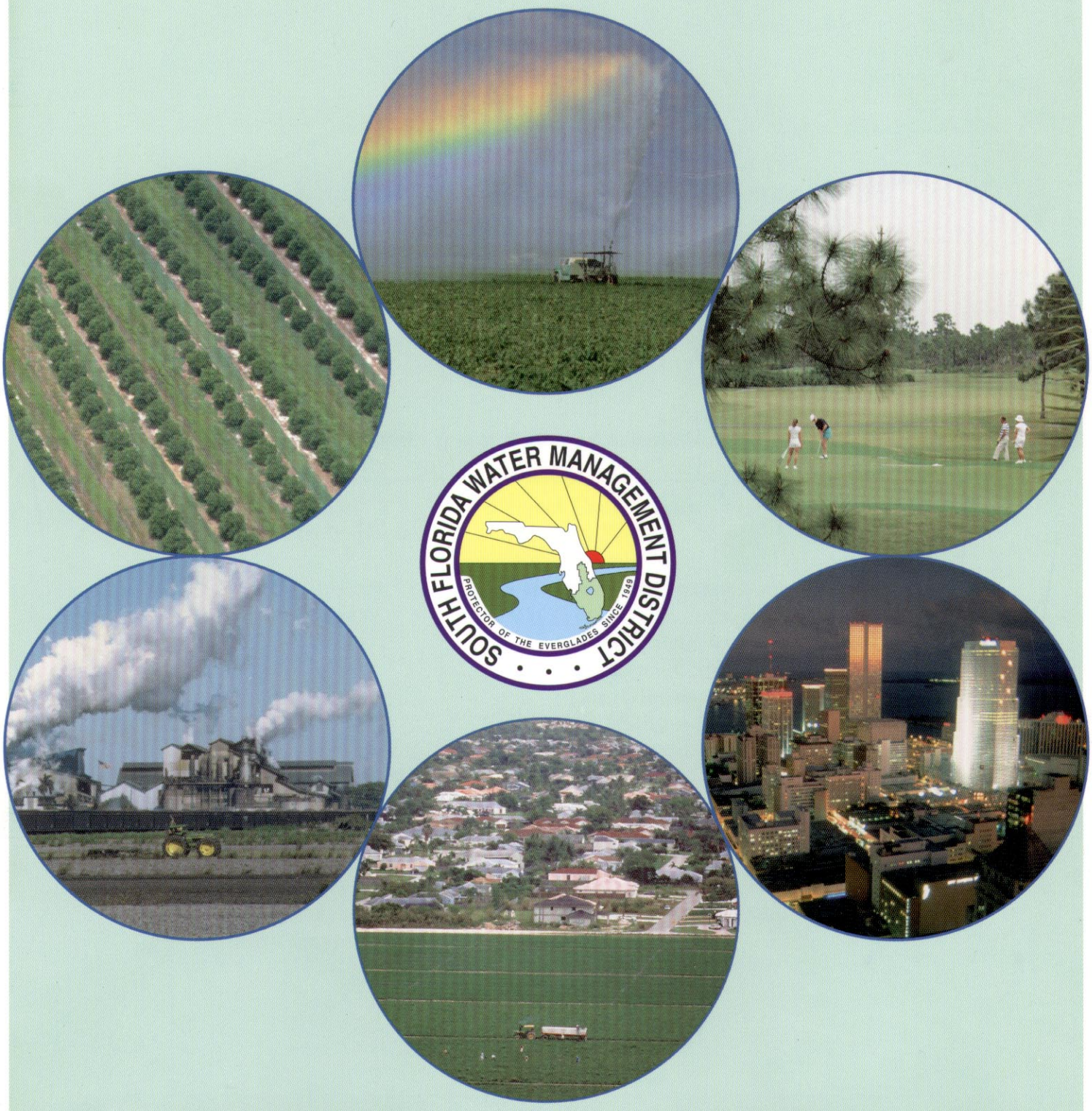
DISTRICTWIDE WATER SUPPLY ASSESSMENT



JULY 1998

Districtwide Water Supply Assessment

South Florida Water Management District
West Palm Beach, Florida

July 1998

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Section I

Executive Summary

During the 1997 legislative session, significant amendments were made to the Florida Water Resources Act of 1972 (Chapter 373, Florida Statutes) regarding regional water supply planning. Section 373.036(2)(b)4 F.S. requires each water management district to prepare a Districtwide Water Supply Assessment (Assessment) by July 1, 1998, and to then prepare water supply plans for regions that are anticipated to have the potential of demand outstripping available supply by the year 2020.

The SFWMD is already committed to preparing water supply plans for each of its four planning regions, which cumulatively cover the entire District, and this Assessment affirms that commitment. Water supply plans for the planning regions have been sequenced based on the history of their water shortage problems. This meant that a water supply plan for the Lower West Coast was the first to be initiated, followed by the Lower East Coast, Upper East Coast, and finally the Kissimmee Basin.

Planning region boundaries are generally defined by the drainage divides of major surface water systems. Minimal changes in these boundaries are proposed within this Assessment to more accurately reflect the way in which analyses have been, and will continue to be, completed for the four planning regions. These changes incorporate transferring small portions of counties from one planning region into an adjacent planning region that encompasses the vast majority of the county.

Demand assessments for 1995 and projections for 2020 are presented for the water use categories of:

- Public Water Supply
- Domestic Self-Supply and Small Public Supply Systems
- Commercial/Industrial Self-Supply
- Recreational Self-Supply
- Thermoelectric Power Generation Self-Supply
- Agricultural Self-Supply

Demand projections for the year 2020 include demand levels associated with average rainfall conditions as well as demands that would be

anticipated in a drought. The severity of the drought is defined as having the frequency of occurrence of once in every ten years (as required by Section 373.036, F.S.). The water resource and demand analyses presented in this Assessment will be refined during each region's water supply planning process. Environmental demands are not quantified in this Assessment, but are addressed during the water supply planning process through the use of resource protection criteria.

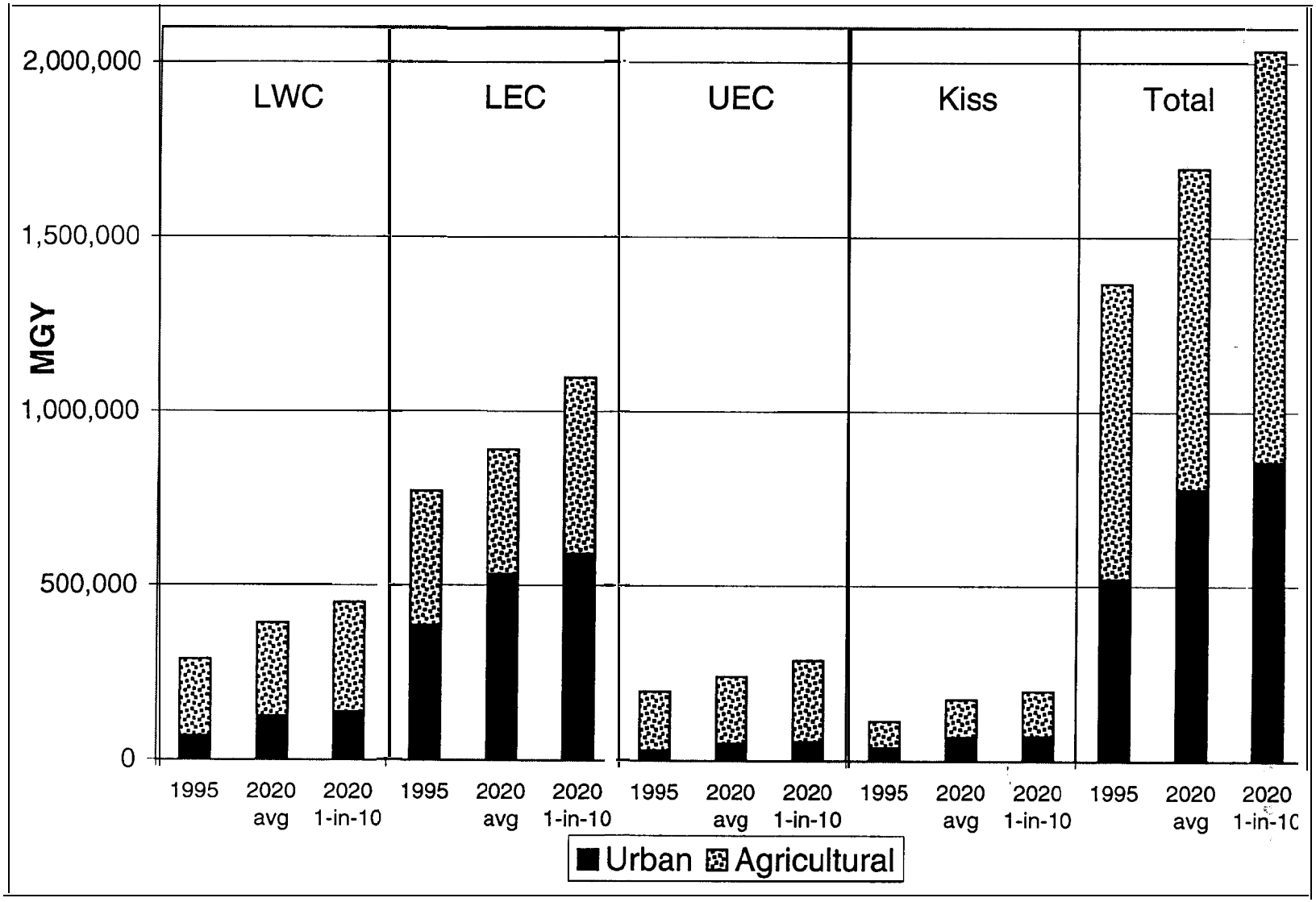
District-wide, population is projected to increase by 43 percent, from 5755,634 in 1995 to 8,222,781 in 2020. Urban demands are projected to rise by 49 percent from 521,011 mgy in 1995 to 777,394 mgy in 2020 (assuming average rainfall) in 2020. Irrigated agricultural acreage in the SFWMD is projected to rise by 5 percent from 1,075,993 acres in 1995 to 1,124,552 acres in 2020. Annual average agricultural demands are projected to rise by 9 percent from 847,699 mgy in 1995 to 920,678 mgy in 2020. Total demands for the entire District are projected to increase by 24 percent, from 1,368,710 mgy in 1995 to 1,698,072 mgy in 2020 (under average rainfall conditions). A l-in-10 year drought in 2020 would increase projected demand to 2,035,092 mgy. Rates of change in urban and agricultural demand do not exactly equal population and irrigated agricultural acreage rates of change due to the mix of: categories of use - each with its own trend; crop types with differing evapotranspiration rates; irrigation systems with varying efficiencies; soil types with a range of usable soil water capacities; and dissimilar weather patterns as evidenced by historical records from rainfall stations.

Figure I-l shows the assessed 1995 and the projected 2020 average and l-in-10 year drought demands for urban and agricultural use. Water demand data are presented for each of the four regional planning regions. These demand assessments and projections are broken down by county, or portion of county, in the Water Demand Projections section for each planning region.

This Assessment provides utility specific demands for 1995 and projections for 2020 for each public water supply utility in the SFWMD with projected pumpage of 0.5 million gallons per day or greater in the year 2020. Source locations for each of these utilities are also provided.

The results of previously completed water supply plans are summarized. Comparisons are made by county, between the populations and irrigated agricultural acreage analyzed in each water supply plan and the corresponding projections for the year 2020 presented in this Assessment.

Figure I-1. Planning Region Demands for 1995 and 2020.



Land use information for 1995 is provided for each of the four planning regions. This information is summarized into general categories in Plates 1 through 4, but is available at a very detailed level. These data are used in the water supply planning process to identify the location of different irrigated crops and land uses for modeling purposes. Land use data are also used as a basis for developing future water demand scenarios.

Water Resource Caution Areas (WRCAs) are also delineated within this Assessment. These areas have experienced or are anticipated to experience some level of water resource problems within the next 20 years, and cumulatively include most of the District. Based on analyses already completed during the water supply planning process, recommendations are made regarding boundary changes to WRCAs. No changes are proposed in the Lower West Coast and Lower East Coast planning regions. In the Upper East Coast Planning Region, it is proposed that the WRCA be reduced from covering the entire region to include only the coastal areas. A review of the needs on changing the WRCAs in the Kissimmee Basin Planning Region is being completed as part the water supply planning process presently taking place.

Preparation of this Assessment was closely coordinated with the four other water management districts in the State of Florida and the Florida Department of Environmental Protection (FDEP). The outline for this Assessment was provided by the FDEP. The water management districts' assessments are incorporated into each district's respective water management plan, and then into the FDEP's Florida Water Plan.

Section II

Introduction

The Districtwide Water Supply Assessment presents water demands for 1995, projections for 2020, and descriptions of the surface water and ground water resources within each of the SFWMD's four planning regions. The availability and limitations of water resources are described for each of the four planning regions.

Previous water supply planning efforts by the District include: the Water Supply Needs and Sources Document 1990-2010 (1992); the Lower West Coast Water Supply Plan (1994); the Interim Plan for Lower East Coast Regional Water Supply (1998); the Upper East Coast Water Supply Plan (1998); and the Kissimmee Basin Water Supply Plan Background Document and Appendices (1996). With the exception of the Upper East Coast Water Supply Plan, these planning efforts have had a future planning horizons through the year 2010. In many cases, however, the demand levels analyzed far exceed the current 2010 projections due to the slowing of population and irrigated agricultural acreage growth rates. The Districtwide Water Supply Assessment has a planning horizon through 2020, and uses 1995 as the base historical year.

Planning Regions

The four planning regions are the Lower West Coast, Lower East Coast, Upper East Coast, and Kissimmee Basin, and are shown in Figure II-l. Planning regions are generally defined by the drainage divides of major surface water systems in South Florida. The series of canals, levees, pump stations, and storage areas that comprise the Central and South Florida Flood Control Project were also considered because these structures have altered the hydrology of the natural water bodies. Minimal changes in the planning region boundaries are proposed in order to more accurately reflect the way in which analyses have been, and will be, presented for the four planning regions. These incorporate transferring slivers or small portions of counties from one planning region into an adjacent planning region that encompasses the vast majority of the county (Figure II-2). This will reduce the number of counties split between SFWMD planning regions from 11 to 5.

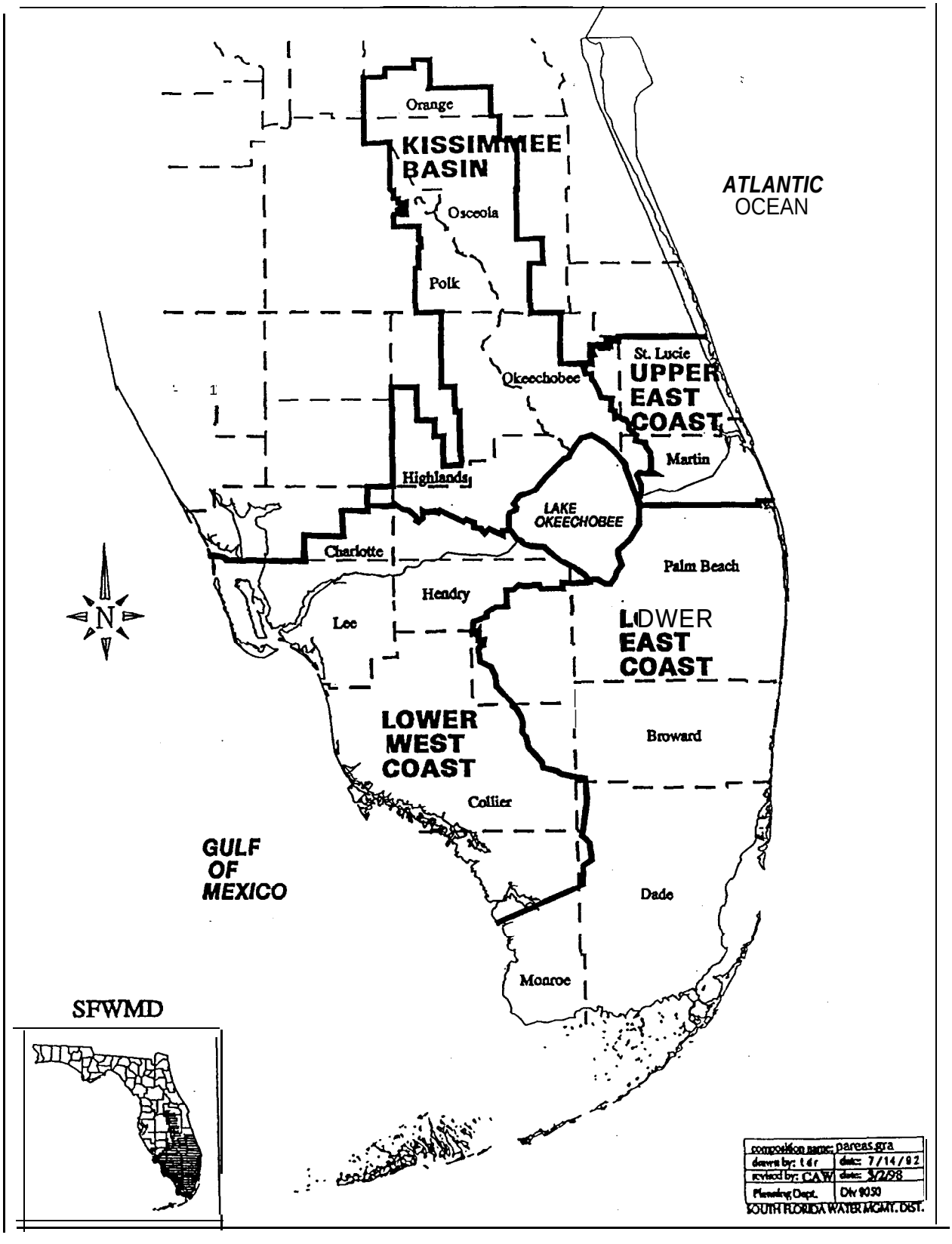


Figure II-l. Existing Planning Regions in the South Florida Water Management District.

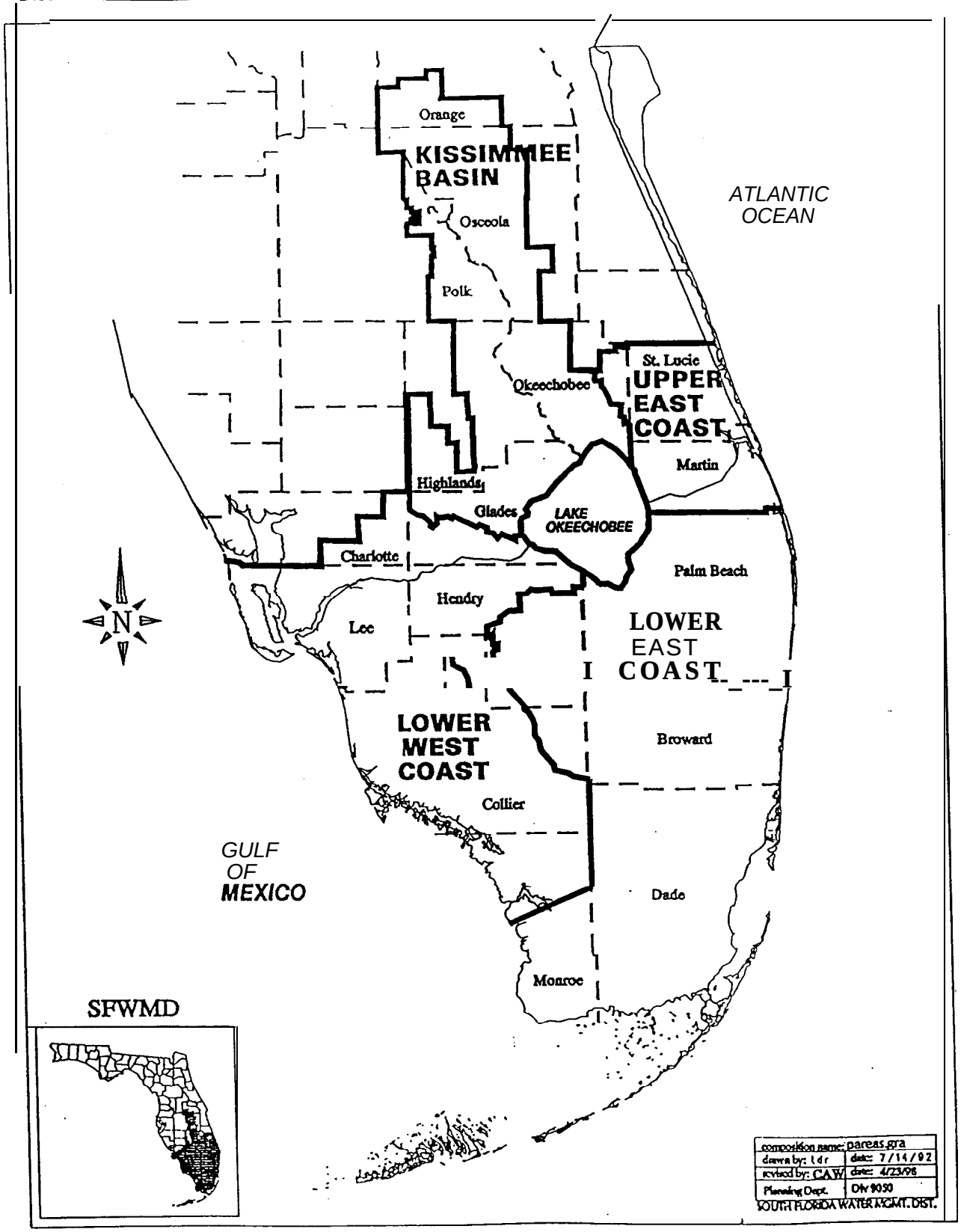


Figure II-Z. Proposed Planning Regions in the South Florida Water Management District.

Counties that are proposed to no longer be in more than one planning region include St. Lucie, Martin, Palm Beach, Broward, Dade, and Charlotte. Counties that are proposed to remain in more than one planning region are Okeechobee, Hendry, Glades, Collier, and Monroe.

Water Resources and Demands

Water resources and demands for 1995 and 2020 are outlined by region, and detailed by county, or portion of county, within each region (using the proposed boundaries shown in Figure II-2). Water demands assessed represent withdrawal. Urban and agricultural demands for 1995 and projected demands for the year 2020 are assessed based on the methods described in Section IV, the Demand Methodology section.

Populations presented are consistent with the Annual Census Estimate for 1995 (U.S. Bureau of the Census, 1998) and the University of Florida's Bureau of Economic and Business Research (BEBR) medium range projection for 2020 (BEBR, 1998). Water demand projections are based on the extrapolation of current trends and/or circumstances, and consequently cannot incorporate unforeseeable radical changes in the variables that determine water use. Projections should therefore be understood as surprise free, and infer an extension of current production, market, and legal circumstances. Demand projections should be considered preliminary and will be modified during the water supply planning process. Environmental demands are not quantified in this Assessment, but are addressed during the water supply planning process through the use of resource protection criteria.

Surface water and ground water systems are outlined by county within each region. The availability and limitations of these resources are described, based on historical information, data gathered during the water supply planning process, and information gathered in preparation of regional, sub-regional and local resource analyses.

After completion of the Districtwide Water Supply Assessment, the regional plans will further identify specific geographical areas that have water resource problems that are critical or are anticipated to become critical by the year 2020. For these critical areas, the regional plans will detail remedial or preventive measures including water resource development projects, water supply development projects, and operational and regulatory

strategies. The regional plans will also serve as a means of identifying areas where collection of resource data and technical studies are necessary.

Water Resource Caution Areas

Chapter 62-40, F.A.C., was amended in 1988 to require the water management districts to designate areas with water supply problems that have become critical, or are anticipated to become critical within the next 20 years. The District identified such critical water supply problem areas and adopted these designations by rule in October 1991. A majority of the SFWMD is within a Water Resource Caution Area (Figure 11-3).

Based on analyses already completed in the water supply planning process no changes in WRCA boundaries are proposed in the Lower West Coast and Lower East Coast planning regions. In the Upper East Coast Planning Region, it is proposed that the WRCA be reduced from covering the entire region to include only the coastal areas (Figure 11-4). A review of the needs of changing the WRCAs in the Kissimmee Basin Planning Region is being completed as part the water supply planning process presently taking place.

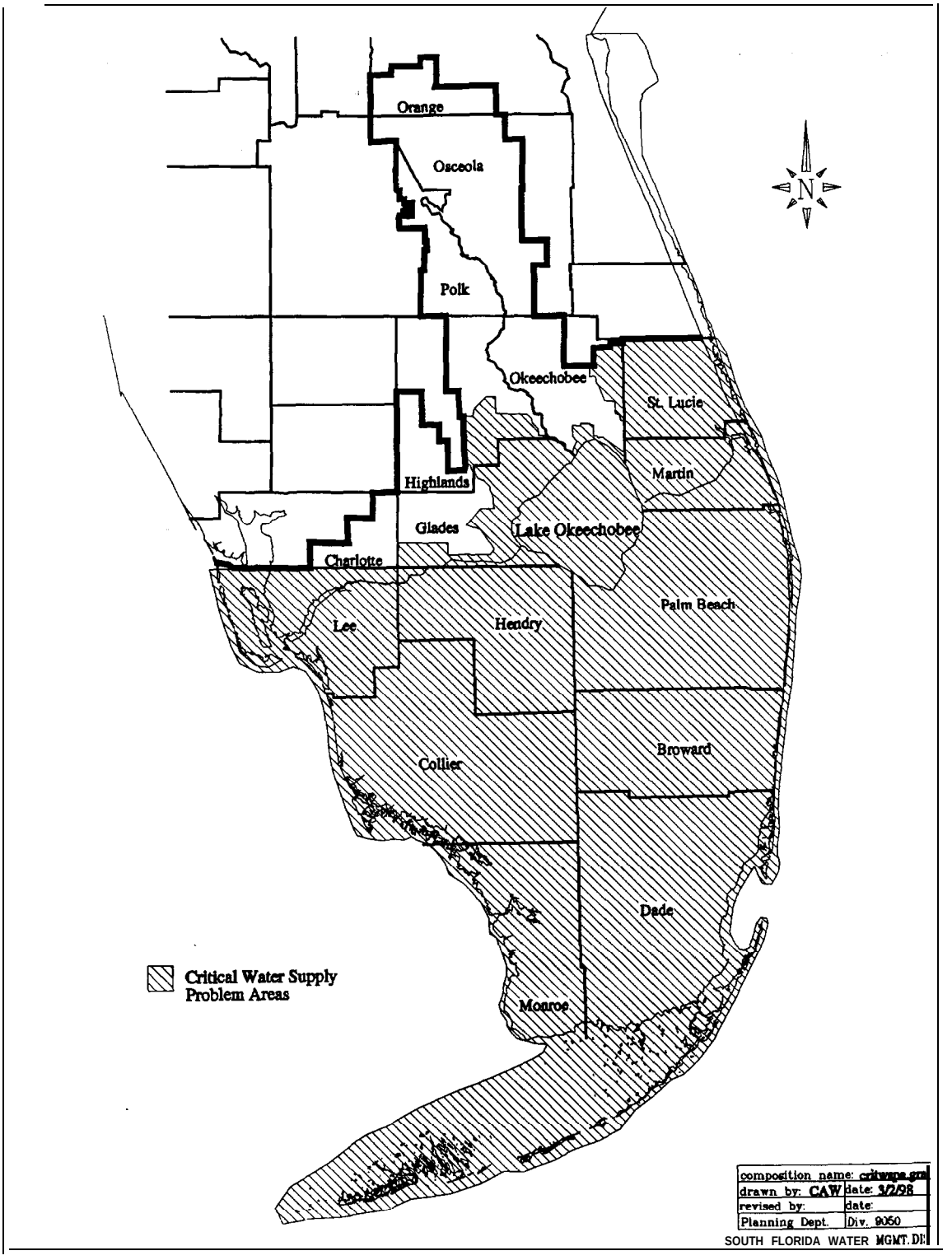


Figure 11-3. Existing Water Resource Caution Areas within the South Florida Water Management District.

