape must be designed to include sprinkler heads that prevent overspray onto impervious surfaces. Second, the system must be regulated by an automatic timer/controller and a rainfall/ moisture sensing device is required if practicable. Finally, water demand zones must be separated.

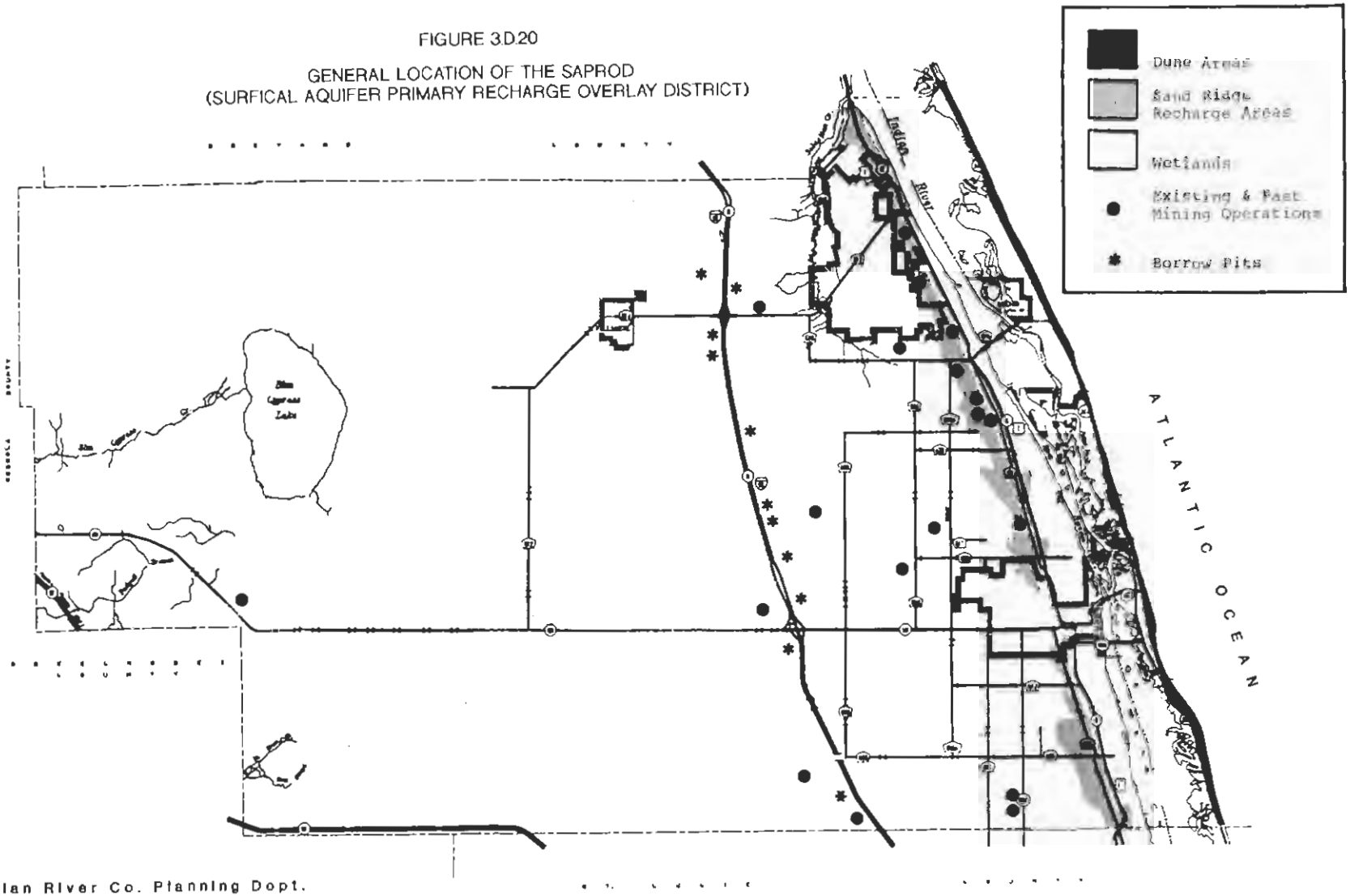
- All new irrigation systems are required to connect to wastewater effluent lines when available. In the event wastewater effluent lines are not available, new irrigation systems must be designed for connection to proposed wastewater effluent lines [926.11(c)].