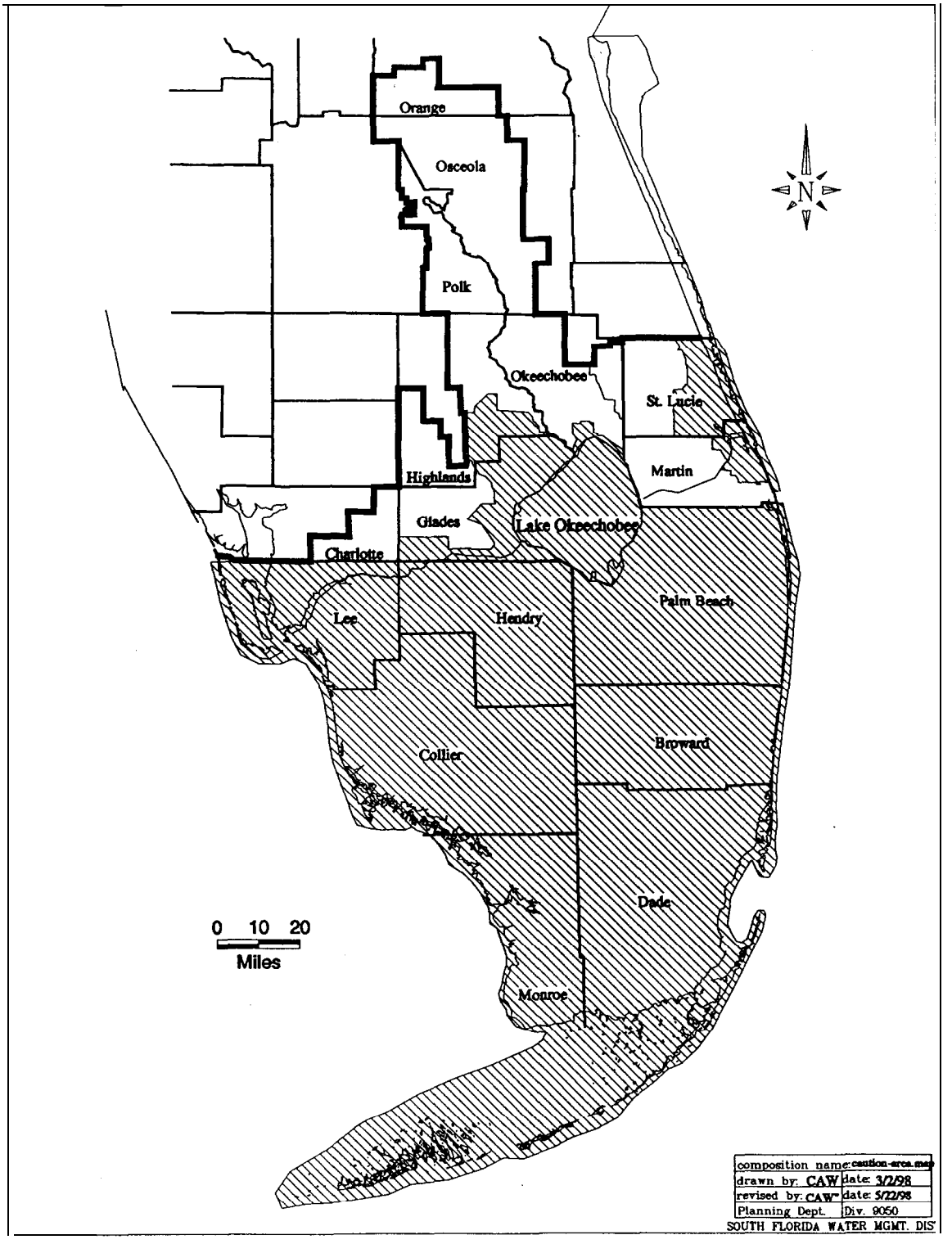


Figure II-4. Proposed Water Resource Caution Areas within the South Florida Water Management District.

Reuse

A requirement of Chapter 62-40, F.A.C., states that a reasonable amount of reuse shall be implemented within these designated Water Resource Caution Areas. This is implemented through the Basis of Review, the District's criteria document governing the issuance of water use permits. Currently proposed District rules require an area to be designated as a Water Resource Caution Area, if it meets at least one of the following criteria:

- Locations designated as reduced threshold areas
- Areas of special concern, as determined through the water use permitting process
- Areas that have experienced water shortage restrictions
- Areas designated as restricted allocation areas
- Areas experiencing saline water intrusion
- Other areas with known or anticipated water supply problems

Wastewater treatment facilities within the SFWMD had a combined rated capacity of 1,006 mgd and processed an average of 786 mgd of wastewater in FY 1996/97. Of the 159 facilities having a rated capacity of 0.10 mgd or greater, reuse was utilized by 131 (82%). These facilities reused a combined total of 139 mgd or 18 percent of the total wastewater treated (SFWMD, 1998). Reclaimed water is available as a source for future water supply, the potential of which will be analyzed during the water supply planning process.

Section III

Assessment Approach

General Assessment Criteria

The Districtwide Water Supply Assessment incorporates the criteria used in the already completed regional water supply plans, and includes knowledge of historical regional water supply problems experienced for each region. The analyses completed in each region's respective water supply plan are compared with the projected rates of increase for the factors that largely determine water demand, namely population and irrigated agricultural acreage.

One of the goals stated in the 1997 legislation for the Assessment is to discern areas for which water supply plans would be necessary. The SFWMD has already committed to preparing four regional water supply plans that together cover the entire District, and this Assessment affirms that commitment.

Water supply plans include mathematical models that simulate the hydraulics of the surface and ground water systems, and quantitatively forecast the range of impacts associated with projected demand levels on available resources. The SFWMD has sequenced its regional water supply planning efforts in order to increase the efficiency of staff resources while addressing priority water resource issues. In this way, technical experts work on the water supply plan for one region followed by another. The regions have been sequenced based on the history of water shortage problems in each region. This meant that a water supply plan for the Lower West Coast was the first to be initiated, followed by the Lower East Coast, Upper East Coast, and finally the Kissimmee Basin.

Demand assessments and projections are presented for the years 1995 and 2020 in Section V. Although these projections were prepared for six categories of water use, they can also be classified into either population related or agricultural production related categories. Population related demand categories would include the Public Water Supply; Domestic Self-Supply and Small Public Supply Systems; Commercial/Industrial Self-Supply; Recreational Self-Supply; and Thermoelectric Power Generation Self-

Supply categories. The Agricultural Self-Supply category covers irrigated commercially produced agricultural crops.

The SFWMD has invested a great deal of resources in the preparation of water supply plans for the Lower West Coast, and Upper East Coast planning regions, as well as an interim plan for the Lower East Coast. Efforts are now underway to prepare a plan for the Kissimmee Basin. Although modeling was not performed in the preparation of this Assessment, the results from modeling efforts associated with these water supply planning processes are described, along with the populations and irrigated agricultural acreages that were used as inputs to the models.

Within the water supply planning process, models are used to mathematically forecast impacts of projected demands on existing users and natural systems. These models require analyses of the quantity, timing, and location of demands. The projections contained in this report include assessments of quantity. Timing is obtainable based on historical use patterns or calculated irrigation demand levels throughout the year. Locating future demands requires the development of a primary projection scenario. This would normally include three steps: (1) locating existing demands; (2) locating permitted demands that are yet to exist; and (3) establishing locations that are deemed suitable for future demands based on stated criteria. This location scenario development is completed within the District's water supply plan development process. The demand locations selected in that process would also very likely be the locations to which demands projected in this Assessment would be assigned. Therefore, it is likely that county population and irrigated agricultural acreage projections of similar magnitudes would be assigned to the same locations in a future projection scenario, and should yield comparable model results.

Demand projections are based on the extrapolation of trends and circumstances that may change over time. Population and irrigated agricultural acreage growth have slowed within the District since the SFWMD initiated its water supply planning process. Population growth rates used in preparing this Assessment are invariably less than the growth rates used in previous water supply planning efforts. In regard to agriculture, citrus underwent a boom period in most counties of the SFWMD in the 1980s, and this growth had previously been projected to continue. This citrus acreage growth has now subsided, and current projections incorporate a much more moderate rate of growth. Added to this, the irrigated agricultural acreages modeled in the previous water supply plans included permitted

citrus (and other irrigated agricultural) acreages. At the time the water supply. plans were initiated, permitted acreages significantly exceeded planted acreages. As a result, in most cases the populations and irrigated agricultural acreages for which analyses have been completed (for 2010), are very close to, and in several instances exceed the equivalent numbers projected for the year 2020 in this Assessment. In order to portray this, the populations and irrigated agricultural acreages used in previous modeling efforts for water supply plans are presented in Section V, along with the equivalent numbers that would be modeled were these models to be run using projections included in this Assessment. Projections developed for this Assessment will be verified during future water supply planning efforts.

How document has been prepared

The District's Planning Department is continuously working on various stages of water supply plan development for one or more of its planning regions. A large part of the preparation of this Assessment has been an extension of those efforts, and included contributions from planners, geographers, economists, engineers, hydrogeologists, analysts, engineering associates, and administrative associates. Intense effort to prepare this document began in September 1997, and the SFWMD has invested the full time equivalent (FTE) of approximately four years of staff time in the development of this document.

The urban demand projections contained in this Assessment have been reviewed by local planning and utility directors. Likewise, the agricultural acreage projections have been reviewed by local Institute of Food and Agricultural Sciences (IFAS) staff. Alternative data and projections provided by these external reviewers were carefully examined by SFWMD staff and incorporated where appropriate. Dialog is taking place between the SFWMD and the relevant parties in the very few cases where consensus was not quickly reached. This type of open dialog, peer review, discussion, and public participation will continue throughout the water supply planning process.

Major factors that may influence underlying assumptions

In order for this Assessment to include demand projections under average rainfall and l-in-10 year drought conditions for all the categories of use, it was necessary to make several calculations, estimations, and inferences.

Statistical methods were used to calculate the average and l-in-10 rainfall years that were initiated in March of each year, as March is normally the beginning of the period of the year when the rainfall-evapotranspiration deficit becomes the greatest.

A log-normal distribution was used as the default rainfall distribution pattern for each of the rainfall stations. A single rainfall station was chosen for each crop/county combination, based on proximity to each crop's center of production within the county. This is in contrast to the water supply planning process, in which several rainfall stations are used to calculate evapotranspiration levels for each crop for each county, each representing a sub-county polygon,

It was taken as a premise that drought events would not affect indoor water use. Estimates of the percentages of total use that are used outdoors were requested in writing from each utility. In the absence of any utility provided information in this regard, the District planner for each county made utility-specific estimates based on the following guidelines: 35 percent for those utilities perceived to have a low level of outdoor usage, 50 percent for medium usage, and 65 percent for high outdoor usage.

Important considerations that may not be addressed or may be deferred to later date

Considerations which may be revisited at a later date include the appropriateness of a log-normal distribution as a default for rainfall patterns, the appropriateness of the estimated level of outdoor use for each utility, and the accuracy of using the District's modified Blaney-Criddle evapotranspiration model to calculate irrigation requirements. Future demand projections could be significantly changed depending on the sensitivity of these factors.

Section IV

Demand Projections Methodology

Demand assessments for 1995 and projections for 2020 were made for the water use categories of:

(1) Public Water Supply
(2) Domestic Self-Supply and Small Public Supply Systems
(3) Commercial/Industrial Self-Supply
(4) Recreational Self-Supply
(5) Thermoelectric Power Generation Self-Supply
(6) Agricultural Self-Supply

Water demand projections for the year 2020 included analyses under average rainfall conditions and under l-in-10 year drought conditions. These projections are based on current trends and circumstances. Projections should therefore be understood as surprise free, and imply an extension of current production, market, and legal circumstances.

In addition, the projections are unconstrained by supply availability or demand management (conservation). Therefore, there is the opportunity to reduce these projected demand levels through the policies and activities that would be put in place based on potential or observed negative natural resource impacts, or in response to actual drought events. During the development of the more detailed water supply plans, unconstrained demands will not be an automatic assumption, and projected scenarios will include efforts to reduce demand rates and increase the level of reuse.

Drought conditions increase the irrigation requirements of agricultural crops, as well as urban outdoor use for landscape watering. The projections described in this Assessment include the complete satisfaction of irrigation requirements, and a proportional response to changing irrigation requirements caused by to changing rainfall patterns.

Irrigation requirements are equal to the difference between evapotranspiration and effective rainfall. Effective rainfall is equal to the rainfall that is stored in the plant root zone. Changing rainfall levels and timing therefore affect irrigation requirements. However, agricultural or

urban irrigation managers may not collectively respond proportionally to dissimilar rainfall patterns. Observed demand levels will vary based on irrigation managers' perceptions and responses to changing rainfall patterns. Realistically, some may allow plants to experience some level of stress before changing irrigation schedules, while others may habitually over-water at a level that satisfies irrigation demands even during drought events.

Wherever population represented an independent variable for projection purposes, the county estimate by the U.S. Bureau of the Census (1998) was used for 1995 and the medium range county population projections published by the Bureau of Economic and Business Research (1998) was used for the 2020 time horizon.

Average and 1 -in-l 0 Rainfall

An average rainfall year is defined as rainfall with a 50 percent probability of being exceeded over a twelve-month period. A l-in-10 year drought condition is defined as below normal rainfall with a 90 percent probability of being exceeded over a la-month period. This means that there is a 10 percent chance that less than this amount will be received in any given year. Section 373.0361(2)(a)1, F.S. states that the level of certainty planning goal associated with identifying demands shall be based upon meeting demands during a l-in-10 year drought event.

Both the average and l-in-10 year drought rainfall values used in this Assessment are synthetic years that have been derived from statistical analysis of a significantly long period of historical record. The rationale for using this method is that many average (or l-in-lo) years could be chosen with significantly different rainfall distributions over the year. Use of a synthetically derived rainfall year diminishes anomalies that may have occurred in specific years that fall into statistically probabilistic categories.

The District has a network of rainfall stations that provide historical rainfall data. Long-term data were obtained from rainfall stations with relatively long and reliable records. These data are maintained in the District's DBHYDRO database. These historical data were used to calculate statistically based average (or l-in-2) and l-in-10 year drought rainfall for rainfall stations across the District. The statistical method used to calculate the average and l-in-10 year drought rainfall involved a logarithmic transformation of monthly rainfall amounts to normalize the distribution of

the data. The average and l-in-10 rainfall were determined on the normalized data and converted back to antilogarithms.

The statistical approach requires selection of the initial month and an analysis of 12 cumulative rainfall data sets. March was chosen as the month from which to begin the analysis because it marks the beginning of the period of the year when the rainfall-evapotranspiration deficit becomes the greatest. A statistical rainfall frequency analysis was performed on March rainfall for each station. Similar analyses were performed on historical rainfall of two months (March through April) through twelve months (March through the following February).

Estimates of 10 percent (l-in-lo) drought frequency rainfall were made for each duration, and individual month amounts were obtained by subtraction of consecutive cumulative amounts (e.g., the November rainfall amount was obtained by subtracting the cumulative March to November drought frequency estimate from the cumulative March to October estimate). This analysis produced a set of monthly values that had a constant cumulative drought frequency of 10 percent. The individual monthly rainfall amounts (other than that of the initial month of March) do not have a prescribed drought frequency.

Each rainfall time series was fitted to the log-normal probability distribution. The average and l-in-10 irrigation demands were calculated using the District's modified Blaney-Criddle evapotranspiration model.

Categories of Water Use

(1&2) Public Water Supply and Domestic Self Supplied Demands

Public water supply (PWS) and domestic self-supply (DSS) demand assessments and projections have been developed for the District for 1995 and 2020. The DSS category includes small public supply systems with projected demands of less than 0.5 million gallons per day (mgd) in 2020 as well as residents that supply their own water needs. Self-supplied residents may be within utility boundaries or outside of utility boundaries (rural self-supplied). Water demands were forecast by multiplying population projections by per capita water use rates. Per capita water use rates were calculated based on 1995 population data from the U.S. Bureau of the Census (1998) and the water pumpage for each utility as reported by the U.S.

Geological Survey (USGS, 1997), and District. pumpage records. The population projections for 2020 for each county were based on the medium-range forecasts published by the Bureau of Economic and Business Research (1998).

The utility service areas used in this analysis were derived from the service areas detailed within District water use permits and utility plans. Areas outside of utility service area boundaries are referred to as rural self-supplied areas. Adjustments were made to account for the known future expansion of the current service areas. It was assumed that all projected population growth within areas being serviced by a utility would be connected to a PWS system. The breakdown of populations within utility service areas into PWS supplied and DSS categories were modified in several instances based on utility input.

Population Served

1995 Population Assessments. U.S. Census data for 1995 and 1990 were used as the basis for the 1995 population and the distribution of that population. Block group level information from the 1990 census count was used as the basic unit of analysis. Total population, total housing units, occupied housing units, and persons per occupied housing unit were retrieved from census data (Strategic Mapping, 1992). The total units connected to a PWS system and total units self supplied were as described in the Summary Tape File 3A sample census data (U.S. Bureau of the Census, 1992).

Estimates of occupied units connected to PWS systems and occupied units that are self-supplied for each block group were calculated. It was assumed that the percentages of units occupied and the number of occupants per unit for PWS connected and DSS units were the same. Public utility supplied population and self-supplied populations were calculated by multiplying the number of occupied units by the number of persons per occupied unit for the respective block group.

The geographic areas represented by the census block groups and the utility service areas were input as polygon coverages into the SFWMD Geographic Information System (GIS). Population density for those areas served by a PWS and those self-supplied were calculated for each block group assuming a uniform density within each block group. The two coverages were overlaid to create a polygon coverage with the attribute data from the two original coverages. Population assessments of PWS served and DSS were

then calculated for the new polygon coverage by multiplying the polygon area by the population density. The populations for each service area were then totaled.

The 1990 census count information was used to identify the utility served and self-supplied populations within each of the utility boundaries. The 1990 population was grown to the 1995 census estimate for the county using Traffic Analysis Zone (TAZ) information to spatially distribute the population growth. Any growth in population within an area being served by a utility was assigned to that utility. This means that within utility served areas, the domestic self-supplied population was assumed to remain the same from 1990 to 1995. Any growth in population within an area not being served by a utility was assigned to the rural self-supplied category.

2020 **Population Projections.** The medium range county projections as published by the Bureau of Economic and Business Research (1998) were used as the basis for population projections for 2020. The geographic distribution of the 2020 population was determined using the ratio of TAZ population growth for the areas covered by TAZs. The geographic distribution of the 2020 population for areas not covered by TAZs was based on the population distribution in the 1990 census block data, or was determined from information in the county's comprehensive plans. Total population was controlled to the total from the BEBR medium range projections.

The geographic areas represented by the TAZs, cities, and the utility service areas, were input as polygon coverages into the SFWMD GIS. Population density was calculated for each TAZ assuming a uniform density within each zone. The coverages were overlaid to create a new polygon coverage with the attribute data from the original coverages. Population estimates were then recalculated for the new polygon coverage by multiplying the area of the polygon by the population density. The populations for each service area were then totaled and controlled to the BEBR medium range population projection for each county.

Per Capita Rates

Per capita water use rates for 1995 for each utility were calculated by dividing raw water pumped by the population served by public water supply utilities. The USGS and District pumpage reports provided raw water withdrawal data. Total population and the number of individuals served by the utilities were determined by the above-mentioned methodology.

Per capita usage was derived for each utility by dividing total withdrawal by permanent resident population for 1995. These per capita rates include total use, incorporating use by seasonal residents and tourists, commercial and industrial utility supplied use, and the losses incurred in water delivery, in addition to the use by permanent residents. Irrigation demand for PWS served households using private well water for their irrigation was not assessed due to the lack of available data.

Per capita rates for 1995 were used to develop the base 2020 utility demand projections. The analysis for the Reedy Creek Improvement District was based on per day visitor rate information in the Comprehensive Plan, permit information, and communication with the utility. Adjustments that were made to these projections to normalize them for average and l-in-10 year drought rainfall conditions are described below.

DSS per capita rates within PWS utility service area boundaries were assumed to be same as for the utility serving that service area. The per capita rates for the DSS areas not served by public utilities were assumed to be the weighted average of the PWS per capita rates for the county.

PWS & DSS Demand Projection Calculations

Unadjusted base demand was calculated as population times a per capita water use rate. PWS and DSS demands were assessed for 1995 and projected for 2020 for each service area. For 2020, it was assumed that all population growth within each utility's service area will be connected to the PWS utility. Current DSS demand within utility service areas was assumed to remain constant. In addition to the utility service areas, demand assessments for 1995 and demand projections for 2020 for the rural self-supplied areas were made. These rural self-supplied areas are not currently served by a PWS utility and no utility has been identified that will serve these areas in the future.

PWS and DSS Average and l-in-10 Year Drought Adjustments

Indoor use categories need no adjustment from the 1995 observed values to an average year or a l-in-10 drought year, as these categories would have no demand shifts related to drought. The adjustments are therefore applied to that portion of PWS and DSS demand that is used outdoors.

Unadjusted base demand for a utility is projected by multiplying a base year per capita rate by a projected population. If desired, the withdrawal distribution (by month) can be derived from historical demand curves for the utility. The difference between the monthly demand for the base year and the unconstrained demand for an average year or a l-in-10 year will directly depend on the changes in the outdoor use, specifically, changes in demand for landscape irrigation. If the base year is an average year, then there is no need for an adjustment from base to average. However, if the base year is significantly wetter or drier than average, then unconstrained demands for outdoor use will adjust proportionally.

The impact of the difference between projections founded on an unadjusted base year and the goal of analysis for an average year can be calculated based on:

1) The ratio of the net irrigation requirements of the unadjusted base year to an average year.

2) The percent of total withdrawal that is for outdoor use. Outdoor use is normally almost exclusively for landscape irrigation.

In order to calculate average year drought demands for utilities, there needs to be an estimation of the percentage of total use that is used outdoors. Letters were sent to directors of each of the utilities for which projections were being developed requesting their assessment of the percentage of total demand from the utility that is used outdoors. In cases where utilities did not respond regarding the percentage of use for outdoors, the District planner for each county used the following guidelines: 35 percent for those utilities perceived to have a low level of outdoor usage, 50 percent for medium usage, and 65 percent for high outdoor usage.

As an example, Marco Island in Collier County has an assessed outdoor usage of 65 percent of total demand. Irrigation requirements for sod for 1995 and an average year were calculated using the District's Modified Blaney-Criddle evapotranspiration model. These requirements are presented in Table IV-l. Rainfall and evapotranspiration data from the Naples rainfall station and a crop type of sod (100 acres) were used.

The calculation takes place as follows:

Average factor = Average irrigation requirement / 1995 irrigation requirement

PWS average adjustment = ((average factor - 1) *percent outdoor use) + 1

This factor may then be multiplied by the demand for a base year (in this case 1995) to yield the projected demand for an average year.

Table IV-l. PWS Average year adjustment for Marco Island.

Average net irrigation requirement (mgy) – 100 acres of sod	134.1 mgy
1995 irrigation requirement (mgy) – 100 acres of sod	108.0 mgy
Average factor	1.242
Percent outdoor use	65%
PWS average adjustment (for Marco Island)	1.16

The average annual demands would be 16 percent higher than those projections made using the base year of 1995 for Marco Island PWS utility.

A similar methodology was then used to assess the average year demands for the domestic self-supplied. For self-supplied residents within utility boundaries, the same percent outdoor use assessment was used as for the utility. A percent outdoor use assessment was made for each county's rural self-supplied residents. This base year to average year adjustment is outlined in each county's public water supplied and domestic self-supplied demand projection tables in Chapter V.

Similar to the average year adjustment, the l-in-10 year demand adjustment assesses the difference in projected demand levels between unconstrained average and l-in-10 drought years. The difference in demand directly depends on the changes in the outdoor use, specifically, changes in demand for landscape irrigation. The impact of a drought event on PWS demand can be calculated based on:

1) The ratio of the net irrigation requirements of an average year to a l-in-10 drought year.

2) The percent of total withdrawal which is for outdoor use.

In order to calculate l-in-10 year drought demands for utilities, the same assessments of the outdoor use percentages were used as were used to convert base year use to average year use.

Continuing to use Marco Island as an example, this utility has an assessed outdoor usage of 65 percent of total demand. Irrigation requirements for sod for an average year and a l-in-10 drought year were calculated using the District's Modified Blaney-Criddle evapotranspiration model, and using the same rainfall station and crop type as in the unadjusted base year to average year conversion. These requirements are presented in Table IV-2.

The calculation takes place as follows:

l-in-10 factor = l-in-10 irrigation requirementlaverage irrigation requirement

PWS l-in-10 adjustment = ((l-in-10 factor - 1) *percent outdoor use) + 1

Table IV-2. PWS l-in-10 drought year adjustment for Marco Island.

1 -in-l 0 irrigation requirement (mgy) – 100 acres of sod	**152.4** mgy
Average irrigation requirement (mgy) – 100 acres of sod	134.1 mgy
1 -in-l 0 factor	1.136
Percent outdoor use	65%
PWS 1 -in-l 0 adjustment (for Marco Island)	1.09

Annual demands in a l-in-10 year drought would be 9 percent higher than projections made for an average year for the Marco Island PWS utility.

A similar methodology was then used to assess the l-in-10 year demands for the domestic self-supplied category. For self-supplied residents within utility boundaries, the same percent outdoor use assessment was used as for the utility. A percent outdoor use assessment was made for each county's rural self-supplied residents.

This average year to l-in-10 year adjustment is presented in each county's public water supplied and domestic self-supplied demand projection table in Chapter V. Table IV-3 describes columns "a" through "o" in the Public Water Supplied and Domestic Self-Supplied Demand Projections tables for each county.

Table IV-3. Column legend for the Public Water Supplied and Domestic Self-Supplied demand projections table for each county.

Columns	Heading	Description
(a)	#	Index numbers that match up with the map showing utility withdrawal facility locations
(b)	Utility	Name of the public water supply utility for which 1995 assessments and 2020 projections are made.
(c)	Total population 1995/2020	Permanent resident population that reside within each utility's active service boundaries.
(d)	PWS population 1995/2020	Permanent resident population served by each PWS utility.
(e)	PWS base MGD 1995/2020	For 1995, pumpage reported by the USGS and/or District pumpage records. For 2020, projected demands are based on the projected population served multiplied by the gallons per capita day (GPCD) observed in 1995 (column f).
(f)	GPCD 1995/2020: Gallons Per Capita Day	For 1995, Pumpage reported by the USGS and/or District pumpage records (column e) divided by permanent resident population served by each PWS utility (column d). For 2020, this per capita rate is the same as observed in 1995 for each utility.
(g)	Percent outdoor use	Percentage of total utility withdrawal that is used outdoors, primarily for landscape irrigation.
(h)	Average factor	Average rainfall year irrigation requirements of 100 acres of sod divided by the 1995 irrigation requirements for that same area/crop as calculated by the District's modified Blaney-Criddle evapotranspiration model.
(i)	PWS average MGD 1995/2020	PWS base MGD (column e) for each utility for 1995/2020 multiplied by the impact of the percent outdoor use (column g) expressed as a decimal on the average factor (column h). i = e*(((h-l)*g)+l)
(i)	1 -in-10 factor	l-in-10 drought rainfall year irrigation requirements of 100 acres of sod divided by the average rainfall year irrigation requirements for that same area/crop as calculated by the District's modified Blaney-Criddle evapotranspiration model.
(k)	PWS 1 -in-l 0 MGD 1995/2020	PWS average MGD (column i) for each utility for 1995/2020 multiplied by the impact of the percent outdoor use (column g) expressed as a decimal on the l-in-10 factor (column j). k = i*(((j-1)*g)+1)
(l)	DSS population	Permanent resident population not served by each PWS utility that resides within each utility's active service boundaries.
(m)	DSS base MGD 1995/2020	Assessed demands based on the self-supplied population (column l) multiplied by the gallons per capita day (GPCD) observed in 1995 (column f).
(n)	DSS average MGD 1995/2020	DSS base MGD 1995/2020 (column m) for each utility for 1995/2020 multiplied by the impact of the percent outdoor use (column g) expressed as a decimal and the average factor (column h). n = m*(((h-l)*g)+l)
(o)	DSS 1 -in-l 0 MGD 1995/2020	DSS average MGD (column n) for each utility for 1995/2020 multiplied by the impact of the percent outdoor use (column g) expressed as a decimal and the l-in-10 factor (column j). 0 = n*(((j-1)*g)+1)

(3) Commercial/Industrial Self-Supply

The employment by sector was evaluated regarding the predominant types of employment found in the District, and whether these employment types could be anticipated to grow at the same rate and in the same direction as the population. In the SFWMD, the majority of the employees are found in the service and retail sales sectors, indicating that water demand by these sectors will generally grow along with the population. Demand for this category of water use was projected to grow at the rate of each county's population growth. The exception to this was in the Everglades Agricultural Area (EAA), where industrial water use is for agricultural processing and is not impacted by population change. Industrial use in the EAA was projected to remain at its 1995 level through 2020. Water used for commercial and industrial purposes supplied by utilities are included with other utility demands.