- Non-regulatory Programs

As previously mentioned, the County participates in a joint cost-share program with the SJRWMD to ~~repair~~ or plug abandoned artesian flow wells. Since 1992, the County's

FIGURE 3.D.20

GENERAL LOCATION OF THE SAPROD
(SURFICAL AQUIFER PRIMARY RECHARGE OVERLAY DISTRICT)



Source: Indian River Co. Planning Dept.
U.S. Fish and Wildlife Service Wetland Inventory

Updated Aug.1997
March 19, 1987

Boyle Engineering Corporation

REPRINTED BY PERMISSION OF FDOT. FINANCIAL ASSISTANCE FOR MAP PREPARATION PROVIDED BY FLORIDA DEPT. OF COMMUNITY AFFAIRS.

NORTH

Miles
0 1 2 3 4
SCALE

INDIAN RIVER COUNTY
FLORIDA

SHEET NO.

Environmental Lands Program has acquired scrub areas, which has resulted in the preservation of large tracts of open space in groundwater recharge areas. Also, the County's Utilities Department promotes water re-use for landscape irrigation throughout the County.

ANALYSIS

The principal purpose of the Analysis section of the Natural Groundwater Aquifer Recharge Sub-Element is to evaluate both of the county's aquifers and to identify the problems and potentials associated with each aquifer. A second purpose is to determine if the aquifers will have sufficient capacity to satisfy the county's future water demand.

In 1995, the population of Indian River County was approximately 100,261. This represents an increase of 10 percent from the 1990 population of 90,208. By the year 2010, the population is expected to reach 135,500. This projection represents a 35 percent increase over the 1995 base population. Most new residents in the county have settled in the coastal areas, and this trend is expected to continue. The projected population growth will create additional demand for potable water.

Surficial Aquifer

The surficial aquifer is the source of potable water for most private wells in the county, as well as the City of Vero Beach's public water system. Therefore, protecting the quantity and quality of groundwater in the surficial aquifer is important for the immediate future growth of the county.

Water Quantity

The Atlantic Coastal Sand Ridge and the Ten Mile Ridge are being altered as sand from the ridges is excavated for use as construction fill. This has the potential to reduce the recharge area and could eventually reduce the overall quantity and yield of the surficial aquifer. Development also impacts natural recharge by increasing the amount of impervious surface area. Consequently, a reduction in the size of the recharge area reduces the quantity and yield of the surficial aquifer. To reduce the impacts of future allow the development on the quantity of water in the surficial aquifer, the county will continue to target the acquisition of environmentally-important lands within prime recharge areas. Additionally, the native upland set-aside requirements contained in LDR Chapter 929 will remain in effect for development sites larger than five (5) acres. Combined, these actions should recharge areas for the surficial aquifer by 2000.

Indian River County's proposed North County water treatment facility will distribute treated groundwater supplied by the Floridan aquifer. Once the proposed North County plant becomes operational at full capacity and the extension of water distribution lines is completed, the County will become less dependent upon private wells tapping the surficial aquifer. According to

SJRWMD Report #SJ94-PP6, reduced reliance on the surficial aquifer will produce a two (2) foot rise in the water table in the eastern portion of the City of Vero Beach's wellfield by 2010.

Water Quality

According to the USGS Water Resources Investigation Report #88-4073, drainage or diversion of surface water and changes in land use that have accompanied development may have altered the natural water balance that existed in the past. Also, groundwater from the Floridan aquifer used for flood irrigation has had a significant effect on the water quality of the surficial aquifer. Furthermore, water levels above sea level have historically prevented lateral intrusion of saltwater in the coastal areas from infiltrating the potable water zone of the surficial aquifer. Excessive pumping, however, has lowered water levels enough to cause saltwater intrusion in some parts of the County.

According to the Future Land Use Element, the majority of existing development is located in the south portion of the county, along U.S. Highway 1 and in the State Road 60 corridor. Most new commercial and industrial development will be directed to these established nodes. Concentrating commercial and industrial development along U.S. Highway 1 would appear to present a dilemma since increased density could potentially exacerbate the aforementioned impacts caused by development. However, the county's wellfield and aquifer protection ordinance (LDR Chapter 931) in conjunction with state regulations has proven effective in reducing the risk of contamination of the surficial aquifer. This is evidenced by the fact that all of the contaminated sites discovered by the DHRS have been linked to abandoned dump sites or leaking underground storage tanks (LUSTs) that existed prior to 1990. To date, no contamination has been linked to sites that have been developed since the adoption of the ordinance.