(4) Recreation Self-Supply

The recreational self-supplied demand category includes self-supplied irrigation demands for large landscaped and recreational areas (as opposed to private homes), and for golf courses. Because of the data sources available, golf course demands by county are projected separately and added to the other landscape and recreation demands. Non-golf course landscaping and recreational water use was assumed to increase at the same rate as the county population, with 1995 used as the base year.

For golf course projections, historical irrigated golf course acreage data were gathered from the District's regional water supply plan appendices, and updated using the Golf Course Directory (National Golf Foundation, 1997), and personal communication with staff from several of the golf courses listed. Irrigated golf course acreage projections were made by statistically correlating historical acreage to historical population, or to a time trend, or to both.

Golf course irrigation requirement estimates for average and l-in-10 year droughts were made using the District's modified Blaney-Criddle model. The irrigation requirements were calculated similarly to other irrigation requirements, using a representative irrigation system/rainfall station/soil type combination for each county.

(5) Thermoelectric Power Generation Self-Supply

Thermoelectric power plants may withdraw large quantities of water for cooling purposes. The vast majority of this water is not consumed, however, in the sense that the same water may pass through the plant repeatedly, sequentially circulating through a series of ponds. There will normally be some evaporative losses (mostly related to the cooling water being kept in ponds), that must be replaced from an external source above and beyond rainfall and runoff. This replacement was assessed for each county for which there was a permitted use 1995. Electricity utilities were contacted with regard to anticipated increased water needs for cooling purposes. However, within the SFWMD there were no anticipated increased needs for this purpose and demand was projected to remain at the 1995 level through 2020.

(6) Agricultural Self-Supply

Crop acreage projections were needed for whole counties and for county portions that are in each planning region. For counties only partially a planning region, crop acreages were frequently projected for the entire county and these projections apportioned. Unless inappropriate, this was done by assuming changes in acreage proportional to the most recently reported acreage ratios. Acreage ratios were developed with the use of District land use maps and with the cooperation of the local Institute of Food and Agricultural Sciences (IFAS) extension offices.

The techniques chosen to project crop acreages were those that were judged to best reflect the specific crop scenario in each county. This led to some variation in projection techniques between crop types, and in method between counties. While it would have been ideal if a comprehensive functional form could have been found which produced tangible projections universally, no such functional form was found. The acreage projections developed here reflect a combination of methods; each deemed appropriate where used. This is consistent with the way in which crop acreage is projected by IFAS and other water management districts.

In some cases, a single mathematical model could be chosen as it accurately explained past trends, and was judged as clearly the most reasonable scenario for the future. In other cases, several models accurately explained past trends, and none of these provided explicitly more likely projections than the others. In these cases, the projections of several

statistically valid and empirically sound models were averaged. This approach was justified by research performed at the Bureau of Economic and Business Research (Mahmoud, 1984) which showed that taking the average of a number of different projections reduces the chances of making large errors and leads to more reliable projections.

When no statistically valid trend was found, or any convincing empirical knowledge of future changes in a crop's acreage, then the specific crop's acreage was projected at its most recently reported value for future time horizons.

Average and l-in-10 irrigation requirements were calculated using the District's modified Blaney-Criddle model. Modifications made to the Blaney-Criddle model are described the District's Management of Water Use Permitting Information Manual Volume III (SFWMD, 1997). Historical weather data from the rainfall station considered to best represent the crop/county combination were used to calculate irrigation requirements.

A crop's supplemental water requirement is the amount of water used for evapotranspiration minus effective rainfall, while irrigation requirement includes both the supplemental water requirement and the losses incurred in getting irrigation to the crop's root zone. Irrigation efficiency refers to the average percent of total water applied that is stored in the plant's root zone.

This relationship is expressed as follows:

Irrigation requirement = Supplemental requirement / Irrigation efficiency

Projections of irrigation system type, and the effect of the corresponding irrigation efficiencies, were based on the interpretation of current ratios and trends. There are three basic types of irrigation systems currently used in crop production in South Florida. These are seepage (50 percent), overhead sprinkler (75 percent), and micro-irrigation (85 percent) systems. The irrigation efficiencies estimated by the District are shown in parentheses.

Soil type, with regard to water use permitting by the District, refers to the soil's usable soil water capacity. Usable soil water capacity has a direct effect on effective rainfall. For each crop type, assumptions for sod type were made for present and future acreage based on the most commonly District permitted crop/soil type combination in the county. The District classifies five

types of soil with regard to usable soil water capacity in inches, i.e., 0.2, 0.4, 0.8, 1.5, and 3.6.

Crop Types

The irrigated commercially grown crop categories were based on the categories developed by the Water Demand Projection Subcommittee, which was made up of representatives from Florida's five water management districts. These categories included (1) citrus, (2) other fruits and nuts, (3) vegetables, melons, and berries, (4) field crops, (5) greenhouse/nursery, (6) sod, (7) pasture, and (8) miscellaneous. The crops within these categories are shown in Table IV-4. Although all of these crops are grown commercially somewhere within the Florida, not all are grown within the SFWMD. Crop acreage projections were sent out and reviewed by the local IFAS extension office.

Table IV-4. Agricultural Crop Categories.

Citrus (all irrigated citrus crops)	**Field Crops** Corn Cotton Hay Peanuts Rice Sorghum Soybean Sugarcane Tobacco Wheat Others
Other Fruits and Nuts Avocados Mangos Papaya Peaches Pecans	**Greenhouse/Nursery** Floriculture Fern Other ornamentals
Vegetables, Melons, and Berries Aromatic vegetables Beans Blueberries Cabbage Cantaloupe Carrots Celery Chinese vegetables Cucumbers Eggplant Escarole Green Peppers Latin vegetables Lettuce Potatoes Squash Strawberries Sweet Corn Tomatoes Watermelons	**Sod**
	Pasture
	Miscellaneous Apiculture Aquaculture Cattle Dairy Poultry Others

Citrus. All categories of citrus (oranges, grapefruit, tangerines, limes, etc.) were grouped together for projection purposes. Historical citrus acreage data were gathered from volumes of the Commercial Citrus Inventory (Florida Agricultural Statistics Service, Various Issues) which is published biennially. Citrus is grown commercially in every county within the District with the exception of Monroe.

Other Fruits and Nuts. Within the SFWMD non-citrus fruit crops (avocados, mangos, papaya, etc.) are produced commercially in Dade and Lee counties. In both of these counties, the local IFAS extension office was the best available data source for historical acreage.

Vegetables, Melons, and Berries. A wide variety of vegetable crops are produced commercially within the SFWMD. For counties with high levels of historical vegetable production, acreage data were gathered from volumes of the Vegetable Summary (Florida Agricultural Statistics Service, Various Issues), which is published annually. Information was provided from the local IFAS extension office for counties where it was not possible to discern acreage from the Vegetable Summary.

Field crops. Field crop projections within the SFWMD included sugarcane, rice, seed corn, soybean, and sorghum. By far the most significant of the field crops in terms of crop acreage is sugarcane, which is grown commercially in Glades, Hendry, Palm Beach, and Martin counties. In these areas, sugarcane acreage growth is limited by available space or haulage distance to the nearest sugar mill. Historical sugarcane acreage data were gathered from annual volumes of the Field Crops Summary (Florida Agricultural Statistics Service, Various Issues).

Historical county acreage numbers for rice, seed corn, soybean, and sorghum were provided by the local IFAS extension offices and research centers. Projected acreages for these crops were made based on milling capacity in the case of rice, and continued at their current level for seed corn, soybean, and sorghum.

Greenhouse/Nursery. A variety of greenhouse and nursery crops are grown within the SFWMD. Historical commercial nursery acreage data for each county were used to make projections using functional forms that correlated nursery acreage with a time trend variable. Historical commercial nursery acreage data were gathered from annual volumes of the Division of

Plant Industry's Annual Reports (Florida Department of Agricultural and Consumer Services, Various Issues).

In addition to nursery plants, there are also regions within the SFWMD that have significant areas used to produce cut flowers and bulbs (caladiums). The acreages of cut flowers and bulbs were projected based on input from the local IFAS extension office.

Sod. There is some variation in the production practices of sod within the SFWMD. Some harvested sod is irrigated, and some is not, serving largely as pasture until the sod is sold. Since the objective here is to project irrigation requirements, only irrigated sod is addressed. Historical county acreages of sod were provided by the local IFAS extension offices and research centers. In Palm Beach County's Everglades Agricultural Area (EAA), sod acreage was projected as a function of a time trend, while in other counties sod acreage was projected based on input from the local IFAS extension office.

Pasture. Improved pasture has, by District definition, the facilities in place to carry out irrigation. However, these facilities were typically designed for drainage and, with the exception of a few noted areas, are very rarely used for irrigation. This is because the returns associated with cattle production do not justify the expense associated with pasture irrigation. When irrigation is carried out, it is usually in a period of extreme drought and is done to prevent grass from dying.

The assumption was made that, with a few exceptions, that pasture will not be irrigated. Although this assumption may not be the case universally, it is much closer to actual production practices than the values given by any irrigation requirement model.

Miscellaneous

Cattle Watering. Water required for cattle watering was calculated as a function of the number and type of cattle (beef or dairy). Demand projections for cattle watering were based on the District allocation of 12 gallons/cow/day for beef cattle and 150 gallons/cow/day for dairy cattle. Demand for cattle watering is projected across the District to remain at about the 1995 level throughout the projection period, or to be reduced as irrigated crops are planted on land that previously had been pasture. Cattle numbers for 1995 were obtained from Cattle County Estimates published by the Florida Agricultural Statistics Service (1997). The observed fluctuation

ranges from year to year in cattle numbers have a minimal impact on the county demand level. However, cattle numbers were projected to decline if there are projections of overall increasing irrigated crop acreage in the relevant county. The relationship between acres used for pasture and beef cattle were assessed for each county, and cattle numbers were projected to decline proportionally to the projected decrease in the area used for pasture as some former pastureland is used for irrigated crops. With the exception of Broward County, dairy cattle numbers were projected at the 1995 level throughout the projection period.

Aquaculture. Aquacultural operations withdraw water for circulation purposes, and to replace evaporative losses. The replacement amount was assessed for each county for which there was a permitted use in 1995. Demand was projected to remain at the 1995 level through 2020.

Section V

Part 1

Lower West Coast Planning Region Assessment

The Lower West Coast Planning Region (LWC), which is shown on Plate 1, includes all of Lee County and portions of Charlotte, Collier, Glades, Hendry, and Monroe counties. The portion of Monroe County in the LWC is either in the Big Cypress National Reserve or the Everglades National Park and has no urban or agricultural demands. Therefore, Monroe County is addressed in the Lower East Coast Section. Analogously, the portion of Collier County outside of the LWC is entirely in the Big Cypress National Preserve and has no urban or agricultural demands. Therefore, Collier County is described in its entirety in this LWC section.

Ground water is the most important source of supply for most of the LWC. However, the Caloosahatchee River is an important source of water for urban and agricultural users in the northern portion of the region. Three major aquifer systems underlie the region: The Surficial Aquifer System (SAS), the Intermediate Aquifer System (IAS), and the Floridan Aquifer System (FAS). The SAS includes one or two aquifers, and it is the most important source of water in the region. The SAS is generally very productive, with good quality water. The IAS underlies the SAS. It contains several aquifers that are usually of lower productivity, and have lower quality compared to the SAS. The IAS appears to have the potential for local aquifer storage and recovery. The FAS occurs below the IAS, and has zones of high productivity containing low quality water. The FAS may have significant potential for use with desalination and with regional aquifer storage and recovery.

Rapid growth in population and irrigated agricultural acreage within the LWC has caused demands for water to increase significantly. Increasing demands for water in the region are projected to cause ground water levels to decline. Continued development of the SAS as the principal source of future needs may cause adverse impacts to wetlands. Alternative water supply development will be needed to supplement conventional sources of water in the region. Alternative sources include aquifer storage and recovery, use of deeper aquifers with desalination treatment, and the increased use of reclaimed water.

Water Demand Projeotions

Lee County

Lee County's population grew by 40 percent in the decade from 1985 to 1995, from 267,107 in 1985 to 375,238 in 1995 (U.S. Bureau of the Census, 1998). It is anticipated that Lee County will continue to experience growth in demands for both urban and agricultural uses over the projection period. Permanent resident population in Lee County is projected to grow to 594,300 by 2020 (BEBR, 1998).

Public Water Supply

In 1995 a population of 317,451 residents were served by PWS utilities, and this is projected to grow to 517,506 by 2020. As shown in Table V-l-l, this increase in PWS served population had associated demands of 40.20 mgd (14,673 mgy) in 1995. The projected average demands in 2020 are 66.63 mgd (24,320 mgy), and the l-in-10 demands in 2020 are 70.89 mgd (25,875 mgy). Public water supply utility source locations are shown in Figure V-l-l.

Domestic Self-Supply and Small Public Supply Systems

The number of Lee County residents that are self-supplied or served by small public utilities is increasing. This is due in part, to the county's rapid population growth, and in part until recently, to the lack of a comprehensive county utility system. Despite the current availability of such a utility system, there are places in Lee County where utility service is unavailable, and communities built with individual wells continue to supply themselves.

The number of self-supplied users in Lee County is projected to increase from 57,787 in 1995 to 76,794 by 2020. This increase in domestic self-supplied population had associated demands of 5.70 mgd (2,081 mgy) in 1995. The projected average demands in 2020 are 8.64 mgd (3,154 mgy), and the l-in-10 demands in 2020 are 9.18 mgd (3,351 mgy).

Figure V-1-1. Public Water Supply Utility Source Locations in Lee County.

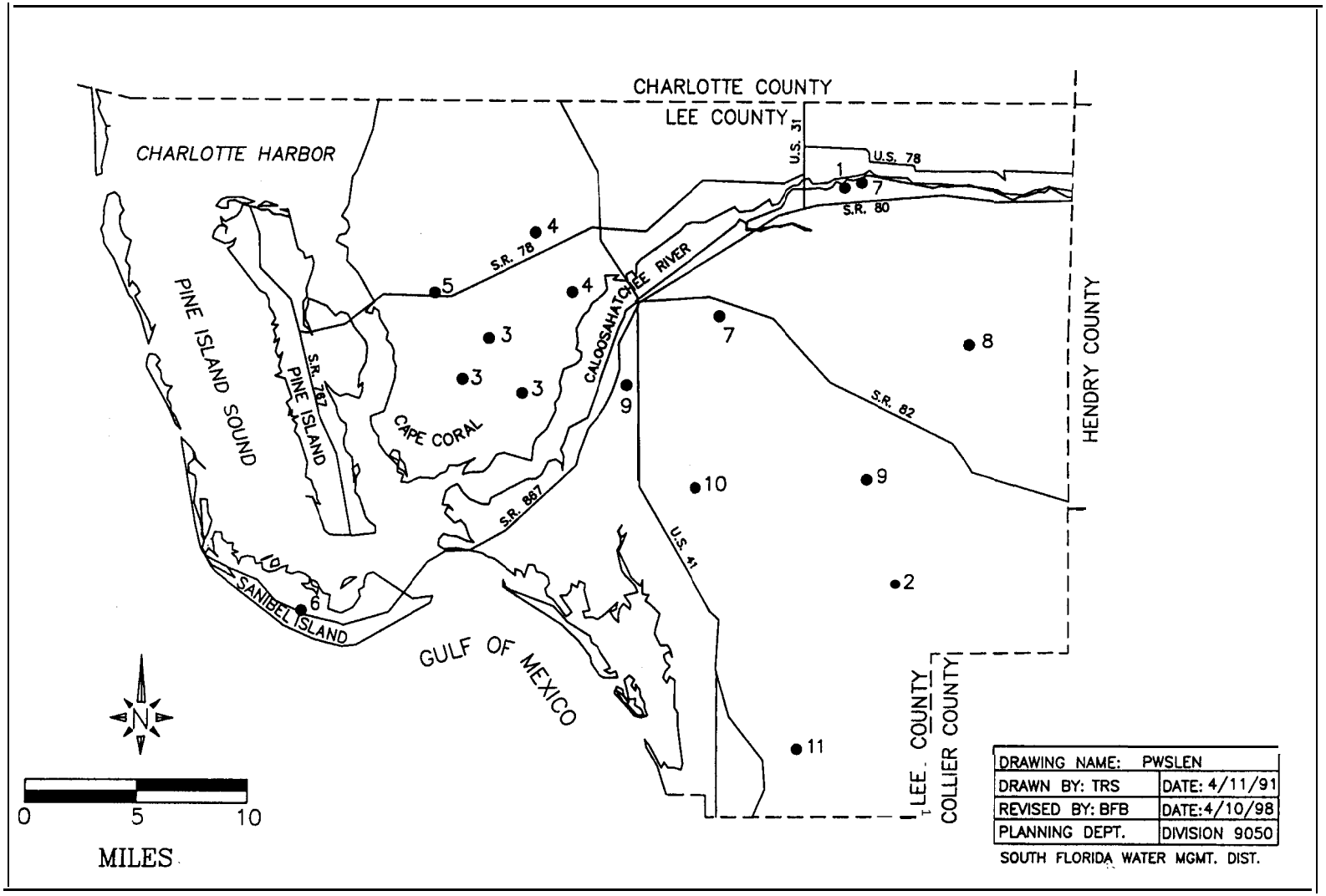


Table V-1-1. Public Water Supplied and Domestic Self-Supplied Demand Projections for Lee County.

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
				PWS				PWS		PWS		DSS	DSS	DSS
		Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
#	Utility	1995	1995	1995	1995	use	factor	1995	factor	1995	1995	1995	1995	1995
1	Lee County Olga	62,143	47,576	3.09	65	35%	1.187	3.29	1.179	3.50	14,567	0.95	1.01	1.07
2	Lee County Corkscrew	35,807	34,795	5.65	162	35%	1.187	6.02	1.179	6.40	1,012	0.16	0.18	0.19
3	Cape Coral Utilities	91,458	73,840	8.62	117	35%	1.187	9.18	1.179	9.76	17,618	2.06	2.19	2.33
4	Fl Cities Waterway	7,559	7,289	0.95	130	35%	1.187	1.01	1.179	1.08	270	0.04	0.04	0.04
5	Greater Pine Island	7,277	6,788	1.25	184	35%	1.187	1.33	1.179	1.42	489	0.09	0.10	0.10
6	Island Water Assoc.	6,121	6,119	2.80	458	50%	1.187	3.06	1.179	3.34	2	0.00	0.00	0.00
7	City of Ft. Myers	44,359	44,031	6.51	148	35%	1.187	6.94	1.179	7.37	328	0.05	0.05	0.05
8	Florida Water Utilities	30,937	21,634	1.27	59	35%	1.187	1.35	1.179	1.44	9,303	0.55	0.58	0.62
9	Fl Cities Green Mead.	41,958	39,374	5.28	134	35%	1.187	5.63	1.179	5.98	2,584	0.35	0.37	0.39
10	Gulf Utilities	19,945	16,682	1.91	114	35%	1.187	2.04	1.179	2.16	3,263	0.37	0.40	0.42
11	Bonita Springs	21,105	19,323	2.87	149	35%	1.187	3.06	1.179	3.25	1,782	0.26	0.28	0.30
	Rural Self Supplied	6,569			127		1.187		1.179		6,569	0.83	0.83	0.83
	Totals	375,238	317,451	40.20				42.91	1.179	45.68	57,787	5.70	6.02	6.35
				PWS				PWS		PWS		DSS	DSS	DSS
		Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
#	Utility	2020	2020	2020	2020	use	factor	2020	factor	2020	2020	2020	2020	2020
1	Lee County Olga	76,991	62,424	4.05	65	35%	1.187	4.32	1.179	4.59	14,567	0.95	1.01	1.07
2	Lee County Corkscrew	44,831	43,819	7.12	162	35%	1.187	7.58	1.179	8.06	1,012	0.16	0.18	0.19
3	Cape Coral Utilities	165,961	148,343	17.32	117	35%	1.187	18.45	1.179	19.61	17,618	2.06	2.19	2.33
4	Fl Cities Waterway	8,215	7,945	1.04	130	35%	1.187	1.10	1.179	1.17	270	0.04	0.04	0.04
5	Greater Pine Island	9,940	9,451	1.74	184	35%	1.187	1.85	1.179	1.97	489	0.09	0.10	0.10
6	Island Water Assoc.	7,031	7,031	3.22	458	50%	1.187	3.52	1.179	3.83	0	0.00	0.00	0.00
7	City of Ft. Myers	57,247	56,919	8.42	148	35%	1.187	8.97	1.179	9.53	328	0.05	0.05	0.05
8	Florida Water Utilities	71,175	61,872	3.63	59	35%	1.187	3.87	1.179	4.11	9,303	0.55	0.58	0.62
9	Fl Cities Green Mead.	53,065	50,481	6.77	134	35%	1.187	7.21	1.179	7.66	2,584	0.35	0.37	0.39
10	Gulf Utilities	36,403	33,140	3.79	114	35%	1.187	4.04	1.179	4.30	3,263	0.37	0.40	0.42
11	Bonita Springs	37,863	36,081	5.36	149	35%	1.187	5.71	1.179	6.07	1,782	0.26	0.28	0.30
	Rural Self Supplied	25,578			127	35%	1.187		1.179		25,578	3.24	3.45	3.67
	Totals	594,300	517,506	62.451				66.63		70.891	76,794	8.11	8.64	9.18

Commercial/Industrial Self-Supply

Commercial/Industrial self-supplied water use is projected to rise with the county population from 1,974 mgy in 1995 to 3,126 mgy by 2020. PWS supplied commercial and industrial demands are included with other public utility demands.

Recreational Self-Supply

The recreational self-supplied demand category includes self-supplied irrigation demands for large landscaped areas (as opposed to private homes) and for golf courses. Self-supplied large landscaped area is projected to increase from 6,076 acres in 1995 to 9,623 acres in 2020. Landscaping self-supplied average demand for Lee County (not counting golf courses) is projected to increase from 7,012 mgy in 1995 to 11,105 mgy by 2020. The l-in-10 irrigation requirements in 2020 are 13,088 mgy.

In 1995, there were 67 golf courses in Lee County. These golf courses had a total irrigated area 6,516 acres. Of the irrigated golf course acreage, 4,332 acres were self-supplied in 1995, and the rest were supplied with reclaimed water from wastewater utilities. Irrigated golf course acreage is projected to increase to 13,335 acres by 2020. If the current (1998) ratio of self-supplied to reuse holds, then 9,260 acres will be self-supplied in 2020. Self-supplied golf acreage in 1995 had average irrigation requirements of 4,999 mgy, and is projected to increase to 10,686 mgy by 2020. The l-in-10 irrigation requirement in 2020 for these self-supplied golf courses is 12,593 mgy.

Combined recreational self-supplied average demands for Lee County are 12,011 mgy in 1995 and 21,791 mgy in 2020. The l-in-10 irrigation requirements in 2020 are 25,681 mgy.

Thermoelectric Power Generation Self-Supply

Thermoelectric power plants use and reuse large quantities of water for cooling purposes. Evaporative losses that must be replaced from an external source above and beyond rainfall and runoff were assessed at 0.77 mgd (281 mgy) for Lee County for 1995, and use is projected to remain at that level through 2020.

Agricultural Self-Supply

The irrigated commercially grown crops in Lee County are citrus, tropical fruit, vegetables, sod, and ornamental nursery. Improved pasture is very seldom irrigated, but there is some use for cattle watering.

Citrus

Citrus acreage in Lee County showed an overall general decline from 1970 to 1984. Since 1984, however, the interregional movement of citrus production from central to southwest Florida has resulted in moderate yet continuous acreage increases. In 1995-6, there were 12,155 acres of citrus in Lee County, up from 6,600 acres in 1984. It is anticipated that growth will continue, and Lee County's citrus production is projected to increase to 16,150 acres by the year 2020. This will mean an increase in the average irrigation requirements from 9,647 mgy in 1995 to 12,817 mgy in 2020. In 2020, the l-in-10 requirements are 15,606 mgy.

Other Fruits and Nuts

In 1995, there were 1,930 acres of tropical fruit production (avocados, mangoes, etc.) in Lee County. Production is forecast to grow to 3,180 acres by the year 2020. This will represent an increase in the average irrigation requirements from 2,102 mgy in 1995 to 3,464 mgy in 2020. In 2020, the l-in-10 requirements are 4,394 mgy.

Vegetables, Melons, and Berries

Vegetable crops grown commercially in Lee County include cucumbers, peppers, tomatoes, squash, watermelons, potatoes, and Latin vegetables. Different types of vegetables are often grown interchangeably. In 1995, there were an assessed 10,689 acres of land used for vegetable production, and this is forecast to increase to 11,758 acres by 2020. This results in an increase in the average irrigation requirements from 6,859 mgy in 1995 to 7,544 mgy in 2020. In 2020, the l-in-10 requirements are 8,685 mgy.

Sod

In 1995 there were 650 acres irrigated for sod production. There are other areas from which sod may be harvested (e.g., pasture), but they are not irrigated. This acreage is projected to remain relatively constant throughout

the projection period, and has average irrigation requirements of, 1,128 mgy, and l-in-10 requirements of 1,330 mgy.

Greenhouse/Nursery

In 1995, there were 1,303 acres of ornamental nursery in Lee County, and this is projected to increase to 2,484 acres by 2020. This represents an increase in average irrigation requirements from 2,261 mgy in 1995 to 4,309 mgy in 2020. In 2020, the l-in-10 requirements are 5,082 mgy.

Miscellaneous

Cattle Watering. In 1995 there were a total of 15,000 total cattle and calves in Lee County (Florida Agricultural Statistics Service, 1997), with no significant amount of these for dairy use. Based on this number the demand for cattle watering is 66 mgy, and is projected to decline to 58 mgy by 2020 as irrigated crops expand onto land that was formerly used as pasture.

Demand Summary

Urban demands in Lee County are projected to grow by 70 percent between 1995 and 2020, and agricultural demand is projected to rise by 33 percent during that period. Total demand is projected to grow by 54 percent, from 53,083 mgy in 1995 to 81,992 mgy in 2020. Urban demands made up 58 percent of the total average demand in 1995, and are projected to make up 64 percent of the total average demands in 2020 (Table V-l-2).

Table V-l-2. Urban and Agricultural Demand for Lee County.

Urban and Agricultural Demands	(a) Assessed 1995 (mgy)	(b) Average 2020 (mgy)	(c) Percent Change (a) to (b)	(d) 1-in-10 2020 (mgy)
Urban				
Public Water Supply	14,673	24,320	66%	25,875
Domestic Self-Supply	2,081	3,154	52%	3,351
Commercial/Industrial Self-Supply	1,974	3,126	58%	3,126
Recreational Self Supply	12,011	21,791	81%	25,681
Thermoelectric Power Generation Self-Supply	281	281	0%	281
Total Urban	**31,020**	**52,672**	**70%**	**58,314**
Agricultural				
Citrus	9,647	12,817	33%	15,606
Other Fruits and Nuts (Tropical Fruit)	2,102	3,464	65%	4,394
Vegetables, Melons, and Berries	6,859	7,544	10%	8,685
Sod	1,128	1,128	0%	1,330
Greenhouse/Nursery	2,261	4,309	91%	5,082
Miscellaneous (Cattle Watering)	66	58	-12%	58
Total Agricultural	**22,063**	**29.320**	**33%**	**35,155**
Total Urban and Agricultural Demands	**53,083**	**81,992**	**54%**	**93,469**

Lee County is experiencing significant growth in population and in irrigated agricultural acreage. Plate 1 outlines the county's 1995 land use. Urban land use is prevalent along the coast, while agriculture largely covers the interior region of the county. Wetlands are found throughout the county, but are more prevalent in the southeast, adjacent to the border with Collier County. Continued growth of urban land use, and to some extent, irrigated agricultural land use, is forecast over the projection period.