Chloride concentrations from most wells that tap the surficial aquifer system in the Vero Beach well field have remained relatively unchanged since the early 1980's. However, as previously mentioned in the Existing Conditions section, contamination was discovered in six (6) public supply wells in the City of Vero Beach's wellfield in the late 1980's. Since the City began a remediation program in 1989, the spread of contamination has been controlled, and groundwater contamination levels have decreased substantially. In fact, one production well is no longer considered contaminated.

Floridan Aquifer

Water Quantity

- Natural Groundwater Aquifer Recharge Areas

The groundwater aquifer recharge areas for the Floridan aquifer are located in the Osceola Plain west of Blue Cypress Lake. Currently, the land uses in this area consist of pastoral open space

and livestock grazing. These lands have not been affected by development nor are they threatened by development. However, the western section of Indian River County is not considered a "prime recharge area" by the SJRWMD. Although there are no plans for land uses changes, there is a need for coordination with Okeechobee County, Osceola County and Brevard County to ensure the preservation of natural land uses in the adjacent area to the west and northwest of the county.

- Estimated Water Demand for 2010

Urban development has replaced groveland along most of U.S. Highway 1 and State Road 60 (east of Interstate 95). Due to changes in the land use pattern and the expansion of more efficient agricultural irrigation systems, agricultural demand is expected to decrease to approximately 49.09 MGD by 2010. Industrial and recreational demand should experience a slight increase by 2010.

Due to the higher yield of the Floridan aquifer and the fact that it is less susceptible to contamination, this aquifer has been chosen as the source of water for the county's existing and proposed potable water plants. The surficial aquifer will remain the primary source of water for the City of Vero Beach and most private wells. However, the City of Vero Beach also utilizes the Floridan aquifer to supplement demand. The projection of future trends shows a change of use from the surficial aquifer to the Floridan aquifer.

- South County ROWTP

By 2010, thirteen (13) production wells will be required to maintain the estimated water demand of 22.67 MGD. The potential well field yield models for the South County facility indicate that a sustained yield in excess of 22 MGD is possible. However, the models do not assess the impact to water quality from pumping 22+ MGD. Drawdowns of 30 to 35 feet are likely to have a substantial impact on water quality due to upconing of saline water (Brown and Caldwell, 1993).

- North County ROWTP

According to the Indian River County Utilities Department Master Plan, peak water demand from the North County ROWTP service area is expected to be 15.04 MGD by 2010. To meet this demand, a total of nine (9) production wells, each with a capacity of 1,400 GPM, will be required. Hydrological modeling of the wellfield indicates that a sustained withdrawal of 16 MGD will result in drawdowns of 20 to 25 feet (Brown and Caldwell, 1993).

- North Beach ROWTP

Five (5) production wells will be required to meet the water demand of 3.40 MGD by 2010. Groundwater modeling data are not available for this site. Due to water quality degradation, future production wells will be located offsite.

According to SJRMWD Report #SJ94-PP6, public water supply withdrawal is expected to more than double to 38.17 MGD by the year 2010. Increased demand coupled with greater reliance on the Floridan aquifer as the main public supply source is expected to cause localized drawdowns near public supply wellfields and should be carefully monitored.

In the Future Land Use Element and the Conservation Element of the Comprehensive Plan, conservation of aquifer recharge areas for the Floridan aquifer as well as the surficial aquifer is discussed in detail. Further discussion of septic tanks and distribution of potable water is contained in the Sanitary Sewer Sub-Element, the Potable Water Sub-Element and the Future Land Use Element.

Water Quality

- Saltwater Intrusion

Saltwater intrusion could potentially contaminate the Floridan aquifer. The principal source of this saltwater intrusion is over-pumping. Contamination of the Floridan aquifer has the potential to impact native vegetation, reduce agricultural yields, and increase the cost of treating water for public supply.

- Sebastian Freshwater Lens

The Sebastian Lens is a confined pocket of potable water within the Floridan aquifer. The confining layers of the Sebastian Freshwater Lens prevent recharge of the aquifer as well as intrusion of water containing high chloride concentrations. This is a non-replenishable source of groundwater; therefore, it should be carefully "mined" only for domestic consumption with continual monitoring. Also, there is a need for coordination with Brevard County in relation to use of water from the Sebastian Freshwater Lens.