Collier County

In the decade from 1985 to 1995, Collier County's population grew by 58 percent, from 115,584 in 1985 to 182,933 in 1995 (U.S. Bureau of the Census, 1998), and is projected to grow by 91 percent to 349,200 by 2020 (BEBR, 1998). Most new residents have settled in the urbanized area along the coast, while agriculture is centered around the Immokalee area in the northern interior part of the county.

Public Water Supply

Population growth in certain public water supply (PWS) service areas, as well as the service area boundaries themselves, has been inconsistent and volatile in Collier County. The PWS served population has risen from 44,000 in 1980 (Woehlcke et al., 1983) to 81,000 in 1985 (Marella, 1988) to 158,708 in 1995, and is projected to grow to 322,919 in 2020. As shown in Table V-l-3, this increase in PWS served population had associated demands of 39.04 mgd (14,250 mgy) in 1995. The projected average demands in 2020 are 82.00 mgd (29,930 mgy), and l-in-10 demands in 2020 are 88.13 mgd (32,167 mgy). Public water supply utility source locations are shown in Figure V-l-2.

Domestic Self-Supply and Small Public Supply Systems

Collier County's domestic self-supplied population was assessed at 24,225 in 1995, and is projected to increase to 26,281 by 2020 (Table V-l-3). This increase in domestic self-supplied population had associated demands of 4.89 mgd (1,785 mgy) in 1995. The projected average demands for 2020 are 5.95 mgd (2,172 mgy), and the l-in-10 demands for 2020 are 6.29 mgd (2,296 mgy).

Commercial/Industrial Self-Supply

Commercial/Industrial self-supplied water use is projected to rise with the county population from 2,181 mgy in 1995 to 4,163 mgy by 2020. PWS supplied commercial and industrial demands are included with other public utility demands.

Figure V-1-2. Public Water Supply Utility Source Locations in Collier County.

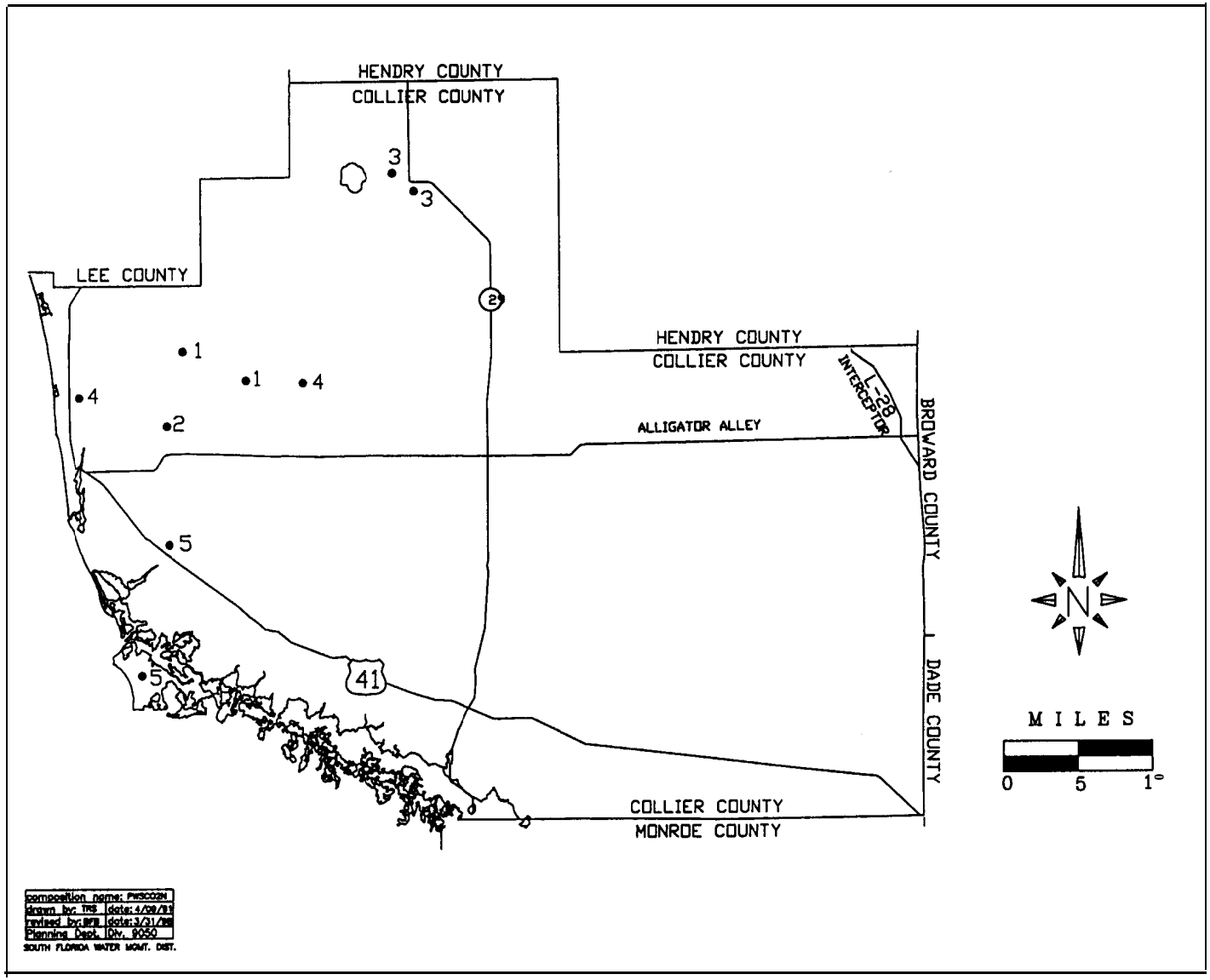


Table V-1-3. Public Water Supplied and Domestic Self-Supplied Demand Projections for Collier County.

a	b	c	d	e	f	g	h	I	j	k	l	m	n	o
				PWS				PWS		PWS		DSS	DSS	DSS
		Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
#	Utility	1995	1995	1995	1995	use	factor	1995	factor	1995	1995	1995	1995	1995
1	Collier County Utilities	81,588	74,707	14.72	197	50%	1.242	16.50	1.136	17.62	6,881	1.36	1.52	1.62
2	Fl Cities Water	15,188	8,698	1.09	125	50%	1.242	1.22	1.136	1.31	6,490	0.81	0.91	0.97
3	Immokalee	21,448	21,281	2.49	117	35%	1.242	2.70	1.136	2.83	167	0.02	0.02	0.02
4	Naples	44,000	43,493	15.24	350	65%	1.242	17.63	1.136	19.20	507	0.18	0.21	0.22
5	SSU Marco Island	10,603	10,529	5.50	522	65%	1.242	6.36	1.136	6.93	74	0.04	0.04	0.05
	Rural Self Supplied	10,106			246	35%	1.2421		1.1361		10,106	2.49	2.701	2.82
	Totals	182,933	158,708	39.04				44.42		47.89	24,225	4.89	5.40	5.72
				PWS				PWS		PWS		DSS	DSS	DSS
		Total	PWS	base		Percent		average		I-in-10	DSS	base	average	I-in-10
		population	population	MGD	GPCD	outdoor	Average	MGD	1-in-101	MGD	population	MGD	MGD	MGD
#	Utility	2020	2020	2020	2020	use	factor	2020	factor	2020	2020	1995	2020	2020
1	Collier County Utilities	189,415	182,534	35.97	197	50%	1.242	40.31	1.136	43.06	6,881	1.36	1.52	1.62'
2	Fl Cities Water	19,612	13,122	1.64	125	50%	1.242	1.84	1.136	1.97	6,490	0.81	0.91	0.97
3	Immokalee	53,772	53,605	6.27	117	35%	1.242	6.80	-1.136	7.13	167	0.02	0.02	0.02
4	Naples	58,206	57,699	20.22	350	65%	1.242	23.39	1.136	25.47	507	0.18	0.21	0.22
5	SSU Marco Island	16,033	15,959	8.34	522	65%	1.242	9.65	1.136	10.50	74	0.04	0.04	0.05
	Rural Self Supplied	12,162			246	35%	1.242		1.136		12,162	2.99	3.24	3.40
	Totals	349,200	322,919	72.44				82.00		88.13	26,281	5.40	5.95	6.29

Recreational Self-Supply

The recreational self-supplied demand category includes self-supplied irrigation demands for large landscaped areas (as opposed to private homes) and for golf courses. Self-supplied large landscaped area is projected to increase from 7,527 acres in 1995 to 14,368 acres in 2020. Landscaping self-supplied average demand for Collier County (not counting golf courses) is projected to increase from 10,093 mgy in 1995 to 19,267 mgy by 2020. The l-in-10 irrigation requirements in 2020 are 21,896 mgy.

In 1995, there were 59 golf courses in Collier County. These golf courses had a total irrigated area of 8,766 acres. Of the irrigated golf course acreage, 4,883 acres were self-supplied in 1995, and the rest were supplied with reclaimed water from wastewater utilities. Irrigated golf course acreage is projected to increase to 19,583 acres by 2020. If the current (1998) ratio of self-supplied to reuse holds, it is estimated the 10,560 acres will be self-supplied in 2020. Self-supplied golf acreage in 1995 had average irrigation requirements of 6,548 mgy, and is projected to increase to 14,161 mgy by 2020. The l-in-10 irrigation requirement in 2020 for these self-supplied golf courses is 16,093 mgy.

Combined recreational self-supplied average demands for Collier County are 16,641 mgy in 1995 and 33,428 mgy in 2020. The l-in-10 irrigation requirements in 2020 are 37,990 mgy.

Agricultural Self-Supply

The irrigated commercially grown crops in Collier County are citrus, vegetables, and greenhouse/nursery. Improved pasture is very seldom irrigated, but there are some demands for cattle watering.

Citrus

The citrus planting rates in Collier County from 1986 to 1992 were at historically high levels, associated with the inter-regional movement of citrus production from central to southwest Florida. This movement was initiated by several severe freezes in central Florida during the 1980s. Citrus acreage growth has since slowed significantly due to a period of low prices.

In 1995-6, there were 36,583 acres of citrus in Collier County. Although the growth rate has slowed, Collier County's citrus production is projected to increase to 49,384 acres by the year 2020. This growth in acreage represents an increase in the average irrigation requirements from 29,818 mgy in 1995 to 40,252 mgy in 2020. The l-in-10 irrigation requirement for citrus in 2020 is 44,729 mgy.

Vegetables, Melons, and Berries

Vegetable crops grown commercially in Collier County include cucumbers, peppers, tomatoes, squash, watermelons, and potatoes. Different types of vegetables are often grown interchangeably. In 1995, there were 32,200 acres of land used for vegetable production, with an average irrigation requirement of 19,368 mgy. Vegetable acreage in Collier County is forecast to increase to 35,420 acres by 2020, with average irrigation requirements of 21,304 mgy. The l-in-10 irrigation requirement for vegetables in 2020 is 25,305 mgy.

Greenhouse/Nursery

In 1995, there were 1,288 acres of ornamental nursery in Collier County. This is projected to increase to 1,965 acres by the year 2020. This growth means an increase in average irrigation requirements from 2,359 mgy in 1995 to 3,599 mgy in 2020. The l-in-10 irrigation requirement for nursery in 2020 is 4,218 mgy.

Miscellaneous

Cattle Watering. In 1995, there were a total of 14,500 total cattle and calves in Collier County, with no significant amount of these for dairy use (FASS, 1997). Based on this number of beef cattle, the demand for cattle watering was 64 mgy in 1995, and is projected to decline to 46 mgy by 2020 as irrigated crops are planted on land that was formerly used as pasture.

Aquaculture. Aquacultural operations withdraw water for circulation purposes and to replace evaporative losses. The replacement amount was assessed for Collier County as 376 mgy in 1995. Demand is projected to remain at the 1995 level through 2020.

Demand Summary

Urban demands are projected to grow by 100 percent between 1995 and 2020, and agricultural demand is projected to rise by 26 percent during that period (Table V-l-4). Total demand is projected to grow by 56 percent, from 86,841 mgy in 1995 to 135,270 mgy in 2020.

Agricultural irrigation demands made up 60 percent of the total average demand in 1995, and is projected to have 48 percent of the total average demand in 2020. Growth in citrus acreage is projected to be the main component of increasing agricultural demands through the year 2020.

Table V-l-4. Urban and Agricultural Demand for Collier County.

Urban and Agricultural Demands	(a) Assessed 1995 (mgv)	(b) Average 2020 (mgv)	(c) Percent Change (a) to (b)	(d) 1 -in-l 0 2020 (mgv)
Urban				
Public Water Supply	14,250	29,930	110%	32,167
Domestic Self-Supply	1,785	2,172	22%	2,296
Commercial/Industrial Self-Supply	2,181	4,163	91%	4,163
Recreational Self Supply	16,641	33,428	101%	37,990
Total Urban	**34,856**	69,693	100%	76,616
Agricultural				
Citrus	29,818	40,252	35%	**44,729**
Vegetables, Melons, and Berries	19,368	21,304	10%	25,305
Greenhouse/Nursery	2,359	3,596	53%	4,218
Miscellaneous (Cattle Watering, Aquaculture)	440	422	-4%	422
Total Agricultural	**51,985**	65,577	26%	74,674
Total Urban and Agricultural Demands	**86,841**	**135,270**	56%	151,290

Forty-one percent of Collier County is publicly owned and set aside for environmental purposes. A significant amount of additional land has also been proposed for land acquisition under the District's Save Our Rivers program. Collier County's land use is shown in Plate 1. All of Collier County's urban and agricultural demands are in the portion of the county in the Lower West Coast Planning Region.

Western Hendry County

Hendry County is divided between the Lower West Coast Planning Region (Western Hendry County) and Lower East Coast Planning Region (Eastern Hendry County). Demand estimates and projections are presented in this section for Western Hendry County, which is shown in Plate 1.

Hendry County's population has increased by 32 percent from 22,393 in 1985 to 29,587 in 1995 (U.S. Bureau of the Census, 1998), and is projected to grow to 42,700 by 2020 (BEBR, 1998). Hendry County is one the fastest growing counties in agricultural production in Florida, especially in citrus. It is anticipated that future growth in citrus acreage will take place, but at a much slower rate than was experienced during the 1984 to 1994 period.

Public Water Supply

Of the total 1995 population of 29,587 in Hendry County, 27,714 (94%) were in the western portion of the county. Of these, 18,617 were served by public utilities. There are two public utilities in Western Hendry County. The utility serving the City of Clewiston is owned by the U.S. Sugar Corporation, and also provides industrial water for sugarcane processing. The demands for these utilities totaled 3.84 mgd (1,402 mgy) in 1995 (Table V-l-5). The population served by these utilities is projected to grow to 28,365 by 2020, with average demands of 5.98 mgd (2,183 mgy), and l-in-10 demands of 6.33 mgd (2,310 mgy). Public water supply utility source locations are shown in Figure V-l-3.

Domestic Self-Supply and Small Public Supply Systems

The self-supplied population in Western Hendry County for 1995 was assessed at 9,097, and is forecast to increase to 11,634 in 2020 (Table V-l-5). Associated domestic self-supplied demands are projected to grow from 1.67 mgd (610 mgy) in 1995 to an average demand of 2.27 mgd (829 mgy) in 2020. The l-in-10 demands for 2020 are 2.41 mgd (880 mgy).

Figure V-1-3. Public Water Supply Utility Source Locations in Western Hendry County.

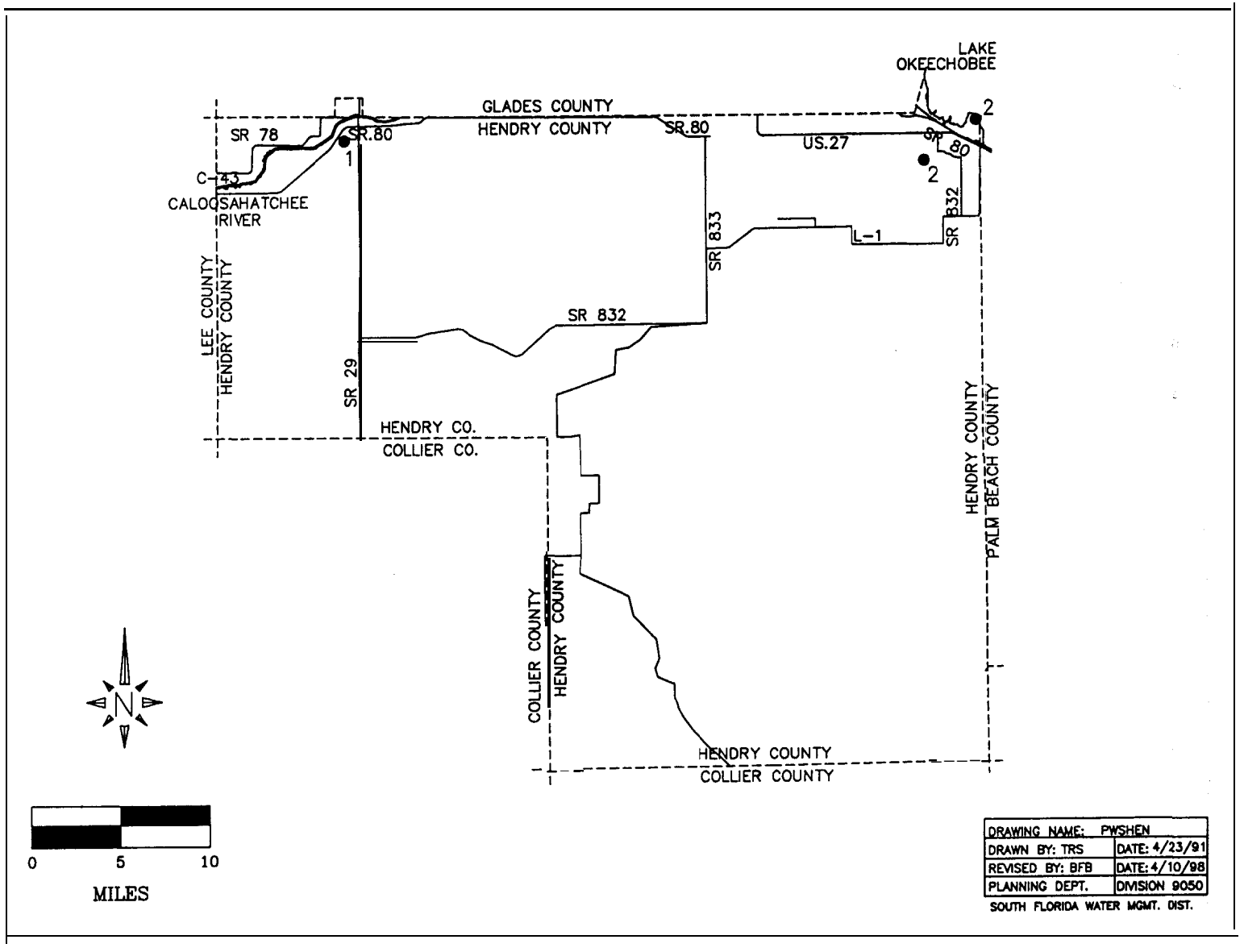


Table V-1-5. Public Water Supplied and Domestic Self-Supplied Demand Projections for Western Hendry County.

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
				PWS				PWS		PWS		DSS	DSS	DSS
		Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
#	Utility	1995	1995	1995	1995	use	factor	1995	factor	1995	1995	1995	1995	1995
1	LaBelle	7,544	4,803	0.59	123	35%	1.111	0.613	1.166	0.649	2,741	0.34	0.35	0.37
2	Clewiston	14,446	13,814	3.25	235	35%	1.111	3.376	1.166	3.573	632	0.15	0.15	0.16
	Rural Self Supplied	5,724			206	35%	1.111		1.166		5,724	1.18	1.23	1.30
	Totals	27,714	18,617	3.84				3.99		4.22	9,097	1.67	1.73	1.83
				PWS				PWS		PWS		DSS	DSS	DSS
		Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
#	Utility	2020	2020	2020	2020	use	factor	2020	factor	2020	2020	2020	2020	2020
1	LaBelle	10,888	8,147	1.00	123	35%	1.111	1.040	1.166	1.100	2,741	0.34	0.35	0.37
2	Clewiston	20,850	20,218	4.76	235	35%	1.111	4.942	1.166	5.229	632	0.15	0.15	0.16
	Rural Self Supplied	8,261			206	35%	1.111		1.166		8,261	1.70	1.77	1.87
	Totals	39,999	28,365	5.76				5.98		6.33	11,634	2.19	2.27	2.41

Recreational Self-Supply

In 1995, there were two golf courses in Western Hendry County, which have a combined irrigated area of 252 acres. Irrigated golf course acreage is forecast to remain constant through 2020, with associated average irrigation requirements of 267 mgy, and l-in-10 irrigation requirements of 311 mgy.

Agricultural Self-Supply

The irrigated commercially grown crops in Western Hendry County are citrus, sugarcane, vegetables, and greenhouse/nursery. Pasture is very seldom irrigated, but there are some demands for cattle watering.

Citrus

In 1995-6, Hendry County had more citrus trees than any other county in Florida. Due to a higher density planting, Hendry County in 1995-6 was third in acreage in Florida, behind St. Lucie and Polk counties. Citrus planting continues in Hendry County, although at a much lower rate than was observed between 1986 and 1994, when acreage grew from 40,269 acres to 98,604 acres. This boom was associated with the interregional movement of citrus from central to southwest Florida following the severe freezes the mid-1980s.

About 72 percent of the citrus acreage in Hendry County in 1995-6 was in the western portion, and this ratio has been used to distribute the projected county acreage. Western Hendry County's citrus acreage is projected to grow from 71,834 acres in 1995 to 81,909 acres by 2020. This increase in acreage has average irrigation requirements of 55,608 mgy in 1995 and 63,406 mgy in 2020. The l-in-10 irrigation requirement for 2020 is 75,620 mgy.

Vegetables, Melons, and Berries

Vegetable crops grown commercially in Western Hendry County include cucumbers, peppers, tomatoes, watermelons, squash, and eggplant. Different types of vegetables are often grown interchangeably. In 1995, there were about 5,600 acres of land used for vegetable production, and production is projected to grow to 6,160 acres by 2020. Vegetable acreage in 1995 had irrigation requirements of 3,303 mgy and projected 2020 acreage has average

irrigation requirements of 3,633 mgy. The l-in-10 irrigation requirements in 2020 are 4,102 mgy.

Field Crops

Sugarcane. In 1995, there were 72,333 acres of sugarcane (for sugar and seed) in Hendry County and production is projected to remain at that level through 2020. About 49 percent of the sugarcane acreage in Hendry County in 1995 were in the western portion. This ratic has been used to distribute the projected county acreage.

Because of the production practices used for sugarcane (ratoon and fallow), there is an additional 25 percent of land used for sugarcane production which is idle in any given year. Sugarcane acreage in Western Hendry County is projected to stay at about its 1995 level of 36,167 acres through 2020. This acreage has average irrigation requirements of 47,614 mgy and l-in-10 requirements of 56,793 mgy.

Greenhouse/Nursery

In 1995, there were 800 acres of ornamental nursery in Western Hendry County, and this is projected to increase to 1,428 acres by the year 2020. In addition to the ornamental nursery surveyed by the Division of Plant Industry, there were a total of 1,000 acres of cut flowers. The combined acreage for greenhouse/nursery production in Western Hendry County is projected to grow from 1,800 acres in 1995 to 2,428 acres in 2020. This represents an increase in average irrigation requirements from 3,062 mgy in 1995 to 4,129 mgy in 2020. The l-in-10 irrigation requirement in 2020 is 4,780 mgy.

Miscellaneous

Cattle Watering. In 1995, Hendry County had 109,000 non-dairy cattle (Florida Agricultural Statistics Service, 1997). From District land use maps (for pasture and rangeland), it was assessed that 42 percent of the cattle in Hendry County were in the western portion in 1995. The 1995 water demand assessment for cattle watering is 201 mgy, and this is projected to decline to 179 mgy by 2020 as irrigated crops are planted on some areas of land formerly used for pasture.

Demand Summary

Urban demands are projected to remain low throughout the projection period in Western Hendry County. As agricultural water demands make up between 97 and 98 percent of the total demand over the projection period. Citrus irrigation demands make up about half of the agricultural requirements through the year 2020. Demand is projected to grow by 9 percent, from 112,066 mgy in 1995 to average demands of 122,239 mgy in 2020 (Table V-l-6).

Table V-l-6. Urban and Agricultural Demand for Western Hendry County.

Urban and Agricultural Demands	(a) Assessed 1995 (mgy)	(b) Average 2020 (mgy)	(c) Percent Change (a) to (b)	(d) l-in-10 2020 (mgy)
Urban				
Public Water Supply	1,402	2,183	56%	2,310
Domestic Self-Supply	610	829	36%	880
Recreational Self-Supply	267	267	0%	311
Total Urban	2,278	3,278	44%	3,501
Agricultural				
Citrus	55,608	63,406	14%	75,620
Vegetables, Melons, and Berries	3,303	3,633	10%	4,102
Field Crops (Sugarcane)	47,614	47,614	0%	56,793
Greenhouse/Nursery	3,062	4,129	35%	4,780
Miscellaneous (Cattle Watering)	201	179	-11%	179
Total Agricultural	**109,788**	**118,961**	**8%**	**141,474**
Total Urban and Agricultural Demands	**112,066**	**122,239**	**9%**	**144,975**

The 1995 land use for Western Hendry County is shown in Plate 1. Agriculture is the predominant land use throughout Western Hendry County. The only urban areas are in the vicinity of Clewiston and LaBelle. Wetlands are found throughout the county, but are more evident in the south-central part of the county, in proximity to the Collier County border.

Southern Glades County

Glades County is rural and sparsely populated. There are only two counties in Florida (Lafayette and Liberty) which have fewer residents. The county is divided between the Lower West Coast Planning Region (Southern Glades County) shown in Plate 1, and Kissimmee Basin Planning Region (Northern Glades County) shown in Plate 4. Demand estimates and projections are presented here for Southern Glades County. Southern Glades County's population was assessed at 4,409 in 1995 and is projected to grow to 7,560 by 2020 (Table V-l-7). The only existing or anticipated urban use in Southern Glades County is for one utility, domestic self-supply, and for one golf course.

Public Water Supply

Southern Glades County's PWS served population is projected to grow from 2,122 in 1995 to 3,710 in 2020 (Table V-l-7). PWS demand was measured at 0.27 mgd (99 mgy) in 1995, and based on the projected population served by the public utility, is forecast to have average demands of 0.50 mgd (183 mgy) in 2020, and have 2020 l-in-10 demands of 0.53 mgd (193 mgy). Public water supply utility source locations are shown in Figure V-l-4.

Domestic Self-Supply and Small Public Supply Systems

About half of Southern Glades County's population is self-supplied and this is projected to grow from 2,287 in 1995 to 3,850 in 2020 (Table V-l-7). Self-supplied demand was assessed to be 0.29 mgd (106 mgy) in 1995 and is forecast to rise to 0.52 mgd (190 mgy) by 2020. The l-in-10 demands in 2020 are 0.55 mgd (201 mgy).

Recreational Self-Supply

In 1995, the only recreational self-supplied demand in Southern Glades County was irrigation of one golf course. This is projected to remain the case through 2020. This golf course has 20 irrigated acres and associated average irrigation requirements of 24 mgy, and l-in-10 irrigation requirements of 28 mgy.

Figure V-1-4. Public Water Supply Utility Source Locations in Southern Glades County.