- Water Treatment

According to the Indian River County Utilities Department Master Plan, the raw water chloride concentration currently averages 250 mg/L at both the South County ROWTP and the proposed North County ROWTP. Based on current values, a significant increase in chloride concentrations could occur before unacceptable levels of chlorides result.

Water quality concerns at the North Beach facility include reducing the levels of sodium, chlorides and total dissolved solids (TDS). An increase in raw water chloride levels could be managed. However, potable water production capacity would be decreased due to a proportional reduction in raw blend waters.

When chlorides combine with naturally occurring organic carbon and other chemicals in groundwater, trihalomethanes (THMs) are formed. THMs are potentially carcinogenic chemicals

that have been linked to cancer. The Florida Department of Environmental Protection's (FDEP) standard for THMs is 0.1 mg/L. Both the North Beach and South County facilities have established future Maximum Contaminant Levels (MCLs) for Total Trihalomethanes (TTHM) at the 0.075 mg/L level. Therefore, limiting THMs is not a treatment concern at the present time. However, if TTHM MCLs are established below the 0.075 mg/L level, the County could maintain compliance through the following methods: reducing raw water bypass thereby limiting production capacity; or by modifying the chlorination process to reduce THM formation.

Contamination of the Floridan aquifer by heavy metals, herbicides, pesticides and synthetic organic chemicals (SOCs), volatile organic compounds (VOCs), and/or biological contamination is remote. In the event contamination were to occur, the County's state-of-the-art reverse osmosis treatment process has the capability to remove the aforementioned pollutants at a relatively high rejection rate (>80 percent) (Brown and Caldwell, 1993).

PLAN

Due to the Indian River County's increasing population and expanding urbanization, the county must focus on the protection of its groundwater resources. The Plan's primary purposes are to protect aquifer recharge areas, to conserve water from the aquifers, and to prevent groundwater contamination. As part of this sub-element, goals, objectives, and policies have been formulated to support the previously mentioned purposes. Following is a summary of measures that the County should undertake to achieve the primary purposes of the plan:

Regarding groundwater quantity and conservation, the county's stormwater management regulations should continue to emphasize the preservation of natural drainage features and the use of retention facilities to maximize aquifer recharge. Also, the County should consider adopting regulations to require wet season water table elevations to be maintained. Furthermore, the county should continue to encourage re-use of treated effluent for irrigation in urban areas to decrease water consumption.

Regarding groundwater quality, there are not sufficient data at the present time to designate scientifically-based wellhead protection areas (WHPAs). When data from the Groundwater Basin Resource Availability Index (GWBRAI) become available, the county will coordinate with the St. Johns River Water Management District to develop scientifically-based WHPAs. Also, the County should actively participate with the St. Johns River Water Management District (SJRWMD), Florida Department of Environmental Protection (FDEP), and other government agencies to develop regional policies and programs to protect groundwater aquifer recharge areas.

GOAL, OBJECTIVES AND POLICIES

GOAL

It is the goal of Indian River County to protect the function of natural groundwater aquifer recharge areas, to prevent the contamination of groundwater and to extend the life span of the county's aquifers through water conservation.

Objective 1 Protection of Water Quality

Through 2020, there will be no instances of contamination of groundwater aquifers or public supply wells within the county. For the purpose of this Objective, water quality will be based on primary and secondary maximum contaminant levels (MCLs), as defined by the FDEP in Chapter 17-550, F.A.C.

Policy 1.1: By 1999, the county shall update the Surficial Primary Recharge Overlay District (SAPROD) map using a geographic information systems (GIS) format.

Policy 1.2: By 1999, the county will assist the SJRWMD and FDEP in developing a Wellhead Protection Area (WHPA) map for Indian River County by providing the following information:

- the location of existing public wellheads;
- the proposed location of future public wellheads; and,
- potential conflicts between existing and future land uses and public wellhead protection areas.

The WPHA map will be compatible with the county's G.I.S. database.

Policy 1.3: The county shall continue to prohibit the location of septic systems within two hundred feet of a public water supply well, unless otherwise approved by the FDEP or HRS.

Policy 1.4: The county, through its stormwater permitting processes, shall ensure that stormwater management structures, except those located within the SAPROD, are designed to function as aquifer recharge areas.