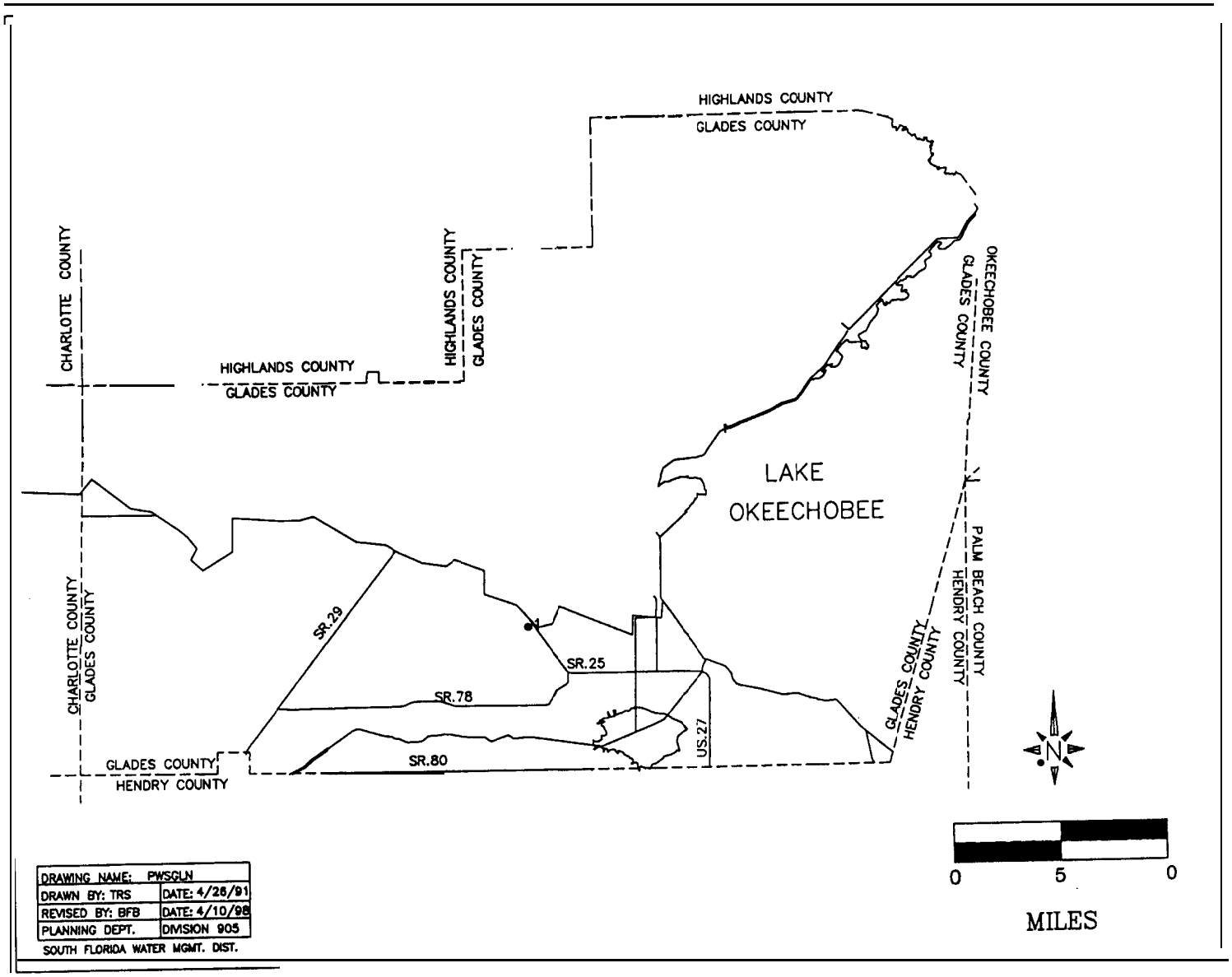


Table V-1-7. Public Water Supplied and Domestic Self-Supplied Demand Projections for Southern Glades County.

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
				PWS				PWS		PWS		DSS	DSS	DSS
		Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
#	Utility	1995	1995	1995	1995	use	factor	1995	factor	1995	1995	1995	1995	1995
1	City of Moore Haven	2,222	2,122	0.27	127	35%	1.182	0.29	1.163	0.30	100	0.01	0.01	0.01
	Rural Self Supplied	2,187	0	0.00	127	35%	1.182	0.00	1.163	0.00	2,187	0.28	0.30	0.31
	Total	4,409	2,122	0.27				0.29		0.30	2,287	0.29	0.31	0.33
				PWS				PWS		PWS		DSS	DSS	DSS
		Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
#	Utility	2020	2020	2020	2020	use	factor	2020	factor	2020	2020	2020	2020	2020
1	City of Moore Haven	3,810	3,710	0.47	127	35%	1.182	0.50	1.163	0.53	100	0.01	0.01	0.01
	Rural Self Supplied	3,750	0	0.00	127	35%	1.182	0.00	1.163	0.00	3,750	0.48	0.51	0.54
	Total	7,560	3,710	0.47				0.50		0.53	3,850	0.49	0.52	0.55

Agricultural Self-Supply

The irrigated commercially grown crops in Southern Glades County are citrus, vegetables, field crops (sugarcane), and greenhouse/nursery. Pasture is very seldom irrigated, but there is some demand for cattle watering.

Citrus

Citrus acreage in Glades County was relatively constant from 1966 to 1978, ranging from 1,413 and 1,661 acres. From 1978 to 1995-6, however, acreage has continuously increased, from 1,613 acres in 1978 to 9,402 acres in 1995-6. This increase in acreage is associated with the inter-regional movement of citrus from central to southwest Florida following the severe freezes in the mid-1980s.

Citrus acreage in the southern portion of the county (Southern Glades County) is projected to grow from 4,889 acres in 1995 to 9,122 acres by 2020. This increase in acreage has average irrigation requirements of 4,060 mgy in 1995 and 7,576 mgy in 2020. The l-in-10 irrigation requirement for citrus in 2020 is 9,072 mgy.

Vegetables, Melons, and Berries

In 1995, there were 473 acres used for vegetable production in Southern Glades County, and the forecast is for production to stay at that level throughout 2020. This acreage has an average irrigation requirement of 286 mgy, and l-in-10 irrigation requirements of 328 mgy.

Field Crops

Sugarcane. In 1995, there were 19,633 acres of sugarcane (for sugar and seed) in Glades County. Of this acreage, 16,295 acres (83%) were in Southern Glades County, and production is projected to grow to 21,880 acres by 2020. Average irrigation requirements are 23,129 mgy for 1995 and 31,055 mgy for in 2020. The l-in-10 demands in 2020 are 37,193 mgy.

Rice. Rice in Southern Glades County is grown during the summer months in rotation with sugarcane or winter vegetables, and takes place on land that would otherwise be fallow. Rice acreage in Southern Glades County was assessed at 200 acres in 1995, and is projected to increase to 800 acres by

2020. Average demands are 175 mgy for 1995 and 699 mgy for in 2020.. The l-in-10 demands in 2020 are 775, mgy.

Greenhouse/Nursery

In 1995, there were 1,431 acres of ornamental nursery in Glades County; all in the southern portion of the county. Nursery acreage is projected to increase to 2,641 acres by the year 2020. This represents an increase in average irrigation requirement from 2,579 mgy in 1995 to 4,760 mgy in 2020. The l-in-10 irrigation requirement for nursery in 2020 is 5,539 mgy.

Miscellaneous

Cattle Watering. In 1995, Glades County had 76,000 cattle, all non-dairy (Florida Agricultural Statistics Service, 1997). From District land use maps (for pasture and rangeland), it was assessed that one-third of the cattle in Glades County were in the southern portion in 1995. The 1995 water demand assessment for cattle watering is 111 mgy, and this is projected to decline to 93 mgy by 2020 as some land formerly used for pasture is used for irrigated crops.

Demand Summary

Urban demands are projected to remain at an extremely low level in Southern Glades County through 2020. Agricultural demand is projected to rise by 47 percent during that period. Total average demand is projected to grow by 47 percent, from 30,568 mgy in 1995 to 44,865 mgy in 2020 (Table V-l-8). Agricultural irrigation demands make up practically all (99 percent) of the total demand over the projection period.

Table V-l-8. Urban and Agricultural Demand for Southern Glades County.

Urban and Agricultural Demands	(a) Assessed 1995 (mgy)	(b) Average 2020 (mgy)	(c) Percent Change (a) to (b)	(d) 1-in-10 2020 (mgy)
Urban				
Public Water Supply	99	183	85%	193
Domestic Self-Supply	106	190	79%	201
Recreational Self Supply	24	24	0%	28
Total Urban	**228**	**396**	**74%**	**422**
Agricultural				
Citrus	4,060	7,576	87%	9,072
Vegetables, Melons, and Berries	286	286	0%	328
Field Crops (Sugarcane, Rice)	23,304	31,754	36%	37,968
Greenhouse/Nursery	2,579	4,760	85%	5,539
Miscellaneous (Cattle Watering)	111	93	-16%	93
Total Agricultural	**30,340**	**44,469**	**47%**	**53,000**
Total Urban and Agricultural Demands	**30,568**	**44,865**	**47%**	**53,422**

Southern Glades County is essentially agricultural, as shown in Plate 1. In recent years, there has been an increase in the acreage of irrigated crops. These crops are usually planted on land that was formerly used for non-irrigated pasture. Wetlands, upland forests, and rangeland areas are more prevalent in the western portion of the county, and there are very few urban areas.

Southeastern Charlotte County

Charlotte County is divided between the Southwest Florida Water Management District and the South Florida Water Management District (Plate 1). Thirty-four percent of the county is in the SFWMD, but less than one percent of the county's population. The only existing or anticipated urban use in Southeastern Charlotte County is domestic self-supply for the few residents (Table V-l-9).

Domestic Self-Supply and Small Public Supply Systems

Charlotte County had 128,969 permanent residents in 1995 (Bureau of the Census, 1998), and this is projected to rise to 210,700 by 2020 (Bureau of Economic and Business Research, 1998). Only 0.5 percent of the county's population are in the SFWMD portion of the county. Southeastern Charlotte County had a population of 645 in 1995, and is projected to have 1,746 residents by 2020. The corresponding domestic self-supplied demands are equal to 0.08 mgd (29 mgy) in 1995, and average demands of 0.23 mgd (84 mgy) in 2020. The l-in-10 demands for 2020 are 0.24 mgd (88 mgy).

Agricultural Self-Supply

The irrigated commercially grown crops in the Southeastern Charlotte County are citrus, vegetables and field crops. Improved pasture is very seldom irrigated and an insignificant amount of water is used for cattle watering.

Citrus

Citrus acreage in Charlotte County was relatively constant from 1968 to 1982 (fluctuating between 6,100 and 6,700 acres). Since 1982, however, acreage has continuously increased from 6,100 acres to 21,183 acres in 1995-6. This large increase in acreage is associated with the inter-regional movement of citrus acreage southward from central Florida, following the severe freezes of the mid-1980s.

Table V-I-9. Public Water Supplied and Domestic Self-Supplied Demand Projections for Southeastern Charlotte County.

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
				PWS				PWS		PWS		DSS	DSS	DSS
		Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
		1995	1995	1995	1995	use	factor	1995	factor	1995	1995	1995	1995	1995
	Rural Self Supplied	645	0	0.00	125	35%	1.111	0.00	1.166	0.00	645	0.08	0.08	0.09
	Total	645	0	0.00				0.00		0.00	645	0.08	0.08	0.09
				PWS				PWS		PWS		DSS	DSS	DSS
		Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
		2020	2020	1995	2020	use	factor	2020	factor	2020	2020	1995	2020	2020
	Rural Self Supplied	1,746	0	0.00	125	35%	1.111	0.00	1.166	0.00	1,746	0.22	0.23	0.24
	Total	1,746	0	0.00				0.00		0.00	1,746	0.22	0.23	0.24

About 15 percent of the citrus in Charlotte County lies -within the SFWMD boundaries. The 1995, estimate for Southeastern Charlotte Area citrus acreage was 3,177 acres, and this is projected to grow to 4,601 acres by 2020. The increase in acreage represents an increase in average irrigation requirements from 2,460 mgy in 1995 to 3,562 mgy in 2020. The l-in-10 irrigation requirements of citrus in 2020 is equal to 4,248 mgy.

Vegetables, Melons, and Berries

Vegetable crops produced commercially in Southeastern Charlotte County include snap beans, peppers, tomatoes, potatoes, and watermelons. There were 2,306 acres of land used for vegetable production in 1995, and production is forecast to remain at that level through 2020. This acreage has average irrigation requirements of 1,360 mgy, and l-in-10 year drought irrigation requirements of 1,535 mgy.

Field Crops

Field crop production in Southeastern Charlotte County varies from year to year, based primarily on the demand for seed corn, which in turn is dependent on seed corn production in other parts of the country. This variation in production is more of a fluctuation than a trend.

The estimate for field crop acreage in Southeastern Charlotte County included 2,100 acres of seed corn production and 1,000 acres of soybeans. While fluctuations are anticipated, the magnitude of this acreage is typical. These combined acreages have average irrigation requirements of 1,782 mgy, and l-in-10 year drought irrigation requirements of 2,020 mgy.

Demand Summary

Urban demands make up only one percent of the total demands for the region over the projection period. Practically all the non-environmental demands are for agricultural irrigation, which is forecast to increase by 20 percent (Table V-1-10).

Table V-1-10. Urban and Agricultural Demand for Southeastern Charlotte County.

Urban and Agricultural Demands	(a) Assessed 1995 (mgy)	(b) Average 2020 (mgy)	(c) Percent Change (a) to (b)	(d) I-in-10 2020 (mgy)
Urban				
Domestic Self-Supply	29	84	190%	88
Total Urban	**29**	**84**	**190%**	**88**
Agricultural				
Citrus	2,460	3,562	45%	4,248
Vegetables, Melons, and Berries	1,360	1,360	0%	1,535
Field Crops (Seed Corn, Soybeans)	1,782	1,782	0%	2,020
Total Agricultural	**5,802**	**8,704**	**20%**	**7,803**
Total Urban and Agricultural Demands	**5,631**	**6,788**	**21%**	**7,891**

Land uses for Southeastern Charlotte County are shown on Plate 1. This area is a mixture of agriculture, wetlands, upland forest and rangeland.

Source Evaluation

Overview of Hydrologic System

Lee County

Surface Water

The Caloosahatchee River (C-43) is the largest source of surface water in Lee County. It is supplied by inflows from Lake Okeechobee and runoff from within its own basin. As a result, water levels in the river are low during dry times, when demand is highest and the river is almost entirely dependent on Lake Okeechobee. During the rainy season however, when demands are minimal, enormous volumes of excess water are discharged into the Gulf of Mexico.

The Caloosahatchee is heavily allocated; nearly every landowner along its banks is permitted to withdraw water for agricultural irrigation. Fort Myers uses water from the Caloosahatchee to recharge its water table wellfield, and the county treats and distributes river water directly for public water supply. During drought periods, an additional 30,000 to 60,000 acre-feet of Lake Okeechobee water is needed to flush the river and push the saltwater front away from utility intakes. Finally, homeowners in Fort Myers use the water to irrigate their lawns.

Ground Water

Ground water is the predominant source of supply to public utilities and agricultural users not adjacent to the Caloosahatchee River. There are three aquifer systems in Lee County: the Floridan (FAS), Intermediate (IAS), and Surficial (SAS) (Table V-l-11).

Although the FAS is capable of high yields, it produces only nonpotable water within Lee County. The quality of water in the FAS deteriorates to the south, increasing in salinity and hardness. Salinity also increases as a function of depth, making the deeper producing zones less suitable for development than those zones near the top of the system. Floridan water requires desalination treatment to be acceptable for potable uses. Currently, only four utilities (the City of Cape Coral, Florida Cities, Greater Pine Island,

and Sanibel Island Water Association) obtain water from the FAS. Elsewhere it supplies only a few agricultural irrigation wells.

Table V-l-11. Ground Water Systems in Lee County.

Hydrogeologic System	Hydrogeologic Unit	Thickness (feet)	Water Resource Potential
Surficial Aquifer System	Water Table Aquifer	20-80	Yields moderate amounts of high quality water, but already heavily allocated. Susceptible to saltwater intrusion near the coast.
	Lower Tamiami Aquifer	o-1 40	Absent from northern Lee County. Where present, yields moderate-to-large amounts of high quality water. Susceptible to saltwater intrusion near the coast.
Intermediate Aquifer System	Sandstone Aquifer	O-110	Yields large quantities of good quality water in south central Lee County, but is absent in the north and east.
	Mid-Hawthorn Aquifer	40-120	Yields small quantities of good quality water in Cape Coral and north of C-43. Elsewhere suitable only for micro-irrigation uses.
Floridan Aquifer System	Lower Hawthorn/ Suwanee Aquifer	Insuff icient Data	Capable of high yields, but requires desalination treatment. Some zones may be suitable for use in aquifer storage and recovery.

The IAS contains two sub-units, which can yield small-to-moderate quantities of water in certain parts of the county. The first subunit, the mid-Hawthorn aquifer, occurs throughout Lee County, but is not extensively used due to poor productivity. In addition to low productivity, the aquifer experiences a general degradation in water quality to the south and east. Isolated areas of high salinity also occur along the coast. This aquifer formerly provided all of the water for the City of Cape Coral and the Greater Pine Island water utility. However, its limited water-producing characteristics made it an unreliable source. Today, the greatest use of the mid-Hawthorn is for domestic irrigation in Cape Coral and southwest Fort Myers, domestic self-supply in areas of Cape Coral not served by city water, and for small water utilities north of the Caloosahatchee River. Elsewhere, the aquifer is used only occasionally for agricultural irrigation.

The second subunit, the sandstone aquifer, provides large- quantities of water for both potable and irrigation uses in the south central portion of.Lee County. The aquifer becomes thinner and less productive as it dips to the west, disappearing altogether just east of Cape Coral. The aquifer provides all of the water withdrawn by the Lehigh Acres public water supply wellfield and a portion of the water withdrawn by the Corkscrew and Green Meadows wellfields. In addition, the aquifer supplies several large agricultural properties. In south and central Lee County, the sandstone aquifer water is of potable quality, but it becomes increasingly saline to the east and south.

The SAS can be divided into two aquifers, the water table and lower Tamiami, separated by leaky confining beds. In northern Lee County, where the confining beds are absent or insignificant, the lower Tamiami is not a separate aquifer, but a part of the unconfined water table aquifer. Except for isolated areas with high iron content, water quality is generally very good, but both aquifers are susceptible to saltwater intrusion. The surficial aquifer is heavily allocated in Lee County. Five major public water suppliers, Lee County Utilities (Corkscrew wellfield), Gulf Utilities, Florida Cities (Green Meadows wellfield), the City of Fort Myers, and Bonita Springs, all pump water from the Surficial Aquifer System. The system also furnishes irrigation water for many uses, including vegetables, nurseries, and landscaping.

Collier County

Surface Water

There are no major sources of surface water available in Collier County. Although the county possesses an extensive network of drainage canals, they receive no water from outside their own drainage basins. The entire canal system is driven by rainfall. This leads to a surplus of water during the rainy summer months, and a deficit during the dry season, making the canals unsuitable for large-scale irrigation projects. Canal stages are kept up to maintain ground water levels.

Ground Water

Ground water is the primary source of supply in Collier County. All PWS wellfields and major agricultural users are supplied from one of the three

major aquifer systems in Collier County, i.e., the Floridan, Intermediate, and Surfcial (Table V-1-12).

Table V-1-12. Ground Water Systems in Collier County.

Hydrogeologic System	Hydrogeologic Unit	Thickness (feet)	Water Resource Potential
Surficial Aquifer System	Water Table Aquifer Lower Tamiami Aquifer	20-I 00 40-I 80	Most productive aquifers in the county. Yield high quality water, except for isolated areas with high iron content. Potential for saltwater intrusion in coastal areas.
Intermediate Aquifer System	Sandstone Aquifer	O-110	Yields large amounts of water in northern portion of Collier County, but is absent south of Alligator Alley. Suitable for mostly agricultural uses.
	Mid-Hawthorn Aquifer	80-I 20	Aquifer is low yielding and produces poor quality water. Suitable only for micro-irrigation uses.
Floridan Aquifer System	Lower Hawthorn/ Suwanee Aquifer	Insuff icient Data	Capable of high yields, but requires desalination treatment. Some zones may be suitable for use in aquifer storage and recovery.

Although the FAS is capable of high yields, it yields only nonpotable water within Collier County. The quality of water in the FAS deteriorates to the south, increasing in salinity and hardness. Salinity also increases as a function of depth, making the deeper producing zones less suitable for development than those zones near the top of the system. Due to the current availability of less expensive freshwater in more shallow aquifers, there has been little incentive for development of the upper Floridan, but it has potential as a future source.

The IAS contains two sub-units that can yield small-to-moderate quantities of water in certain parts of the county. The first subunit, the mid-Hawthorn aquifer, occurs throughout Collier County, but is generally not used due to poor quality and low productivity. It is suitable only for micro-irrigation applications in isolated areas. The second subunit, the sandstone aquifer, provides large quantities of water in the northern portion of the county, but pinches out to the south near Alligator Alley. Only marginally acceptable for

potable uses, the sandstone aquifer is suitable for irrigation purposes throughout its extent.

The SAS can be divided into two aquifers, the water table and the lower Tamiami. These two aquifers are separated by leaky confining beds. The lower Tamiami and water table aquifers are the most prolific in Collier County. Except for isolated areas of high iron content, they produce potable water. These aquifers supply the City of Naples, Marco Island, and county regional utilities, as well as most domestic self-supply, landscape and agricultural irrigation wells. Because of the large demands on the SAS, it has been endangered by saltwater intrusion on the coast and is frequently included in water shortage declarations.

Western Hendry County

Surface Water

The Caloosahatchee River (C-43) and Lake Okeechobee are sources of water for much of northwestern Hendry County. Water is drawn from the river or lake through a series of canals, which also provide drainage for the northern portion of the county. These canals include the Townsend Canal, the Roberts Canal, Gerber Groves Canal (C-21, Collins Slough Canal (C-3), the Hendry-Hilliard Canal, the Forty-Foot Canal, and the Industrial Canal. The City of Clewiston's potable water supply is withdrawn from the Industrial Canal.

The U.S. Army Corps of Engineers operate the three water control structures on the Caloosahatchee River (S-77, S-78, and S-79). Stages in the river are maintained primarily for navigation. Water withdrawn for irrigation results in a lowering of the stage. The Corps releases water from Lake Okeechobee to restore the stage to navigable levels. Water is also periodically released to flush the system of saline water, entering the river as a result of the operation of the navigation locks.

Ground Water

All of southern Hendry County, and an increasing percentage of northern Hendry County, depend on ground water as its primary source. The southern portion of the county has always been dependent on ground water because of the lack of surface water sources. The northern portion of the county is becoming more dependent on ground water as irrigation demands increase and surface water supplies reach their capacity.

Three aquifer systems occur in the county: the Surficial Aquifer System (SAS), the Intermediate Aquifer System (IAS), and the Floridan Aquifer System (FAS). Water in the FAS is too saline for most uses, leaving the Surficial and Intermediate Aquifer Systems as the primary sources of ground water in the county. Individual aquifers used include the water table aquifer, the lower Tamiami aquifer, and the sandstone aquifer (Table V-1-13).

Table V-1-13. Ground Water Systems in Western Hendry County.

Hydrogeologic System	Hydrogeologic Unit	Thickness (feet)	Water Resource Potential
Surficial Aquifer System	Water Table Aquifer	3-99	Extensive throughout Hendty County. Productivity varies widely. Heavily used in isolated areas where other aquifers do not exist, or are low yielding.
	Lower Tamiami Aquifer	o-135	Thin or nonexistent in the northern and western portions of Hendty County.
Intermediate Aquifer System	Sandstone Aquifer	O-120	Occurs in western Hendry County. Heavily used in areas where the lower Tamiami is thin or nonexistent. Moderately productive; water nonpotable in many areas.
	Mid-Hawthorn Aquifer	No Data	Limited occurrence in Hendry County. Very low productivity; water quality not suitable for most irrigation uses.
Floridan Aquifer System	Lower Hawthorn/ Suwanee Aquifer	No Data	Little is known about the Floridan in Hendry County. It is believed to be capable of producing large volumes of water through flowing wells. Water is not suitable for irrigation.

The SAS consists of two aquifers: the water table aquifer and the lower Tamiami aquifer, separated by the Tamiami confining zone. The water table aquifer is the only aquifer that occurs throughout all of Hendry County. Due to the system's variable water-bearing characteristics, its susceptibility to drought stress, and its potential impacts to wetlands, it is not heavily used throughout the county. However, there are some isolated areas where intensive use of the water table aquifer does take place. The City of LaBelle, for example, obtains its potable water supply from the water table aquifer. The lower Tamiami aquifer is not prolific in north Hendry County, and is absent in northwestern Hendry County.

The IAS consists of two aquifers: the sandstone aquifer and the deeper mid-Hawthorn aquifer. The sandstone aquifer is a moderately productive aquifer that occurs in western Hendry County. Because of the absence of the lower Tamiami aquifer in northwestern Hendry County, the sandstone aquifer has had significant demands placed upon it. Consequently, there are severe water supply problems associated with the sandstone aquifer in Western Hendry County. Port LaBelle obtains its potable water from the sandstone aquifer. The mid-Hawthorn aquifer yields very small quantities of poor quality water in Hendry County. Therefore, it is not used as a source of water.

The FAS contains a series of aquifers and producing zones. Some of these zones have the capability to produce large quantities of water through flowing wells. However, the quality of the water is quite poor. The FAS, therefore, is not used as a source of water in Hendry County.

Southern Glades County

Surface Water

Major surface water features include Lake Okeechobee and the Caloosahatchee River (C-43). The Caloosahatchee River is heavily used as a water source by Glades County agricultural interests.

Ground Water

Three aquifer systems are present in southern Glades County: the SAS, the LAS, and the FAS (Table V-1-14). Little data exists on the water-bearing characteristics of any of the aquifer systems in Glades County.

The. SAS has fairly low productivity throughout Southern Glades County. Near Lake Okeechobee, the permeability of the aquifer is especially low due to the presence of finer grained sediments. This low permeability and consequently slow movement of ground water is related to the poorer quality SAS ground water near Lake Okeechobee. The lower permeability has limited flushing of the shallow ground water by infiltrating rainwater. The slower flow rate also increases the residence time of the water within the aquifer allowing the water more time to dissolve minerals from the aquifer matrix, which, in turn, contributes to poorer quality water.

In the southwest corner of the Glades County, the IAS exhibits low-to-moderate productivity and supplies water for domestic use, as well as for irrigation at several citrus groves in the area. Throughout south-central and southeastern Glades County the IAS has low productivity and is not a significant source of water.

The FAS is present throughout all of Glades County. It consists of several producing zones that are capable of yielding large volumes of water. Floridan wells flow at land surface throughout the county. Water quality in the FAS varies from potable quality in the extreme north to unsuitable for most irrigation uses in Southern Glades County along the Hendry County boundary. The water quality within the aquifer decreases with depth; TDS, chlorides and sulfates generally increase with depth.

Table V-1-14. Ground Water Systems in Southern Glades County.

Hydrogeologic System	Hydrogeologic Unit	Thickness (feet)	Water Resource Potential
Surficial Aquifer System	Surficial Aquifer	20-100	Adequate in most areas for private domestic supply, but water quality is poor near Lake Okeechobee.
Intermediate Aquifer System	Equivalent of the sandstone aquifer of Hendry and Lee counties.	90-230	Adequate in most areas for private domestic supply and small to moderate irrigation.
Floridan Aquifer System	Floridan Aquifer	500-l 400	Aquifer is under flowing artesian condition throughout Glades County. The aquifer is highly productive. Productivity generally increases with depth; however, chloride, TDS, and sulfate concentrations increase with depth throughout the county. Aquifer is unsuitable for irrigation in Southern Glades County.

Southeastern Charlotte County

Surface Water

There are three major drainage basins in the Southeastern Charlotte Area: Gator Slough, Rainey Slough, and Telegraph Swamp. The major surface waters in these regions are dominated by wetland vegetation, and therefore not suitable for water supply.

Ground Water

Ground water is the primary source of supply for both agricultural irrigation and domestic supply in Southeastern Charlotte County. Three aquifer systems occur in Southeastern Charlotte County: the FAS, IAS, and the SAS (Table V-1-15).

The FAS consists of several aquifers of varying productivity and water quality. As a rule, aquifer productivity increases and water quality decreases with depth. The upper portion of the Floridan, consisting of the lower Hawthorn and upper Tampa aquifers, yields as much as 500 gpm. It is widely

used for irrigation in Southeastern Charlotte County, but requires desalination treatment for potable use.

Table V-1-15. Ground Water Systems in Southeastern Charlotte County.

Hydrogeologic System	Hydrogeologic Unit	Thickness (feet)	Water Resource Potential
Surficial Aquifer System	Surficial Aquifer	O-70	Aquifer productivity is variable. Most wells yield less than 50 gpm, but can range as high as 600-700 gpm in wells tapping the Caloosahatchee mar! in Southeastern Charlotte County. Water quality is suitable for most purposes.
Intermediate Aquifer System	Upper Hawthorn Confining Zone	75-250	Separates the Intermediate and Surficial Aquifer Systems.
	Sandstone/Mid-Hawthorn Aquifer	70-260	Important source of water for domestic and irrigation wells in the Southeastern Charlotte County.
Floridan Aquifer System	Lower Hawthorn Confining Zone	50-l 30	Separates the Intermediate and Floridan Aquifer Systems.
	Lower Hawthorn Aquifer/Upper Tampa Aquifer	150-300	Widely used for irrigation, but requires desalination treatment for potable use. Most productive zone lies at the contact between the lower Hawthorn and Tampa formations.
	Suwanee Limestone	200-300	Most productive aquifers in Charlotte County, but require desalination treatment for all uses. Water quality deteriorates from east to west.
	Ocala Limestone	200-300	

The lower Floridan aquifers, consisting of the Suwanee and Ocala Limestones, are the most productive in the county. Wells finished in these units are capable of yielding thousands of gallons of water per minute. Unfortunately, this water is highly mineralized and requires desalination treatment before it is suitable for most uses.

The IAS consists of the sandstone and mid-Hawthorn aquifers. The IAS is an important source of water for domestic and irrigation wells. The aquifers produce moderate quantities of water, up to 200 gpm in wells screened for their entire thickness. Water quality is fair to good.

The SAS is an important source of water for domestic self-supply and public water supply wells along the coast. It is also used to irrigate vegetable crops and water cattle. The SAS contains potable quality water across most of the eastern portion of the county, but contains unacceptable chloride levels in many locations along the coast. Water availability is also better in the eastern portions of the county, where certain parts of the aquifer can produce as much as 600 to 700 gpm. Throughout most of Charlotte County, wells finished in the Surficial Aquifer yield less than 50 gpm.

Assessment Criteria Used

The Lower West Coast Water Supply Plan with a 2020 future horizon is now in development, and is scheduled for completion in the year 2000. In order to provide information on the state of the SFWMD regarding water supply planning in the Lower West Coast, and to fulfill FDEP outline requirements for this Assessment, results from the previous iteration of the Lower West Coast Water Supply Plan (1994) are included. This is similar to the approach being used by other water management districts.

The assessment criteria for the Lower West Coast Water Supply Plan (1994) were resource protection criteria. The criteria were designed to prevent adverse impacts to wetlands and ground water resources caused by the pumping of ground water, and account for natural system needs. These criteria were developed through a process that included: (1) consultation with District staff, (2) input from members of the Lower West Coast Water Supply Plan Advisory Committee, and (3) consultation with recognized environmental specialists from the region. The resource protection criteria include definitions of the severity, duration, and frequency for declines in ground water levels. All three of the criteria were defined to evaluate the results of ground water flow models. All criteria will be reviewed during the development of future water supply plans.

Wetland Protection Criterion

The wetland protection criterion is generally defined as follows: ***Ground water level drawdowns should not exceed 1 foot for more than 1 month during any drought event that occurs as frequently as once every ten years in areas that are classified as a wetland. This*** wetland protection criterion applies to

the shallow aquifer system in areas that have been classified as a wetland according to the National Wetlands Inventory.

Seawater Intrusion Protection Criterion

This criterion applies uniformly along the Gulf Coast in Lee and Collier counties based on evidence of historical seawater intrusion or upon other evidence of susceptibility to seawater intrusion. Ground water levels were chosen for aquifers in the intermediate and shallow aquifer to limit seawater intrusion during a l-in-10 year drought. The seawater intrusion criterion is generally defined as follows: ***Ground water levels should not decline below the selected, site-specific level for any period of time during any drought event that occurs as frequently as once every ten years.*** Appendix K of the Lower West Coast Water Supply Plan (SFWMD, 1994) shows the locations where the seawater intrusion protection criterion was evaluated using ground water modeling.

General Aquifer Protection Criterion

The general aquifer protection criterion applies to confined aquifers in the Lower West Coast Planning Region. It was applied to limit potential adverse impacts such as aquifer compaction, reduced well yields, land subsidence, and upconing of saline water. The general aquifer protection criterion is defined as follows: ***Ground water levels should not decline below the selected, site-specific level for any period of time during any drought event that occurs as frequently as once every 10 years.***

The water levels for the general aquifer protection criterion were set at varying distances above the top of the aquifer. The distance above the top of the aquifer was based on the uncertainty about the elevation of the top of the aquifer. For example, if the top of the aquifer is estimated to be at an elevation of 50 feet below sea level (-50 ft NGVD) with an uncertainty of 10 feet, then the criteria level was set at 40 feet below sea level (-40 ft NGVD). Appendix K of the Lower West Coast Water Supply Plan (1994) shows the general aquifer protection criterion levels that were used for ground water modeling.

Hydrologic Impacts Due to Demands

During the Lower West Coast water supply planning process, two water demand levels for Lee, Collier, and Hendry counties were examined using ground water flow models: (1) the 1990 permitted demand level, and (2) the 2010 projected demand level. The 1990 permitted demand level represents the total urban and agricultural water demand that was permitted by the District through the end of 1990. The 2010 projected demand level is based on estimates of population in 2010 and estimates of irrigated acreage in 2010.

The 1990 permitted demand level is higher than the actual 1990 demand level because significantly more agricultural acreage was permitted in 1990 than had been planted. Actual crop acreages are usually less than the permitted acreages due to the normal differences in time between permitting and planting. These time differences vary in length. Permitted acreage may run far ahead of the planted acreage in an area experiencing rapid growth in agricultural acreage. Because the 1990 permitted demand level is greater than the actual 1990 demands, the projected 2010 demand level is only slightly higher than the 1990 permitted demand level. Table V-1-16 shows the populations and acres of irrigated agriculture simulated by county during the LWC water supply planning process, and compares these with the population and acres of irrigated agriculture projected for the year 2020 in this Assessment.

Table V-1-16. Population and irrigated agricultural acreage comparison between the Lower West Coast Water Supply Plan (2010) and the Districtwide Water Supply Assessment (2020).

County	Population LWCWSP (2010)	Population DWSA (2020)	Irrigated agricultural acreage LWCWSP (2010)	Irrigated agricultural acreage DWSA (2020)
Lee	640,516	594,300	28,798	34,222
Collier	293,469	349,200	88,218	86,769
Hendry (total county)	41,610	42,700	158,193	208,543

Note: The LWC Water Supply Plan included only irrigated agricultural acreage that had ground water as a source (ground water alone or ground and surface water), while this Assessment includes acreage that has surface water as its only source.

Lower West Coast Water Supply Plan (1994) Results

Ground water flow models were used to evaluate how well resource protection criteria could be met. The ground water models used the program known as MODFLOW, which was written by the U.S. Geological Survey (McDonald and Harbaugh, 1983). The models simulate ground water flow and levels within the water table, lower Tamiami, sandstone, and mid-Hawthorn aquifers. Base case model runs for demands associated with population and irrigated agricultural acreage which had been projected for the year 2010 utilized conventional sources of water to supply the increased demands. In general, this meant that the surficial aquifer system supplied the projected demands. The base case modeling results indicated that resource protection criteria would not be met in certain locations using conventional sources of water. Alternative modeling scenarios were developed to better meet the resource protection criteria.

Water demands for the 1990 and 2010 time periods were simulated for both average rainfall and l-in-10 year drought conditions. Simulated irrigation demands were based on the modified Blaney-Criddle method as referenced in the Basis of Review Permit Information Manual, Volume III (SFWMD, 1993). Public water supply and domestic self-supplied demands varied on a monthly basis based on historical monthly distribution patterns.

The base case modeling results indicated problem areas where resource protection criteria were not met. These problem areas occurred at both the 1990 permitted demand level and 2010 projected demand level. Some problem areas occurred under both average rainfall and l-in-10 year drought conditions.

Information used for the Lower West Coast Water Supply Plan (SFWMD, 1994) indicated that there were approximately 558,000 acres of wetlands within the Lower West Coast Planning Area (447,000 acres in Collier County; 63,000 acres in Lee County; and 48,000 in Western Hendry County). Drawdowns under 50,000 acres of wetlands (9 percent of total wetlands) did not meet the wetland protection criterion at the 1990 permitted demand level. Drawdowns under 73,000 acres of wetlands (13 percent of total wetlands) did not meet the wetland protection criterion at the 2010 projected demand level.

The seawater intrusion protection criterion was exceeded along portions of the coast in the water table and lower Tamiami aquifers in the base case model runs for both the 1990 permitted demand level and the 2010 projected demand level. However, there was not a large difference in the number of occurrences.

Water levels met the general, aquifer protection criterion for the base case model runs with the exception of small areas of the sandstone aquifer in eastern Lee and western Hendry counties. There was only a minor difference in areas not meeting the general aquifer protection criterion between the 1990 permitted demand level and 2010 projected demand level.

In addition to the base case model runs, several alternative modeling scenarios were simulated using the 2010 projected demand level. These alternative modeling scenarios were evaluated for their effectiveness in meeting the resource protection criteria in the same way as the base case model runs. The results from each alternative modeling scenario were compared to the results from the base case model run at the 2010 projected demand level.

Adequacy of Regional Sources

The Lower West Coast Water Supply Plan (SFWMD, 1994) was completed prior to the 1997 revisions to Chapter 373, Florida Statutes, pertaining to regional water supply plans. Consequently, the 1994 plan does not include all of the components referenced in the 1997 legislation. The 1994 plan does not include any information concerning the adequacy of sources, regional or otherwise, for supplying water to existing legal uses and reasonably anticipated future needs. The water supply plan did conclude, however, that there was insufficient information to evaluate the full capacity of some new water sources. The plan recommended that such information be developed as quickly as possible.

The analyses completed in the LWC water supply planning process included projected populations and irrigated agricultural acreages. Demand levels associated with these populations and irrigated acreages have associated:

- Wetland drawdowns in Lee, Hendry and Collier counties
- Seawater intrusion into the lower Tamiami aquifer along Lee and Collier counties' coastline
- Impacts to the sandstone aquifer in eastern Lee and western Hendry County

Although this Assessment includes population and irrigated agricultural acreage projections for the year 2020 that are not identical to the projections used in the LWC Water Supply Plan (SFWMD, 1994) (Table V-1-16), they suggest similar base case impacts (by using existing sources only). During development of the next LWC Water Supply Plan, an alternative combination of sources will be found that avoids unacceptable impacts.

Section V

Part 2

Lower East Coast Planning Region Assessment

The Lower East Coast Planning Region, which is shown on Plate 2, includes all of Palm Beach, Broward and Dade counties, and portions of Hendry, Monroe, and Collier counties. Collier County is addressed in the Lower West Coast Planning Region because the portion of Collier County in the LEC is entirely within the Big Cypress National Preserve.

The LEC Planning Region encompasses a sprawling, fast-growing urban complex along the coast; extensive agricultural lands, including the Everglades Agricultural Area; critical environmental resources, such as the Everglades ecosystem; and important estuaries, including Biscayne Bay and Florida Bay.

The region's primary water supply source is Lake Okeechobee, which has a surface area of 730 square miles. Lake Okeechobee is especially important to the LEC because it forms the headwaters of the planning region. The SFWMD has the ability to move water stored in the lake to the Everglades, coastal communities, the Everglades Agricultural Area, the St. Lucie River basin, and the Caloosahatchee River basin. In addition to Lake Okeechobee, the Water Conservation Areas can provide water supply through ground water recharge and surface water releases.

Two main ground water systems supply water to the LEC: the Surficial Aquifer System (SAS) and the Floridan Aquifer System (FAS). Nearly all public water supplies in the LEC are withdrawn from shallow, unconfined aquifers comprising the SAS. With the close interconnection between surface and ground water resources, much of the water that recharges these shallow aquifers comes from the regional canal system.

Because of the close proximity of the water table to the land surface, surface waters and ground waters in the region are closely linked. This link is enhanced by the network of canals used for flood control and water supply. Flow occurs from the aquifers to the canals when the water levels in the canals are at a lower elevation than the water table. Flow occurs from the

canals to the aquifer when the reverse situation occurs. The regulation of water levels in the canals and the operation of high capacity supply wells significantly affect the slope of the water table, and consequently, ground water flow patterns. Generally, the LEC regional ground water flow tends toward the south and the east, from inland areas of higher water levels to coastal areas of lower water levels.

The FAS is separated from the SAS by a thick (800-1,000 foot) sequence of low permeability sediments. Ground water flow within the deeper, confined FAS is completely independent of the LEC region's surface water and surficial ground water system. Use of the FAS for water supply within the LEC Planning Region has been limited because the salinity of the water naturally occurring in this aquifer system is too high for most uses. There is interest in using the FAS for aquifer storage and recovery

Water Demand Projections

Palm Beach County

Palm Beach County encompasses regions with very significant urban and agricultural demands. The urban portion of the county is in the east (Plate 2). The eastern coastal area is home to a fast growing population with increasing water demands. The population of Palm Beach County has grown by 35 percent, from 723,005 in 1985 to 976,358 in 1995 (U.S. Bureau of the Census, 1998). Population is projected to grow to 1,464,000 by 2020 (BEBR, 1998).

Agricultural areas are inland, and include the majority of the Everglades Agricultural Area (EAA). The high fertility of the organic soils in the EAA makes this area highly suitable for agricultural production. This has resulted in practically all the available land in the EAA being used for some form of irrigated agriculture. The size of the EAA has been projected to decline somewhat as areas have been identified and scheduled to be used as Stormwater Treatment Areas (STAs)

Public Water Supply

The population served by public water supply (PWS) is projected to grow from 809,088 in 1995 to 1,298,717 by 2020 (Table V-2-l). In addition, there are five golf courses and numerous commercial and industrial users that are supplied by PWS utilities. Total PWS demand in Palm Beach County is projected to increase from 186.89 mgd (68,215 mgy) in 1995 to 294.98 mgd (107,668 mgy) in 2020. The l-in-10 demands in 2020 are 326.95 mgd (119,337 mgy). Figure V-2-l shows the public water supply utility source locations in Palm Beach County.

Domestic Self-Supply and Small Public Supply Systems

The self-supplied population was assessed at 167,270 in 1995, and is forecast to decline slightly to 165,283 by 2020 (Table V-2-l). Domestic self-supplied demands have been assessed as 35.78 mgd (13,060 mgy) in 1995 and average demands are projected to be 35.59 mgd (12,990 mgy) in 2020. The l-in-10 demands in 2020 are 39.39 mgd (14,377 mgy).

Figure V-2-1. Public Water Supply Utility Source Locations in Palm Beach County.

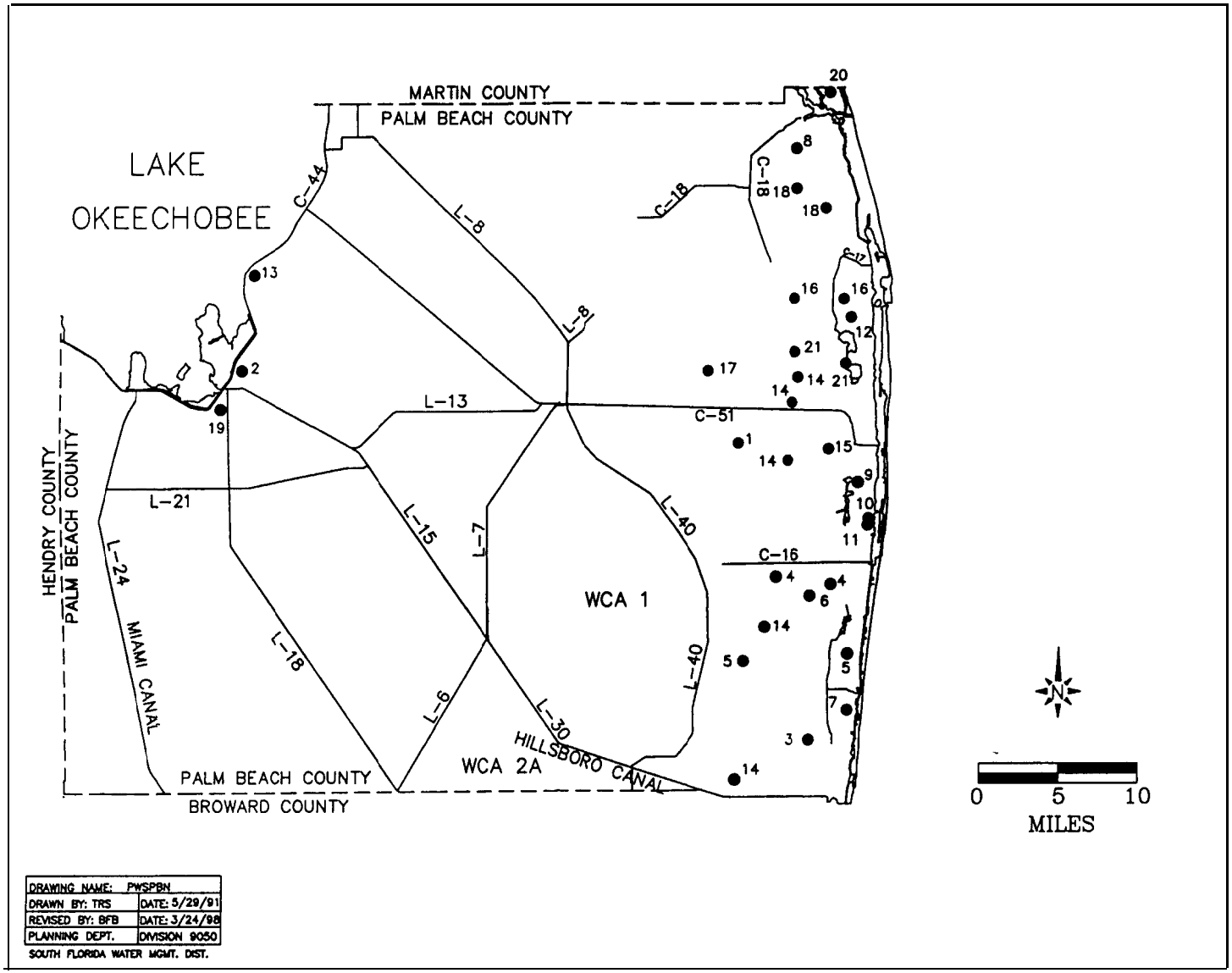


Table V-2-1. Public Water Supplied and Domestic Self-Supplied Demand Projections for Palm Beach County.

a	b	c	d	e	f	g	h	I	j	k	l	m	n	o
				PWS				PWS		PWS		DSS	DSS	DSS
		Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
#	Utility	1995	1995	1995	1995	use	factor	1995	factor	1995	1995	1995	1995	1995
1	Acme Improvement District	24,267	22,291	4.40	197	65%	1.015	4.44	1.213	5.06	1,976	0.39	0.39	0.45
2	Belle Glade	12,814	12,575	6.02	479	35%	1.015	6.05	1.213	6.50	239	0.11	0.12	0.12
3	Boca Raton	87,889	87,367	35.91	411	70%	1.015	36.28	1.213	41.69	522	0.21	0.22	0.25
4	Boynton Beach	71,890	68,147	12.56	184	50%	1.015	12.65	1.213	14.00	3,743	0.69	0.69	0.77
5	Delray Beach	49,000	47,030	12.17	259	50%	1.015	12.26	1.213	13.56	1,970	0.51	0.51	0.57
6	Golf	1,110	1,086	0.42	387	65%	1.015	0.42	1.213	0.48	24	0.01	0.01	0.01
7	Highland Beach	3,211	3,185	1.13	355	65%	1.015	1.14	1.213	1.30	26	0.01	0.01	0.01
8	Jupiter	42,050	36,775	11.46	312	50%	1.015	11.54	1.213	12.77	5,275	1.64	1.66	1.83
9	Lake Worth	34,092	32,762	7.16	219	35%	1.015	7.20	1.213	7.73	1,330	0.29	0.29	0.31
	Seminole Manor	*	*	*	*	*	*	*	*	*	*	*	*	*
10	Lantana	7,812	7,721	2.06	267	35%	1.015	2.07	1.213	2.22	91	0.02	0.02	0.03
11	Manalapan	1,033	964	1.00	1,038	70%	1.015	1.01	1.213	1.16	69	0.07	0.07	0.08
12	Mangonia Park	1,236	1,126	0.34	302	35%	1.015	0.34	1.213	0.37	110	0.03	0.03	0.04
13	Pahokee	9.3881	9.3881	0.871	931	35%	1.0151	0.87	1.2131	0.941	0	0.001	0.00	0.00
14	Palm Beach County	276,002	240,086	34.70	145	50%	1.015	35.04	1.213	38.76	35,916	5.20	5.24	5.80
	Atlantis	*	**	**	**	**	*	**	**	. .	. .	**		**
	Century Village	*	**	**	**	**	. .	*	**	. .	**	**		**
	Jamaica Bay	*	*	**	*	**	*	*	*	**	**	*		**
15	Palm Springs	33.960	28.138	4.01	143	85%	1.015	4.05	1.213	4.81	5,822	0.83	0.84	0.95
16	Riviera Beach	30,319	29,734	8.94	301	35%	1.015	8.99	1.213	9.66	585	0.18	0.18	0.19
17	Royal Palm Beach	16,568	16,541	2.20	133	35%	1.015	2.21	1.213	2.38	27	0.00	0.00	0.00
18	Seacoast	75,534	71,974	13.91	193	40%	1.015	13.99	1.213	15.18	3,560	0.69	0.69	0.75
19	South Bay	4,960	4,945	0.92	186	35%	1.015	0.93	1.213	1.00	15	0.00	0.00	0.00
20	Tequesta	8,136	7,989	1.41	176	35%	1.015	1.42	1.213	1.52	147	0.03	0.03	0.03
21	West Palm Beach	83,929	79,263	25.22	318	50%	1.015	25.41	1.213	28.11	4,666	1.48	1.50	1.65
	Rural Self Supplied	101,157			231	50%	1.015		1.213		101,157	23.37	23.54	26.04
	Totals	976,358	809,088	186.89				188.31		209.00	167,270	35.78	36.04	39.90

. included in Lake Worth Service Area:** included in Palm Beach County Service Area.

Table V-2-1. (continued) Public Water Supplied and Domestic Self-Supplied Demand Projections for Palm Beach County.

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
#	Utility	Total population 2020	PWS population 2020)	PWS base MGD 2020	GPCD 2020	Percent outdoor use	Average factor	PWS average MGD 2020	1-in-10 factor	PWS 1-in-10 MGD 2020	DSS population 2020	DSS base MGD 2020	DSS average MGD 2020	DSS 1-in-10 MGD 2020
1	Acme Improvement District	43,656	41,680	8.23	197	65%	1.015	8.31	1.213	9.45	1,976	0.39	0.39	0.45
2	Belle Glade	16,232	15,993	7.66	479	35%	1.015	7.70	1.213	8.27	239	0.11	0.12	0.12
3	Boca Raton	104,842	104,842	43.09	411	70%	1.015	43.54	1.213	50.02	0	0.00	0.00	0.00
4	Boynton Beach	104,045	100,302	18.49	184	50%	1.015	18.62	1.213	20.60	3,743	0.69	0.69	0.77
5	Delray Beach	65,908	63,938	16.55	259	50%	1.015	16.67	1.213	18.44	1,970	0.51	0.51	0.57
6	Golf	1,839	1,8151	0.701	387	65%	1.015	0.71	1.213	0.81	24	0.01	0.01	0.01
7	Highland Beach	3,692	3,666	1.30	355	65%	1.015	1.31	1.213	1.49	26	0.01	0.01	0.01
8	Jupiter	86,591	81,316	25.34	312	50%	1.015	25.53	1.213	28.24	5,275	1.64	1.66	1.83
9	Lake Worth	39,571	38,241	8.36	219	35%	1.0151	8.40	1.213	9.03	1,330	0.29	0.29	0.31
	Seminole Manor	*	*	*	*	*	*	*	*	*	*	*	*	*
10	Lantana	8,905	8,814	2.35	267	35%	1.015	2.36	1.213	2.54	91	0.02	0.02	0.03
11	Manalapan	4,120	4,051	4.201	1,038	70%	1.015	4.25	1.213	4.88	69	0.07	0.07	0.08
12	Mangonia Park	2,018	1,908	0.58	302	35%	1.015	0.58	1.213	0.62	110	0.03	0.03	0.04
13	Pahokee	13,000	13,000	1.20	93	35%	1.015	1.21	1.213	1.30	0	0.00	0.00	0.00
14	Palm Beach County	452,366	416,450	60.33	145	50%	1.015	60.77	1.213	67.24	35,916	5.20	5.24	5.80
	Atlantis	*	**	**	*	*	**	**	*	**	**	**	**	*
	Century Village	**	**	**	**	**	**	**	**	**	**	**	**	**
	Jamaica Bay	**	**	**	**	**	**	**	**	**	**	**	**	**
15	Palm Springs	39,653	33,831	4.821	143	65%	1.015	4.87	1.213	5.54	5,822	0.83	0.84	0.95
16	Riviera Beach	47.4121	46.8271	14.081	301	35%	1.015	14.15	1.213	15.21	585	0.18	0.18	0.19
17	Royal Palm Beach	35.861	35.834	4.77	1331	35%	1.015	4.79	1.213	5.15	27	0.00	0.00	0.00
18	Seacoast	147,161	146,161	28.25	193	40%	1.015	28.41	1.213	30.83	1,000	0.19	0.19	0.21
19	South Bay	8,500	8,485	1.58	186	35%	1.015	1.59	1.213	1.71	15	0.00	0.00	0.00
20	Tequesta	6,785	6,638	1.17	176	35%	1.015	1.18	1.213	1.27	147	0.03	0.03	0.03
21	West Palm Beach	129.591	124.925	39.75	318	50%	1.015	40.04	1.213	44.30	4,666	1.48	1.50	1.65
	Rural Self Supplied	102,252			231	50%	1.015		1.213		102,252	23.62	23.79	26.33
	Totals	1,464,000	1,298,717	292.791				294.98		326.95	165,283	35.32	35.59	39.39

* included in Lake Worth Service Area; ** included in Palm Beach County Service Area.

Commercial/Industrial Self-Supply

Demand for self-supplied water for commercial and industrial use was projected to grow at the rate of each county's population growth. The exception to this was in the Everglades Agricultural Area (EAA), where industrial water use is for agricultural processing and is not impacted by population change. Industrial use in the EAA was projected to remain at its 1995 level through 2020.

Combined commercial/industrial self-supplied average demands for Palm Beach County are equal to 10,939 mgy in 1995 and 12,167 mgy in 2020. PWS supplied industrial demand is included with other public utility demands.

Recreation Self-Supply

The recreational self-supplied demand category includes self-supplied irrigation demands for large landscaped areas (as opposed to private homes) and for golf courses. Self-supplied large landscaped areas are projected to increase from 6,295 acres in 1995 to 9,439 acres in 2020. Landscaping self-supplied average demand in Palm Beach County (not counting golf courses) is projected to increase from 6,950 mgy in 1995 to 10,421 mgy by 2020. The l-in-10 irrigation requirements in 2020 are 12,639 mgy.

In 1995, there were 130 golf courses in Palm Beach County. Of these, 13 were supplied with reclaimed water from wastewater utilities and 5 were irrigated with potable water from public water supply utilities. Since 1995, another four have converted to reclaimed water, and another four are planning to convert in 1998. Self-supplied golf courses in Palm Beach County in 1995 had a combined irrigated acreage of 15,436 acres, and this is projected to increase to 23,014 by 2020. Self-supplied golf course acreage in 1995 had average irrigation requirements of 17,041 mgy, and are projected to increase to 25,407 mgy by 2020. The l-in-10 irrigation requirements in 2020 for these golf courses are 30,815 mgy.

Combined recreational self-supplied average demands for Palm Beach County are equal to 23,991 mgy in 1995 and 35,828 mgy in 2020. The l-in-10 irrigation requirements in 2020 are 43,454 mgy.

Thermoelectric Power Generation Self-Supply

Thermoelectric power plants use and reuse large quantities of water for cooling purposes. Evaporative losses must be replaced from an external source above and beyond rainfall and runoff. There is one power plant in Palm Beach County that has a permit to replace water used in this way. This plant had an assessed use of at 0.19 mgd (69 mgy) in 1995, and use is projected to remain at that level through 2020.