Policy 1.5: The county shall continue to protect existing and future public water supply wells from contamination by continuing to implement Chapter 931 of the County's land development regulations and by prohibiting any non-residential land use which stores, handles, or produces a toxic degradation or petroleum-based product, or any substance regulated under 40 CFR 302, 40 CFR 122.21, and/or Chapter 487, F.S. from locating within 1,000 feet of a public water supply well. The minimum radial separation distances for land uses and structures from public wellhead regulated areas are as follows:

- 200 feet for on-site disposal systems, unless approved by the FDEP or DHRS;
- 300 feet for wet retention/detention areas, unless approved by the SJRWMD;
- 500 feet for landfill and/or transfer stations, above ground or underground storage tanks, feed lots and animal facilities, and WWTP effluent discharges, unless approved by the FDEP;
- 1,000 for any mining and/or excavation of waterways or drainage facilities which intersect the water table.

Policy 1.6: The county shall prohibit new developments or changes of uses that produce hazardous materials from locating on the Atlantic Coastal Sand Ridge or the Ten Mile Ridge areas of Indian River County.

Policy 1.7: The county shall continue to prohibit injection wells for the disposal of wastewater.

Policy 1.8: The county, in cooperation with the Indian River Soil and Water Conservation District (IRSWCD), shall discourage the use of flood irrigation with water from the Floridan aquifer by providing incentives for low volume irrigation systems.

OBJECTIVE 2: Preserving the Quantity of the Surficial Aquifer

Through 2020, there will be no reduction in the availability of groundwater from the surficial aquifer. For the purpose of this Objective, water quantity will be based on an average well depth of 90 feet for domestic wells that tap the surficial aquifer, and on data that will be available in the Groundwater Basin Resource Availability Inventory (GWBRAI), pending completion by the SJRWMD.

Policy 2.1: The county shall implement water conservation measures, as designated in the policies under Objective 4 of the Potable Water Sub-Element and Objective 4 of the Sanitary Sewer Sub-Element, to protect the surficial aquifer from depletion.

Policy 2.2: By 1999, the county shall adopt a water conservation ordinance to minimize the unnecessary and wasteful use of groundwater from the surficial aquifer.

Policy 2.3: The county shall use natural groundwater aquifer recharge areas for passive parks and open space.

Policy 2.4: To ensure preservation of the surficial aquifer, the county shall continue to issue permits for all proposed excavation/mining projects in the unincorporated county that are exempt from SJRWMD permitting requirements. For proposed excavation/mining projects that are

located along the Atlantic Coastal Sand Ridge and are exempt from SJRWMD permitting requirements, the county shall prohibit the following:

- excavation within 1,000 feet of a public supply wellfield;
- excavation within 1,000 feet of any platted subdivision not serviced by potable water; and,
- excavation that results in an average elevation less than 25 feet above mean sea level.

Policy 2.5: The county shall preserve the aquifer recharge function of palustrine wetlands by adopting the Comprehensive Wetlands Management Program, as described in the Conservation Element.

Policy 2.6: The county will require all wet detention/retention ponds with a surface area greater than one (1) acre be designed to utilize stormwater runoff for irrigation.

OBJECTIVE 3: Preserving the Quantity of the Floridan Aquifer

There will be no reduction in the availability of groundwater from the Floridan aquifer through 2020. For the purpose of this Objective, Floridan aquifer quantity will be based on an average yield of 650 gallons per minute (GPM) for water supply wells that tap the Floridan aquifer. Also, data contained in the Groundwater Basin Resource Availability Inventory (GWBRAI) will be used to measure aquifer quantity, pending completion by the SJRWMD.

Policy 3.1: The county shall protect and preserve open space in the west portion of the county, which has been identified as a natural groundwater aquifer recharge area for the Floridan aquifer, by designating those areas for agricultural use with a very low residential density, as depicted on the future land use map.

Policy 3.2: The county shall coordinate with the SJRWMD and the IRSWCD to encourage the use of low volume irrigation systems to prevent over pumping from the Floridan aquifer.

Policy 3.3: The county shall continue to require that new developments install a minimum of 50% water-conserving xeriscape plant material, as specified in the Landscape ordinance.

Policy 3.4: The county shall reuse 100% of treated wastewater effluent for irrigation to prevent over pumping of the Floridan aquifer.

Policy 3.5: The county shall renew its annual contract with the SJRWMD to identify and plug or repair abandoned free flowing artesian wells.

OBJECTIVE 4: Intergovernmental Coordination

By 2000, Indian River County will have written intergovernmental coordination agreements with local governments and state agencies to ensure protection of the natural groundwater aquifer system.

Policy 4.1: The county shall cooperate with agencies, such as the SJRWMD and the FDEP, in performing assessments of groundwater resources, and shall review any recommendations for incorporation into the land development regulations. County support shall include, but not be limited to, providing information, providing staff assistance, and implementing recommendations.

Policy 4.2: The county shall assist the SJRWMD with updating SJRWMD's Needs and Sources Assessment by providing water use data relating to agricultural irrigation, recreational irrigation, and public supply.

Policy 4.3: The county will assist the SJRWMD in coordinating with the other counties to the west and northwest of Indian River County to protect the natural groundwater aquifer recharge areas of the Floridan aquifer by maintaining a very low land use density in these areas, compatible with densities identified in the Indian River County future land use map.

Policy 4.4: The county shall continue to utilize existing interlocal agreements with other local governments, as identified in table 11.3 of the Intergovernmental Coordination Element, to ensure maximum efficiency of water management, by combining resources and eliminating duplication.

Policy 4.5: By 2003, the county, in coordination with the state and other local governments, shall study the feasibility of combining the operational responsibilities of all water related activities under one agency to eliminate duplication of effort and to ensure efficient protection and provision of water for various uses.

OBJECTIVE 5: Capital Improvements

By 2000, the County shall protect a minimum of 100 additional acres of aquifer recharge areas for the surficial aquifer through conservation easements and fee simple acquisition.

Policy 5.1: The county will maintain a seven (7) year schedule of capital improvement needs for public facilities, to be updated annually in conformance with the review process for the Capital Improvements Element of this plan.

Policy 5.2: The county shall pursue state and federal sources of funding available for the preservation and protection of environmentally sensitive areas, such as natural groundwater aquifer recharge areas.

Policy 5.3: The county shall evaluate and rank proposed capital improvement projects for the acquisition and preservation of the natural groundwater aquifer recharge areas according to the following guidelines:

- Level One - Whether the acquisition is needed to protect public health, to protect the function of aquifer recharge, and to fulfill the county's legal commitment to provide water services.
- Level Two - Whether the acquisition will improve the existing condition and prevent or reduce future capital costs.

Policy 5.4: By 2000, the county will develop standard operating procedures for groundwater quality monitoring.

PLAN IMPLEMENTATION

An important part of any plan is its implementation. Implementation involves execution of the plan's policies by taking actions and achieving results.

For the Natural Groundwater Aquifer Recharge Sub-Element, implementation involves various activities. While some of these actions will be ongoing, others are activities that will be taken by certain points in time. For each policy in this element, Table 3.D.4 identifies the type of action required, the entity or entities responsible for taking the action, the timing, and whether or not the policy necessitates a capital expenditure.

To implement the Natural Groundwater Aquifer Recharge Sub-Element, several types of action must be taken. These include, but are not limited to: revisions to land development regulations and ordinances, intergovernmental coordination, and provision of funding.

Overall plan implementation responsibility will rest with the planning department. Besides its responsibilities as identified in Table 3.D.4, the planning department has the additional responsibility of ensuring that other entities discharge their responsibilities. This will entail notifying other applicable departments of capital expenditures to be included in their budgets, notifying other departments and groups of actions that must be taken, and assisting other departments and agencies in their plan implementation responsibilities.

EVALUATION & MONITORING PROCEDURES

To be effective, a plan must provide a means for implementation and a mechanism for assessing the plan's effectiveness. Generally, a plan's effectiveness can be judged by the degree to which the plan's objectives have been met. Since objectives are structured, to be measurable and to

have specific timeframes, the plan's objectives are the benchmarks used as a basis to evaluate the plan.

Table 3.D.5 identifies each of the objectives of the Natural Groundwater Aquifer Recharge Sub-element and the measures used to evaluate progress in achieving the objectives. Table 3.D.5 also identifies an anticipated date of completion for each objective.

The planning department staff will be responsible for monitoring and evaluating the Natural Groundwater Aquifer Sub-Element. This will involve compilation of information, when available, regarding groundwater quantity and quality.

While monitoring will occur on a periodic basis, formal evaluation of the Natural Groundwater Aquifer Recharge Sub-Element will occur every five (5) years in conjunction with the Evaluation and Appraisal of the Comprehensive Plan. Besides assessing progress, the Evaluation and Appraisal Report (EAR) will also be used to determine if the Natural Groundwater Aquifer Recharge Sub-Element's objectives and policies should be maintained, revised or deleted. In this way, the monitoring and evaluation of the Natural Groundwater Aquifer Recharge Sub-Element will provide a means of determining the degree of success of the plan's implementation, as well as, providing a mechanism for evaluating needed changes to the Sub-Element.