Agricultural Self-Supply

Citrus, vegetables, field crops (sugarcane, rice), and nurseries are the irrigated agricultural crops in the Palm Beach County. Apart from the areas of irrigated pastureland in the EAA, improved pasture is very seldom irrigated. There are also some water demands for cattle watering and fish farming (aquaculture). Plate 2 shows the area currently used for agriculture. Some of the crops in the EAA are grown on a rotational basis. Examples of this are rice and sweet corn grown on sugarcane land in fallow.

Citrus

Palm Beach County citrus acreage was fairly constant from 1968 through 1995-6. There has been, however, a modest overall decline, from a high of 17,566 acres in 1970 to 12,746 acres in 1995-6. This decline is forecast to continue through 2020, although minor fluctuations are likely. With the exception of a constant 679 acres that are in the EAA, all the citrus production in Palm Beach County takes place in eastern portion of the county.

Citrus acreage in the Palm Beach County is projected to decline from the 1995-6 level of 12,746 acres to 10,121 acres by 2020. This moderate decline in citrus acreage has an associated decline in average irrigation requirements from 8,034 mgy in 1995 to 6,341 mgy in 2020. The l-in-10 demands in 2020 are 8,295 mgy.

Vegetables, Melons, and Berries

The main vegetable crops grown in the EAA portion of Palm Beach County are carrots, celery, lettuce, escarole, endive, radishes, and sweet corn. Minor vegetable crops include parsley, cabbage, snap beans, Chinese

vegetables, aromatic vegetables (e.g., basil), and peppers. Different types of vegetables are often grown interchangeably. In 1995, there were 21,745 acres of land used for vegetable production in the Palm Beach EAA, and production is projected to remain about this level throughout the projection period. This acreage has average demands of 8,552 mgy, and l-in-10 demands of 10,915 mgy.

Vegetable crops grown commercially in the non-EAA portion of Palm Beach County include snap beans, squash, sweet corn, cucumbers, eggplant, peppers, tomatoes, and Chinese vegetables. Vegetable crops are often grown interchangeably. In 1995, there were about 21,500 acres of land used for vegetable production in the non-EAA portion of Palm Beach County, and this is projected to decline to 2,129 acres by 2020. This reduction in acreage represents a decrease in average irrigation requirements from 10,618 mgy in 1995 to 1,014 mgy in 2020. The l-in-10 demands in 2020 are 1,243 mgy.

This means that the combined projection for vegetable production in Palm Beach County is to decline from 43,245 acres in 1995 to 23,874 acres by 2020. This reduction in acreage represents a decrease in average irrigation requirements from 19,170 mgy in 1995 to 9,566 mgy in 2020. The l-in-10 demands in 2020 are 12,158 mgy.

Field Crops

Sugarcane. Sugarcane is by far the dominant crop in the EAA. Production was at 328,592 acres in 1995 (not including sugarcane land in fallow). This acreage is forecast to decline to 285,542 acres by 2020, primarily due to the conversion of agricultural land into Stormwater Treatment Areas. This will represent a decrease in the average irrigation requirements from 202,614 mgy in 1995 to 176,069 mgy in 2020. The l-in-10 demands in 2020 are 288,606 mgy.

Rice. Rice is grown in the EAA during the summer months in rotation with sugarcane or winter vegetables, and takes place on land that would otherwise be fallow. Rice production in the EAA is limited by the capacity of the two existing processing mills. Historically, rice acreage has fluctuated with the opening, expansion, and closing of different mills. Production in 1995 was assessed at 18,600 acres and is projected to decline to 18,500 acres by 2020. This will represent a decrease in the average irrigation requirements from 12,065 mgy in 1995 to 12,000 mgy in 2020. The l-in-10 demands in 2020 are 14,135 mgy.

Sod

In 1995, there were 6,000 acres of sod production in Palm Beach County, all of which takes place in the EAA. Production is projected to remain at that level through 2020. This acreage has average irrigation requirements of 5,695 mgy and l-in-10 demands of 8,228 mgy.

Greenhouse/Nursery

In 1995, there were 5,045 acres of ornamental nursery in Palm Beach County. Only 238 acres of this were in the EAA, and the rest were in eastern Palm Beach County. Total acreage is projected to increase to 10,175 acres by 2020. The projected rise in acreage has an associated increase in average irrigation requirement from 8,202 mgy in 1995 to 14,794 mgy in 2020. The l-in-10 demands in 2020 are 18,294 mgy.

Pasture

The EAA was once a major cattle producing region. In recent years, however, the conversion of pasture acreage to other crops has resulted in the reduction of improved pasture to about 200 acres. The remaining pastureland consists of very small parcels that have not been converted to other crops, and pasture acreage in the EAA is projected to remain constant over the projection period. These 200 acres of pasture have an average irrigation requirement of 83 mgy, and l-in-10 requirements of 130 mgy. Pasture acreage in Palm Beach County outside of the EAA is very rarely irrigated.

Miscellaneous

Cattle Watering. In 1995, there were a total of 12,000 total cattle and calves in Palm Beach County (Florida Agricultural Statistics Service, 1997), with no significant amount of these for dairy use. Based on this number the demand for cattle watering is 53 mgy, and is projected to remain relatively constant throughout the projection period.

Aquaculture. Aquacultural operations withdraw water for circulation purposes, and to replace evaporative losses. This replacement was assessed for Palm Beach County as 725 mgy in 1995. Demand was projected to remain at the 1995 level through 2020.

Demand Summary

Urban demands are projected to grow by 45 percent between 1995 and 2020, and agricultural demand is projected to decline by 12 percent during that period. Total demand is projected to grow by 6 percent, from 372,915 mgy in 1995 to 394,048 mgy in 2020. In 1995, urban demands made up 31 percent of total demands, and are projected to increase to 43 percent of total demands by 2020 (Table V-2-2).

Table V-2-2. Urban and Agricultural Demand for Palm Beach County.

Urban and Agricultural Demands	(a) Assessed 1995 (mgy)	(b) Average 2020 (mgy)	(c) Percent Change (a) to (b)	(d) 1-in-10 2020 (mgy)
Urban				
Public Water Supply	68,215	107,668	58%	119,337
Domestic Self-Supply	13,060	12,990	- 1%	14,377
Commercial/Industrial Self-Supply	10,939	12,167	11%	12,167
Recreational Self Supply	23,991	35,828	49%	43,454
Thermoelectric Power Generation Self-Supply	69	69	0%	69
Total Urban	**116,274**	**168,722**	**45%**	**189,404**
Agricultural				
Citrus	8,034	6,341	- 21%	8,295
Vegetables, Melons, and Berries	19,170	9,566	- 50%	12,158
Field Crops (Sugarcane, Rice)	214,679	188,069	- 12%	302,741
Sod	5,695	5,695	0%	8,228
Greenhouse/Nursery	8,202	14,794	80%	18,294
Pasture	83	83	0%	130
Miscellaneous (Cattle Watering, Aquaculture)	778	778	0%	778
Total Agricultural	**256,641**	**225,326**	**- 12%**	**350,624**
Total Urban and Agricultural Demands	**372,915**	**394,048**	**6%**	**540,028**

The 1995 land use for Palm Beach County is shown in Plate 2. Urban land use is prevalent along the coast, while agriculture largely covers the interior region of the county. Protected areas and stormwater treatment areas are located between the urban and agricultural areas. Continued growth of urban land use, and a decline in irrigated agricultural land use, is forecast over the projection period.

Broward County

Broward County's population has grown by 25 percent in the decade from 1985 to 1995, from 1,132,921 in 1985 to 1,412,942 in 1995 (U.S. Bureau of the Census, 1998), and is projected to increase to 1,926,600 by 2020 (BEBR, 1998). Agriculture has declined as the non-protected portions of Broward County have become increasingly urbanized.

Public Water Supply

The population served by public water supply (PWS) in 1995 was assessed at 1,380,362 and is projected to grow to 1,886,658 by 2020. This increase in PWS served population had associated demands of 221.94 mgd (81,008 mgy) in 1995 and has projected 2020 average demands of 324.53 mgd (118,453 mgy). The l-in-10 demands in 2020 are 356.92 mgd (130,276 mgy). Figure V-2-2 shows the location of public water supply source locations in Broward County.

Domestic Self-Supply and Small Public Supply Systems

A total of 32,580 residents of Broward County were self-supplied or served by small public supply systems in 1995, and this number is forecast to increase to 39,942 by 2020 (Table V-2-3). These self-supplied populations had assessed demands of 5.05 mgd (1,843 mgy) in 1995, which is projected to increase to 2020 average demands to 6.84 mgd (2,497 mgy). The l-in-10 demands in 2020 are 7.43 mgd (2,712 mgy).

Commercial/Industrial Self-Supply

The demand for commercial/industrial self-supplied water (as opposed to PWS supplied) in Broward County is projected to increase from 1,338 mgy in 1995 to 1,824 mgy by 2020. PWS supplied commercial/industrial demand is included with other public utility demands.

Figure V-2-2. Public Water Supply Utility Source Locations in Broward County.

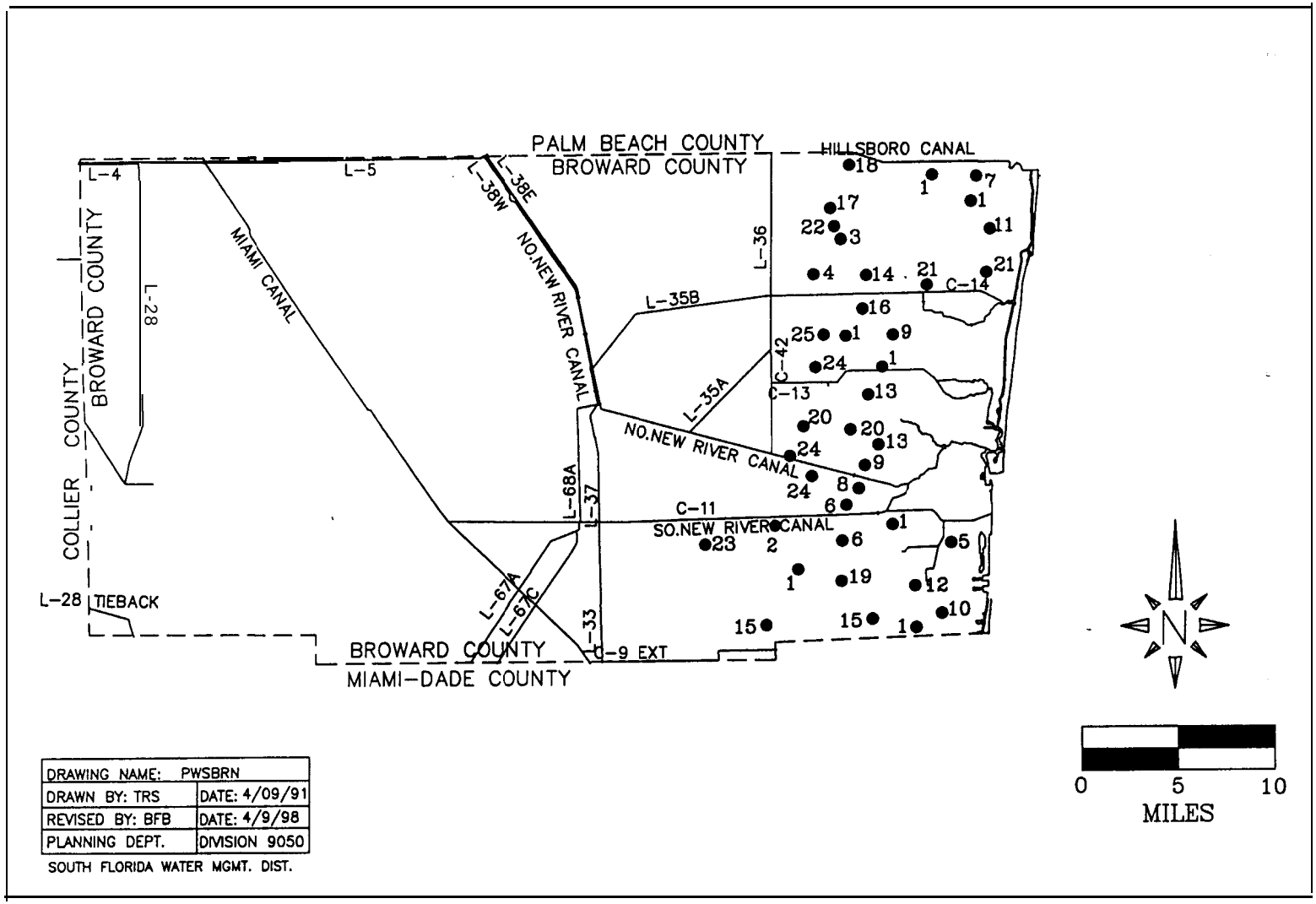


Table V-2-3. Public Water Supplied and Domestic Self-Supplied Demand Projections for Broward County.

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
				PWS				PWS		PWS		DSS	DSS	DSS
		Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
#	Utility	1995	1995	1995	1995	use	factor	1995	factor	1995	1995	1995	1995	1995
1	Broward County	191,755	189,785	28.67	151	50%	1.250	32.26	1.231	35.99	1,970	0.30	0.33	0.37
	Coconut Creek	*	*	*	*	*	*	*	*	*	*	*	*	*
2	Cooper City	27,398	27,398	3.50	128	50%	1.250	3.94	1.231	4.39	0	0.00	0.00	0.00
3	Coral Springs, City of	51,166	51,004	7.24	142	65%	1.250	8.42	1.231	9.68	161	0.02	0.03	0.03
4	Coral Springs Imp. Dist.	33,242	33,191	4.08	123	65%	1.250	4.74	1.231	5.46	52	0.01	0.01	0.01
5	Dania	14,068	14,011	2.46	176	35%	1.250	2.68	1.231	2.89	57	0.01	0.01	0.01
6	Davie	23,313	23,313	3.05	131	50%	1.250	3.43	1.231	3.83	0	0.00	0.00	0.00
7	Deerfield Beach	46,747	46,635	10.96	235	35%	1.250	11.92	1.231	12.88	112	0.03	0.03	0.03
8	Ferncrest Utilities	3,193	3,193	0.77	241	50%	1.250	0.87	1.231	0.97	0	0.00	0.00	0.00
9	Fort Lauderdale	227,387	226,815	48.74	215	50%	1.250	54.84	1.231	61.18	572	0.12	0.14	0.15
10	Hallandale	31,739	31,717	3.46	109	50%	1.250	3.89	1.231	4.34	22	0.00	0.00	0.00
11	Hillsboro Beach	1,678	1,664	0.86	517	65%	1.250	1.00	1.231	1.15	14	0.01	0.01	0.01
12	Hollywood	121,538	121,019	19.31	160	35%	1.250	21.00	1.231	22.70	519	0.08	0.09	0.10
13	Lauderhill	49,467	49,392	7.43	150	35%	1.250	8.08	1.231	8.73	75	0.01	0.01	0.01
14	Margate	57,194	57,144	8.34	146	50%	1.250	9.38	1.231	10.47	50	0.01	0.01	0.01
15	Miramar	40,926	40,616	4.19	103	50%	1.2501	4.711	1.2311	5.26	310	0.03	0.04	0.04
16	North Lauderdale	28,164	28,1301	3.041	108	35%	1.250	3.31	1.231	3.57	35	0.00	0.00	0.00
17	North Springs Imp. Dist.	13,922	11,7871	1.41	1201	65%	1.250	1.64	1.231	1.89	2,134	0.26	0.30	0.34
18	Parkland	2,376	1,249	0.20	160	65%	1.250	0.23	1.231	0.27	1,126	0.18	0.21	0.24
19	Pembroke Pines	86,465	85,054	9.33	110	0%	1.250	9.33	1.231	9.33	1,411	0.15	0.15	0.15
20	Plantation West	74,171	74,171	13.92	188	50%	1.250	15.66	1.231	17.47	0	0.00	0.00	0.00
21	Pompano Beach	71,635	71,382	16.25	228	35%	1.250	17.67	1.231	19.10	253	0.06	0.06	0.07
22	Royal Utilities	1,993	1,992	0.36	1811	50%	1.2501	0.411	1.2311	0.451	0	0.00	0.001	0.00
23	South Broward Utilities	7,351	6,788	0.661	97	50%	1.2501	0.74	1.2311	0.831	563	0.05	0.06	0.07
24	Sunrise	137,485	137,437	18.11	132	35%	1.250	19.70	1.231	21.29	48	0.01	0.01	0.01
25	Tamarac	45,521	45,475	5.60	123	35%	1.250	6.09	1.231	6.58	46	0.01	0.01	0.01
	Rural Self Supplied	23,049			161	35%	1.250		1.231		23,049	3.71	4.03	4.36
	Totals	1,412,942	1,380,362	221.94				245.94		270.72	32,580	5.05	5.54	6.03

Table V-2-3 (continued). Public Water Supplied and Domestic Self-Supplied Demand Projections for Broward County.

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
				PWS				PWS		PWS		DSS	DSS	DSS
		Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
#	Utility	2020	2020	2020	2020	use	factor	2020	factor	2020	2020	2020	2020	2020
1	Broward County	230,505	229,173	34.61	151	50%	1.250	38.94	1.231	43.44	1,332	0.20	0.23	0.25
	Coconut Creek	*	*	*	*	*	*	*	*	*	*	*	*	*
2	Cooper City	31,102	31,102	3.98	128	50%	1.250	4.48	1.231	5.00	0	0.00	0.00	0.00
3	Coral Springs, City of	68,231	68,070	9.67	142	65%	1.250	11.24	1.231	12.93	161	0.02	0.03	0.03
4	Coral Springs Imp. Dist.	49,743	49,692	6.11	123	65%	1.250	7.11	1.231	8.17	52	0.01	0.01	0.01
5	Dania	19,461	19,404	3.42	176	35%	1.250	3.71	1.231	4.01	57	0.01	0.01	0.01
6	Davie	31,802	31,802	4.17	131	50%	1.250	4.69	1.231	5.23	0	0.00	0.00	0.00
7	Deerfield Beach	56,018	55,906	13.14	235	35%	1.250	14.29	1.231	15.45	112	0.03	0.03	0.03
8	Ferncrest Utilities	4,966	4,966	1.20	241	50%	1.250	1.35	1.231	1.50	0	0.00	0.00	0.00
9	Fort Lauderdale	264,004	263,431	56.64	215	50%	1.250	63.73	1.231	71.09	572	0.12	0.14	0.15
10	Hallandale	38,723	38,701	4.22	109	50%	1.250	4.75	1.231	5.30	22	0.00	0.00	0.00
11	Hillsboro Beach	2,374	2,360	1.22	517	65%	1.250	1.42	1.231	1.63	14	0.01	0.01	0.01
12	Hollywood	144,170	143,651	22.98	160	35%	1.250	25.00	1.231	27.02	519	0.08	0.09	0.10
13	Lauderhill	55,946	55,871	8.38	150	35%	1.250	9.11	1.231	9.85	75	0.01	0.01	0.01
14	Margate	66,042	65,992	9.63	146	50%	1.250	10.84	1.231	12.09	50	0.01	0.01	0.01
15	Miramar	120,088	119,778	12.34	103	50%	1.250	13.88	1.231	15.49	310	0.03	0.04	0.04
16	North Lauderdale	34,765	34,731	3.75	108	35%	1.250	4.08	1.231	4.41	35	0.00	0.00	0.00
17	North Springs Imp. Dist.	41,289	39,154	4.70	120	65%	1.250	5.46	1.231	6.28	2,134	0.26	0.30	0.34
18	Parkland	3,194	2,067	0.33	160	65%	1.250	0.38	1.231	0.44	1,126	0.18	0.21	0.24
19	Pembroke Pines	150,224	148,813	16.37	110	0%	1.250	16.37	1.231	16.37	1,411	0.16	0.16	0.16
20	Plantation West	89,917	89,917	16.90	188	50%	1.250	19.02	1.231	21.22	0	0.00	0.00	0.00
21	Pompano Beach	88,215	87,962	20.06	228	35%	1.250	21.81	1.231	23.58	253	0.06	0.06	0.07
22	Royal Utilities	3,069	3,068	0.56	181	50%	1.250	0.62	1.231	0.70	0	0.00	0.00	0.00
23	South Broward Utilities	11,751	11,188	1.09	97	50%	1.250	1.22	1.231	1.36	563	0.05	0.06	0.07
24	Sunrise	231,141	231,093	30.50	132	35%	1.250	33.18	1.231	35.86	48	0.01	0.01	0.01
25	Tamarac	58,810	58,764	7.23	123	35%	1.250	7.86	1.231	8.50	46	0.01	0.01	0.01
	Rural Self Supplied	31,049			161	35%	1.250		1.231		31,049	5.00	5.44	5.88
	Totals	1,926,600	1,886,658	293.18				324.53		356.92	39,942	6.25	6.84	7.43

* included in Broward County Service Area.

Recreational Self-Supply

The recreational self-supplied demand category includes self-supplied irrigation demands for large landscaped areas (as opposed to private homes) and for golf courses. Self-supplied large landscaped area is projected to increase from 14,345 acres in 1995 to 19,560 acres in 2020. Landscaping self-supplied average demand in Broward County (not counting golf courses) is projected to increase from 15,220 mgy in 1995 to 20,753 mgy by 2020. The l-in-10 irrigation requirements in 2020 are 25,624 mgy.

In 1995, there were 56 golf courses in Broward County, with a combined irrigated area of 6,662 acres. One of these courses was supplied with reclaimed water, and the rest were self-supplied. An additional five courses switched to reclaimed water for irrigation between 1995 and 1998. The self-supplied irrigated golf course acreage had a combined irrigated area of 6,311 acres in 1995 and this is projected to increase to 6,494 acres by 2020. Self-supplied golf acreage in 1995 had average irrigation requirements of 6,696 mgy, and this is projected to increase to 6,890 mgy by 2020. The l-in-10 irrigation requirement in 2020 for these self-supplied golf courses is 8,507 mgy.

Combined recreational self-supplied average demands for Broward County are equal to 21,916 mgy in 1995 and 27,643 mgy in 2020. The l-in-10 irrigation requirements in 2020 are 34,131 mgy.

Thermoelectric Power Generation Self-Supply

Thermoelectric power plants use and reuse large quantities of water for cooling purposes. Evaporative losses which must be replaced from an external source above and beyond rainfall and runoff were assessed at 0.49 mgd (179 mgy) for 1995, and is projected to remain relatively constant through 2020.

Agricultural Self-Supply

The irrigated commercially grown crops in Broward County are citrus, vegetables, and ornamental nursery. Improved pasture is very seldom irrigated, but there are some demands for cattle watering. Plate 2 shows the agricultural areas, along with the other general land uses in Broward County.

Citrus

Broward County citrus acreage has continuously declined from 5,200 acres in 1966 to 108 acres in 1995-6, and is projected to continue declining to an insignificant level by 2020. This reduction in citrus acreage represents a fall in average irrigation requirements from 67 mgy in 1995 to an insignificant level by 2020.

Vegetables, Melons, and Berries

Vegetable crops grown commercially in Broward County include snap beans, eggplant, peppers, tomatoes, squash, sweet corn, cucumbers, and strawberries. Different types of vegetables are often grown interchangeably. In 1995 there were an estimated 579 acres of land used for vegetable production, and this is forecast to decline to an insignificant level by 2020. This reduction in vegetable acreage represents a fall in average irrigation requirements from 413 mgy in 1995 to an insignificant level by 2020.

Greenhouse/Nursery

In 1995, there were 2,668 acres of ornamental nursery in Broward County. Although some growth in acreage has been recently observed, it is anticipated that urban expansion will limit the 2020 acreage to its 1995 level. These 2,668 acres have average irrigation requirements of 2,485 mgy and l-in-10 irrigation requirements of 3,820 mgy.

Miscellaneous

Cattle Watering. In 1995, there were 21,000 head of cattle in Broward County, including 3,100 dairy cows. Based on the number and type of cattle, the demands for cattle watering were 248 mgy. Recent declines in dairy cattle numbers suggest that by 2020 the dairy industry will not be significant in Broward County, reducing demand for this category to 78 mgy.

Demand Summary

Assessed and projected urban and agricultural demands for Broward County are presented in Table V-2-4. These values for 1995 and 2020 illustrate increasing urbanization. Agricultural demand is projected to decline, with only the nursery industry having significant irrigation demands by 2020. Urban uses make up between 97 and 98 percent of the total average demands throughout the projection period.

Table V-2-4. Urban and Agricultural Demand for Broward County.

Urban and Agricultural Demands	(a) Assessed 1995 (mgy)	(b) Average 2020 (mgy)	(c) Percent Change (a) to (b)	(d) 1 -in-l 0 2020 (mgy)
Urban				
Public Water Supply	81,008	118,453	48%	**130,276**
Domestic Self-Supply	1,843	2,497	35%	**2,712**
Commercial/Industrial Self-Supply	1,338	1,824	36%	**1,824**
Recreational Self Supply	21,916	27,643	26%	**34,131**
Thermoelectric Power Generation Self-Supply	179	179	0%	**179**
Total Urban	**108,284**	**150,598**	**42%**	**189,122**
Agricultural				
Citrus	67	INSIG	- 100%	**INSIG**
Vegetables, Melons, and Berries	413	INSIG	- 100%	**INSIG**
Greenhouse/Nursery	2,485	2,485	0%	**3,820**
Miscellaneous (Cattle Watering)	248	78	-69%	**78**
Total Agricultural	**3,213**	**2,583**	**-20%**	**3,898**
Total Urban and Agricultural Demands	**109,497**	**153,159**	**40%**	**173,020**

INSIG = Insignificant

Approximately two-thirds of Broward County is included in Conservation Areas 2A, 2B, and 3A. The remainder of the county is primarily urban, and is becoming even more urbanized. The 1995 land use is shown in Plate 2. There are a few agricultural areas near the Water Conservation Areas, near the Palm Beach County border, and on the Miccosukee tribal lands west of the Water Conservation Areas.

Dade County

With 2,046,078 residents in 1995, Dade County is the most populous county in Florida. This population has grown by 15 percent between 1985 (when there were 1,776,908 residents) and 1995, and is projected to grow to 2,587,400 by 2020 (BEBR, 2020). The Metro form of city government has led to centralized services, including public water supply utilities.

Public Water Supply

Dade County has a large and centralized PWS distribution system in the Miami-Dade Water and Sewer Authority Department (WASAD). There are five other utilities with pumpages over 0.5 mgd which serve Dade County, and two of these utilities purchase large quantities of water from WASAD (Table V-2-5). The public water supply served population is projected to grow from 1,989,282 in 1995 to 2,514,382 by 2020. Pumpage reports submitted to the District show a demand of 373.34 mgd (136,269 mgy) in 1995. This is projected to increase to average demands of 493.98 mgd (180,303 mgy) by 2020. The l-in-10 demands in 2020 are 537.00 mgd (196,005 mgy). Figure V-2-3 shows the location of public water supply utility withdrawal locations in Dade County.

These demand projections do not include demands from the Florida Keys Aqueduct Authority (FKAA), which has its wellfield in Dade County, but only serves the Florida Keys, which are in Monroe County. FKAA demands are presented in the Monroe County section of this document.

Domestic Self-Supplied and Small Public Supply Systems

About three percent of Dade County's residents were self-supplied in 1995 (Table V-2-5). This percentage is projected to projected to remain about the same through 2020. The self-supplied population is forecast to increase from 56,796 in 1995 to 73,018 in 2020. The associated demands are 10.88 mgd (3,971 mgy) in 1995, with average demands of 14.32 mgd (5,227 mgy) in 2020. In 2020, Dade County has projected l-in-10 domestic self-supplied demands of 15.57 mgd (5,683 mgy).

Figure V-2-3. Public Water Supply Utility Withdrawal Locations in Dade County.