TABLE 3.D.4
Natural Groundwater Aquifer Recharge Sub-Element Implementation Matrix

Policy	Type of Action	Responsibility	Timing	Capital Expenditure
1.1	Update SAPROD map to G.I.S. format	Planning Dept.	1999	NO
1.2	Assist in developing WHPA map by providing information	Planning Dept./Utilities Dept./SJRWMD/FDEP	1999	NO
1.3	Restrict location of septic tanks	FDEP/DHRS	Ongoing	NO
1.4	Stormwater management structure design	Public Works	Ongoing	NO
1.5	Continue enforcing LDR Chapter 931 to protect public supply wellheads	Planning Dept.	Ongoing	NO
1.6	Restrict hazardous materials in NGAR areas	Planning Dept.	Ongoing	NO
1.7	Prohibit new injection wells	Planning Dept.	Ongoing	NO
1.8	Discourage flood irrigation	IRSWCD	Ongoing	NO
2.1	Implement Objective 4 of the Potable Water Sub-Element and Objective 4 of the Sanitary Sewer Sub-Element	Planning Dept./City of VB Utilities/SJRWMD	Ongoing	NO
2.2	Adopt water conservation ordinance	BCC/Planning Dept.	1999	NO

Policy	Type of Action	Responsibility	Timing	Capital Expenditure
2.3	Use NGAR areas for parks and open space	Planning Dept./ Public Works	Ongoing	NO
2.4	Continue to issue permits for proposed mining projects exempt from SJRMWD regulations	Planning Dept./ Public Works	Ongoing	NO
2.5	Adopt Comprehensive Wetlands Management Program	Planning Dept.	Ongoing	NO
2.6	Require all stormwater ponds over 1 acre to utilize runoff for irrigation	F.S. 298 Districts/ SJRWMD/IRSWCD/ Public Works	Ongoing	YES
3.1	Preserve open space in the western county	Planning Dept.	Ongoing	NO
3.2	Encourage use of low volume irrigation	IRSWCD/SJRWMD	Ongoing	NO
3.3	Require 50% xeriscape for new developments	Planning Dept.	Ongoing	NO
3.4	Reuse 100% of treated wastewater effluent	IRC Utilities Dept/ City of Vero Beach Utilities	Ongoing	YES
3.5	Plug/repair abandoned flow wells	Planning Dept./SJRWMD	Ongoing	YES
4.1	Coordinate/Provide assistance	SJRWMD/FDEP/IRC	Ongoing	NO
4.2	Provide water use data to the SJRMWD	SJRMWD/Utilities Dept.	Ongoing	NO
4.3	Intergovernmental coordination	SJRMWD	Ongoing	NO
4.4	Inter local agreements	BCC/SJRWMD/ Municipalities	Ongoing	NO
4.5	Study combining responsibilities of Utilities Department	BCC/Utilities Dept / Municipalities	2003	NO
5.1	Maintain 7 year schedule of capital improvements	Utilities Dept./ Finance Dept.	Annual	YES
5.2	Pursue state and federal funding sources	Planning Dept.	Ongoing	NO
5.3	CIP Evaluation/Prioritization	Utilities Dept./ Finance Dept.	Ongoing	NO
5.4	Develop SOP for groundwater monitoring	FDEP/SJRWMD/IRS/ Utilities Dept.	Ongoing	NO

BCC: Board of County Commissioners
FDEP: Florida Department of Environmental Protection
SJRWMD: St. Johns River Water Management District
IRSWCD: Indian River Soil and Water Conservation District
DHRS: Florida Department of Health and Rehabilitative Services (Environmental Health)

TABLE 3.D.5
NATURAL GROUNDWATER AQUIFER RECHARGE SUB-ELEMENT
EVALUATION MATRIX

OBJECTIVE	MEASURE	TIMEFRAME
1	No instances of contamination of groundwater aquifers or public supply wells, based on primary and secondary MCLs, as defined by the FDEP	Ongoing
2	Availability of groundwater from the surficial aquifer	2020
3	Availability of groundwater from the Floridan aquifer	2020
4	Inter-governmental coordination mechanisms	2000
5	Amount of natural groundwater aquifer recharge areas preserved	2000