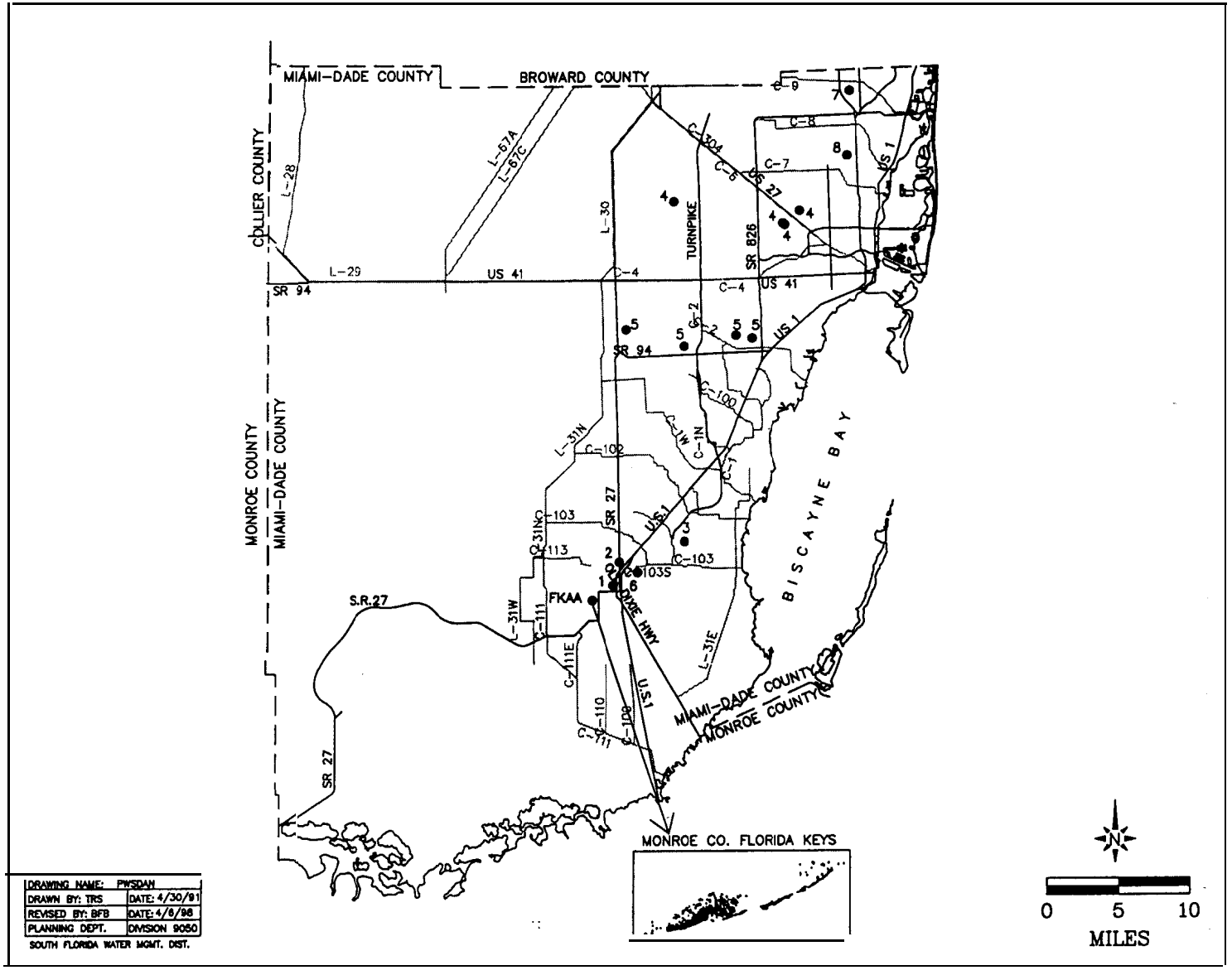


Table V-2-5. Public Water Supplied and Domestic Self-Supplied Demand Projections for Dade County.

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
#	Utility	Total population 1995	PWS population 1995	PWS base MGD 1995	GPCD 1995	Percent outdoor use	Average factor	PWS average MGD 1995	1-in-10 factor	PWS 1-in-10 MGD 1995	DSS population 1995	DSS base MGD 1995	DSS average MGD 1995	DSS 1-in-10 MGD 1995
1	Florida City	6,051	6,026	2.301	382	35%	1.081	2.37	1.249	2.57	25	0.01	0.01	0.01
2	Homestead City	24,151	23,805	6.45	271	35%	1.081	6.63	1.249	7.21	346	0.09	0.10	0.10
3	Homestead AFB	3,014	2,985	1.04	348	35%	1.081	1.07	1.249	1.16	29	0.01	0.01	0.01
4	Miami-Dade (H/P)	764,045	760,148	Incl. below	200	35%	1.081	Incl. below	1.249	Incl. below	3,897	0.78	0.80	0.87
5	Miami-Dade (Orr)	917,668	894,545	340.98	200	35%	1.081	350.67	1.249	381.211	23,123	4.631	4.76	5.18
6	Miami-Dade (Rex)	51,267	48,262	Incl. above	200	35%	1.081	Incl. above	1.249	Incl. above	3,005	0.60	0.62	0.67
7	North Miami Beach *	176,141	174,568	15.39	88	35%	1.081	15.88	1.2491	17.21	1,573	0.14	0.14	0.16
8	North Miami *	79,298	78,943	7.181	91	35%	1.0811	7.381	1.2491	8.03	355	0.03	0.03	0.04
	Rural Self Supplied	24,443			188	35%	1.081		1.249		24,443	4.59	4.72	5.13
	Total	2,046,078	1,989,282	373.34				383.95		417.39	56,796	10.88	11.19	12.17
#	Utility	Total population 2020	PWS population 2020	PWS base MGD 2020	GPCD 2020	Percent outdoor use	Average factor	PWS average MGD 2020	1-in-10 factor	PWS 1-in-10 MGD 2020	DSS population 2020	DSS base MGD 2020	DSS average MGD 2020	DSS 1-in-10 MGD 1995
1	Florida City	9,732	9,707	3.70	382	35%	1.081	3.811	1.2491	4.141	25	0.011	0.01	0.01
2	Homestead City	61,408	61,062	16.54	271	35%	1.081	17.02	1.249	18.50	346	0.09	0.10	0.10
3	Homestead AFB	6.9611	6,932	2.421	348	35%	1.081	2.48	1.249	2.70	29	0.01	0.01	0.01
4	Miami-Dade (H/P)	876,134	872.2371	174.651	200	35%	1.081	179.61	1.249	195.25	3,897	0.78	0.80	0.87
5	Miami-Dade (Orr)	1,152,751	1,129,628	226.18	200	35%	1.081	232.61	1.249	252.87	23,123	4.63	4.76	5.18
6	Miami-Dade (Rex)	166,062	163,057	32.65	200	35%	1.081	33.58	1.249	36.50	3,005	0.60	0.62	0.67
7	North Miami Beach *	192,135	190,562	16.80	88	35%	1.081	17.28	1.249	18.78	1,573	0.14	0.14	0.16
8	North Miami .	81,552	81,197	7.39	91	35%	1.081	7.59	1.249	8.26	355	0.03	0.03	0.04
	Rural Self Supplied	40,665			188	35%	1.081		1.249		40,665	7.63	7.85	8.53
	Total	2,587,400	2,514,382	480.33				493.98		537.00	73,018	13.93	14.32	15.57

* In addition to their own sources, North Miami Beach and North Miami purchase water from Miami-Dade

Commercial/Industrial Self-Supply

Commercial/Industrial water use in Dade County is a function of construction and economic growth, and was assessed at **10,556** mgy in 1995. The demand for industrial self-supplied water (as opposed to PWS supplied) is projected to increase to 13,300 mgy by 2020. PWS supplied industrial demand is included with other public utility demands.

Recreational Self-Supply

The recreational self-supplied demand category includes self-supplied irrigation demands for large landscaped areas (as opposed to private homes) and for golf courses. Self-supplied large landscaped area is projected to increase from 829 acres in 1995 to 1,048 acres in 2020. Landscaping self-supplied average demand for Dade County (not counting golf courses> is projected to increase from 850 mgy in 1995 to 1,075 mgy by 2020. The l-in-10 irrigation requirements for 2020 are 1,342 mgy.

In 1995, there were 36 golf courses in Dade County. These golf courses had a total irrigated area of 4,125 acres. All the golf courses in Dade County in 1995 were self-supplied. Irrigated golf course acreage is projected to increase to 5,644 acres by 2020. Self-supplied golf course acreage in 1995 had average irrigation requirements of 4,228 mgy, and this is projected to increase to 5,785 mgy by 2020. The l-in-10 irrigation requirement for these self-supplied golf courses in 2020 is 7,244 mgy.

Combined recreational self-supplied average demands for Dade County are equal to 5,078 mgy in 1995 and 6,860 mgy in 2020. The l-in-10 irrigation requirements in 2020 are 8,566 mgy.

Thermoelectric Power Generation Self-Supply

Thermoelectric power plants withdraw large quantities of water for cooling purposes. The vast majority of this water is recycled. Evaporative losses were assessed at 1.35 mgd (493 mgy) for Dade County for 1995, and use is projected to remain relatively constant through 2020.

Agricultural Self-Supply

The irrigated commercially grown crops in Dade County are citrus, tropical fruit, vegetables, field crops, and ornamental nursery. Improved pasture is very seldom irrigated, but there are some demands for cattle watering. Plate 2 shows the area currently used for agriculture.

Citrus

Citrus acreage in Dade County is dominated by lime production. Dade County had 86 percent of the lime acreage in Florida in 1995-6, and all the commercial citrus acreage in the county was used for lime production (Florida Agricultural Statistics Service, 1996). Dade County citrus acreage remained relatively constant from 1968 to 1978, in the range from 4,185 to 4,587 acres. Acreage then increased to a high of 7,158 acres in 1982, and then gradually declined to 6,076 acres in 1992.

In August 1992, Hurricane Andrew destroyed much of the citrus acreage in the county, and this acreage is not projected to return. Citrus acreage in Dade County is projected to decline from 2,618 acres in 1995-6 to 1,667 acres in 2020. The decline in citrus acreage has an associated reduction in the average irrigation requirement from 1,996 mgy in 1995 to 1,271 mgy in 2020. The l-in-10 irrigation requirement for citrus in 2020 is 1,621 mgy.

Other Fruits and Nuts

Tropical fruit production (avocados, mangoes, papayas, etc.) was assessed at 8,200 acres in 1995, and is projected to grow to 8,650 acres by 2020. This growth in acreage represents an increase in average irrigation requirements from 4,786 mgy in 1995 to 5,048 mgy in 2020. The l-in-10 irrigation requirement for tropical fruit in 2020 is 6,868 mgy.

Vegetables, Melons, and Berries

A wide variety of vegetables are produced, including the more traditional (bush and pole beans, eggplant, peppers, tomatoes, squash, sweet corn, cucumbers), and Latin vegetables (boniato, malanga, yuca, calabaza). Different types of vegetables are often grown interchangeably. In 1995, there were 49,348 acres of land used for vegetable production, and this is projected to decline to 34,023 acres by 2020. This decline in vegetable acreage represents a decrease in average irrigation requirements from 19,526 mgy in

1995 to 13,462 mgy in 2020. The l-in-10 irrigation requirement for vegetables in 2020 is 15,257 mgy.

Field Crops

The field crops grown in Dade County include field corn, soybean, and sorghum. Field crop acreage was assessed at 3,500 acres in 1995, and is projected to increase to 4,275 acres by 2020. This increase in acreage has average irrigation requirements of 1,473 mgy in 1995 and 1,799 mgy in 2020. The l-in-10 irrigation requirement for field crops in 2020 is 1,976 mgy.

Greenhouse/Nursery

In 1995, there were 8,403 acres of ornamental nursery in Dade County and this is projected to increase to 16,278 acres by the year 2020. This acreage growth increases the average irrigation requirements from 8,456 mgy in 1995 to 16,380 mgy in 2020. The l-in-10 irrigation requirement for nurseries in 2020 is 20,015 mgy.

Miscellaneous

Cattle Watering. In 1995, there were a total of 5,000 head of cattle and calves in Dade County, with no significant amount of these for dairy use. Based on this number the demand for cattle watering is 22 mgy, and is projected to remain relatively constant throughout the projection period.

Aquaculture. The existing fish farming operation involves a continuous flow through system, with withdrawal pumps running 24 hours per day. This withdrawal was assessed as 3,679 mgy in 1995, and was projected to remain at that level through 2020. There is also the continuously disposal of a similar quantity of wastewater, after. the withdrawn water has moved through the system.

Demand Summary

Urban demands are projected to grow by 32 percent between 1995 and 2020. Agricultural demand is projected to rise by 4 percent during that period, primarily due to projected increases in ornamental nursery acreage. Total demand is projected to grow by 26 percent, from 196,305 mgy in 1995 to 247,844 mgy in 2020. Urban demands made up 80 percent of the total average demand in 1995, and are projected to increase to 83 percent of the total average demands by 2020.

Table V-2-6. Urban and Agricultural Demand for Dade County.

Urban and Agricultural Demands	(a) Assessed 1995 (mgy)	(b) Average 2020 (mgy)	(c) Percent Change (a) to (b)	(d) 1-in-10 2020 (mgy)
Urban				
Public Water Supply	136,269	180,303	32%	196,005
Domestic Self-Supply	3,971	5,227	32%	5,683
Commercial/Industrial Self-Supply	10,556	13,300	26%	13.300
Recreational Self Supply	5,078	6,860	35%	8,566
Thermoelectric Power Generation Self-Supply	493	493	0%	493
Total Urban	**156,367**	**206,183**	**32%**	**224,047**
Agricultural				
Citrus	1,996	1,271	- 36%	1,621
Other Fruits and Nuts	4,786	5,048	5%	6,868
Vegetables, Melons, and Berries	19,526	13,462	- 31%	15,257
Field Crops (Field Corn, Soybean, Sorghum)	1,473	1,799	22%	1,976
Greenhouse/Nursery	8,456	16,380	94%	20,015
Miscellaneous (Cattle Watering, Aquaculture)	3,701	3,701	0%	3,701
Total Agricultural	**39,938**	**41,661**	**4%**	**49,438**
Total Urban and Agricultural Demands	**196,305**	**247,844**	**26%**	**273,485**

The Miami area is one of the most urbanized areas in Florida. The surviving agricultural areas are predominantly near Homestead, and produce a wide variety of tropical crops. Water Conservation Areas 3A and 3B and the Everglades National Park are protected areas, and are made up mostly of wetlands. Dade County's land uses are shown in Plate 2.

Monroe County

Monroe County consists of the Florida Keys and a mainland area. The mainland area is largely owned by the federal government and has extremely few residents. The population of Monroe County has grown by 15 percent from 70,522 in 1985 to 81,152 in 1995 (U.S. Bureau of the Census, 1998), and is projected to have 106,000 permanent residents in 2020 (BEBR, 1998).

Practically all of the non-environmental water demands in Monroe County are for urban use in the Florida Keys, and is supplied by the Florida Keys Aqueduct Authority (FKAA). Agricultural water use in Monroe County is negligible (a few very small local nurseries and herb gardeners) and is supplied by the FKAA. Agricultural self-supplied water use is forecast to remain insignificant through the year 2020.

Public Water Supply

All public water supplied (PWS) water used in Monroe County is provided by the FKAA, which has its wellfield in Florida City (in Dade County), and pipes water to the Florida Keys. The location of this wellfield is shown in Figure V-2-3, along with the other PWS utility source locations in Dade County. Other than private well and cistern use, all potable water use is from FKAA.

The PWS served population was assessed at 78,850 in 1995, and is projected to grow to 103,698 by 2020 (Table V-2-7). This increase in PWS served population had associated demands of 14.07 mgd (5,136 mgy) in 1995. Projected average demands for 2020 are 18.88 mgd (6,891 mgy), and the l-in-10 demands in 2020 are 19.47 mgd (7,107 mgy).

Domestic Self-Supply and Small Public Supply Systems

A total of 2,302 residents of Monroe County were self-supplied in 1995. This number is forecast to remain the same through 2020 (Table V-2-7). This self-supplied population had assessed demands of 0.41 mgd (150 mgy) in 1995, and has projected 2020 average demands of 0.42 mgd (153 mgy). The l-in-10 demands in 2020 are 0.43 mgd (157 mgy).

Table V-2-7. Public Water Supplied and Domestic Self-Supplied Demand Projections for Monroe County.

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
				PWS				PWS		PWS		DSS	DSS	DSS
		Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
	Utility	1995	1995	1995	1995	use	factor	1995	factor	1995	1995	1995	1995	1995
	FKAA	81,152	78,850	14.07	178	35%	1.058	14.35	1.090	14.81	2,302	0.41	0.42	0.43
	Total	81,152	78,850	14.07				14.35		14.81	2,302	0.41	0.42	0.43
				PWS				PWS		PWS		DSS	DSS	DSS
		Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	population	MGD	GPCD	outdoor	Average	MGD	I-in-10	MGD	population	MGD	MGD	MGD
	Utility	2020	2020	2020	2020	use	factor	2020	factor	2020	2020	2020	202Q	2020
	FKAA	106,000	103,698	18.50	178	35%	1.058	18.88	1.090	19.47	2,302	0.41	0.42	0.43
	Total	106,000	103,698	18.50				18.88		19.47	2,302	0.41	0.42	0.43

Commercial/Industrial Self-Supply

Commercial/Industrial water use in Monroe County is largely supplied by FKAA and included in the use assessment for that utility. There were about 26 mgy which were self-supplied in 1995, and this is projected to increase to 33 mgy by 2020.

Recreational Self-Supply

There are seven golf courses in Monroe County, two of which are irrigated with self-supplied water, while the others are supplied by the FKAA. Water for the two self-supplied golf courses is pumped from the Floridan aquifer, desalinated by reverse osmosis and used for irrigation. These two golf courses irrigate a total of 287 acres with self-supplied water, and have an average demand of 800 mgy and l-in-10 demands of 872 mgy. This is projected to remain constant through 2020.

Demand Summary

Urban demands are projected to grow by 29 percent, from 6,111 mgy in 1995 to average demands of 7,878 mgy in 2020. Agricultural self-supplied demands are projected to remain insignificant throughout the projection period.

Table V-2-8. Urban and Agricultural Demands for Monroe County.

Urban and Agricultural Demands	(a) Assessed 1995 (mgy)	(b) Average 2020 (mgy)	(c) Percent Change (a) to (b)	(d) l-in-10 2020 (mgy)
Urban				
Public Water Supply	5,136	6.891	**34%**	7,107
Domestic Self-Supply	150	153	**2%**	157
Commercial/Industrial Self-Supply	26	33	**27%**	33
Recreational Self-Supply	800	800	**0%**	872
Total **Urban**	6,111	7,878	**29%**	8,168
Total Agricultural	INSIG *	INSIG"		**INSIG***
Total Urban and Agricultural Demands	6,111	7,878	**29%**	8,168

• INSIG = Insignificant

The mainland area of Monroe County is comprised of portions of the Everglades National Park and the Big Cypress National Preserve, both of which are owned by the federal government and are protected from future urban or agricultural development. The mainland area of Monroe County is classified as wetlands, including the portion in the Lower West Coast Planning Region. All of Monroe County's non-environmental demands are in the Lower East Coast Planning Region

Eastern Hendry County

Hendry County is one the fastest growing counties in agricultural production in Florida, especially in citrus. It is anticipated that future growth in citrus acreage will take place, but at a much slower rate than was experienced during the 1984 to 1994 period. The county is divided between the Lower East Coast Planning Region (Eastern Hendry County) and the Lower West Coast Planning Region (Western Hendry County). Demand estimates and projections are presented here for Eastern Hendry County, which is shown in Plate 2. There are no public utilities in Eastern Hendry County, and all the residents are self-supplied.

Domestic Self-Supply and Small Public Supply Systems

The self-supplied population in Eastern Hendry County for 1995 was assessed at 1,871, and is forecast to increase to 2,700 by 2020 (Table V-2-9). Associated residential self-supplied demands are projected to increase from 0.39 mgd (142 mgy) in 1995 to average demands of 0.58 mgd (212 mgy) in 2020. The l-in-10 demands in 2020 are projected to be 0.61 mgd (223 mgy).

Agricultural Self-Supply

The irrigated commercially grown crops in Eastern Hendry County are citrus, sugarcane, rice, vegetables, sod, and greenhouse/nursery. Pasture is very seldom irrigated, but there are some demands for cattle watering.

Citrus

During 1995-6, Hendry County had more citrus trees than any other county in Florida. Due to higher density planting, Hendry County in 1995-6 was third in the state, behind St. Lucie and Polk counties. Citrus acreage continuously increased from 16,200 acres during 1966 to 99,770 acres during 1995-6. The most significant increases have occurred between 1986 and 1994. This boom is associated with the interregional movement of citrus from central to southwest Florida following the severe freezes in the mid-1980s.

Table V-2-9. Public Water Supplied and Domestic Self-Supplied Demand Projections for Eastern Hendry County.

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
				PWS				PWS		PWS		DSS	DSS	DSS
		Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
		1995	1995	1995	1995	use	factor	1995	factor	1995	1995	1995	1995	1995
	Rural Self Supplied	1,871	0	0.00	206	35%	1.111	0.00	1.166	0.00	1,871	0.39	0.40	0.42
	Total	1,871	0	0.00				0.00		0.00	1,871	0.39	0.40	0.42
				PWS				PWS		PWS		DSS	DSS	DSS
		Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
		2020	2020	2020	2020	use	factor	2020	factor	2020	2020	2020	2020	2020
	Rural Self Supplied	2,700	0	0.00	206	35%	1.111	0.00	1.166	0.00	2,700	0.56	0.58	0.61
	Total	2,700	0	0.00				0.00		0.00	2,700	0.56	0.58	0.61

About 28 percent of the citrus acreage in Hendry County during 1995-6 was in the eastern portion and this ratio has been used to distribute the projected county acreage. Eastern Hendry County citrus acreage is projected to grow from 27,936 during 1995-6 to 31,853 acres by 2020. This increase in acreage represents an increase in average irrigation requirements from 21,625 mgy in 1995-6 to 24,658 mgy in 2020. The l-in-10 irrigation requirement for citrus in 2020 is 29,408 mgy.

Vegetables, Melons, and Berries

Vegetable crops grown commercially in Eastern Hendry County include cucumbers, peppers, tomatoes, watermelons, squash, and eggplant. Different types of vegetables are often grown interchangeably. In 1995, there were about 5,600 acres of land used for vegetable production, and production is projected to grow to 6,160 acres by 2020. Vegetable acreage in 1995 had irrigation requirements of 3,303 mgy and projected 2020 acreage has average irrigation requirements of 3,633 mgy. The l-in-10 irrigation requirements in 2020 are 4,102 mgy.

Field Crops

Sugarcane. In 1995, there were 37,740 acres of sugarcane in Eastern Hendry County. This represented 51 percent of the sugarcane acreage in Hendry County in that year, and this proportion has been used to distribute the projected county acreage. Between 1995 and 1997, sugarcane acreage declined slightly to 36,890 (for sugar and seed) and is projected to stay at that level through 2020. The projected decrease in acreage represents a decrease in average irrigation requirements from 49,685 mgy in 1995 to 48,566 mgy in 2020. The l-in-10 irrigation requirement for sugarcane in 2020 is 57,929 mgy. Because of the production practices used for sugarcane (ratoon and fallow), there is an additional 25 percent of land used for sugarcane production which is fallow in any given year.

Rice. Rice in Eastern Hendry County is grown during the summer months in rotation with sugarcane or winter vegetables, and takes place on land that would otherwise be fallow. Rice acreage in Eastern Hendry County was assessed at 3,500 acres in 1995. Between 1995 and 1997, rice acreage in Eastern Hendry County declined to 2,400 acres, and is projected to remain at that level through 2020. Average demands are 3,010 mgy in 1995, and are projected to be 2,064 mgy in 2020. The l-in-10 demands in 2020 are 2,257 mgy.

Sod

In 1995, there were only two companies producing irrigated sod in Eastern Hendry County, using a total of 4,100 acres. Sod production is forecast to remain at that level through 2020. The associated average irrigation requirements are 6,972 mgy, and the l-in-10 irrigation requirement is equal to 8,071 mgy.

Greenhouse/Nursery

Greenhouse/nursery production in Eastern Hendry County is projected to grow from 267 acres in 1995 to 476 acres in 2020. This represents average irrigation requirements of 454 mgy in 1995 and 809 mgy in 2020. The l-in-10 irrigation requirement for greenhouse/nursery in 2020 is 937 mgy.

Miscellaneous

Cattle Watering. In 1995, Hendry County had 109,000 non-dairy cattle. From District land use maps (for pasture and rangeland) it was assessed that 58 percent of the cattle in Hendry County were in the eastern portion in 1995. The 1995 water demand assessment for cattle watering is 277 mgy, and this is projected to decline to 269 mgy by 2020 as some former pastureland is used for irrigated crops.

Demand Summary

Urban demands are projected to remain at an extremely low level in Eastern Hendry County through 2020. Agricultural demand is projected to rise by two percent during that period, due to projected increases in acreage for citrus and ornamental nurseries. Total demand is projected to grow by two percent, from 85,468 mgy in 1995 to average demands of 87,183 mgy in 2020. Agricultural irrigation demands make up 99.8 percent of the total demand over the projection period (Table V-2-10).

Table V-2-10. Urban and Agricultural Demand for Eastern Hendry County.

Urban and Agricultural Demands	(a) Assessed 1995 (mgy)	(b) Average 2020 (mgy)	(c) Percent Change (a) to (b)	(d) l-in-10 2020 (mgy)
uroan				
Domestic Self-Supply	142	212	49%	223
Total Urban	142	212	49%	223
Agricultural				
Citrus	21,625	24,658	14%	29,408
Vegetables, Melons, and Berries	3,303	3,633	10%	4,102
Field Crops (Sugarcane, Rice)	52,695	50,630	-4%	60,186
Sod	6,972	6,972	0%	8,071
Greenhouse/Nursery	454	809	76%	937
Miscellaneous (Cattle Watering)	277	269	-3%	269
Total Agricultural	85,326	86,971	2%	102,973
Total Urban and Agricultural Demands	85.468	87,183	2%	103,196

The 1995 land use for Eastern Hendry County is shown in Plate 2. Agriculture is the predominant land use, and is most intense on the muck soils in proximity to the Palm Beach County border. Wetlands are interspersed throughout the county but are more prevalent near the Collier County border.

Source Evaluation

Overview of Hydrologic System

Palm Beach County

Palm Beach County has two distinct hydrologic areas. These are the Everglades Agricultural Area (EAA) and eastern Palm Beach County. Although these two areas are in the same county, they are significantly different in many aspects, including the characterization of their water supply and demand.

Surface Water

Everglades Agricultural Area. Surface water is the only source of irrigation to the rich croplands of the EAA. A complicated network of canals, levees, control structures and pumps provides both drainage and irrigation for the area. During the dry season, water from Lake Okeechobee is released under the force of gravity to flow into the primary canal systems. Irrigation on most farms is achieved by pumping water from the main canal into a network of field ditches, thereby raising the water table and providing water to crop roots.

During the wet season this process is reversed. Water is pumped from the irrigation ditches into the primary canal network, and ultimately into the water conservation areas. If runoff exceeds the capacity of the southern EAA pump stations (S-6, S-7, and S-8) water may also be pumped back into Lake Okeechobee. This water may contain high concentrations of dissolved minerals, as well as above normal concentrations of nutrients.

The canals are recharged from runoff within their own basins and inflows from Lake Okeechobee. The lake also provides public water supplies to the cities of South Bay, Pahokee, and Belle Glade.

Eastern Palm Beach County. Surface water systems in or adjacent to areas east of the EAA (eastern Palm Beach County) are so extensive that they control ground water levels to a large degree. Major fresh surface water systems include Water Conservation Area 1 (WCA-l), the City of West Palm Beach Water Catchment Area, the Hillsboro canal, C-51, C-15, C-16, L-40, L-8, C-17, C-18, and M canals, Clear Lake, Lake Mangonia, and numerous surface water management systems operated by independent drainage and water

control districts. Most of these surface water systems are operated for both drainage and water supply purposes. Surface water is used predominantly for agricultural and domestic landscape irrigation. In eastern Palm Beach County, only the City of West Palm Beach uses surface water for its public water supply source.

An additional benefit from the county's maintained canal systems, which is particularly important during droughts, is providing recharge to the Surficial Aquifer System. This recharge has the greatest impact on ground water in the vicinity of large wellfields. Shine et. *al* (1989) reported that under typical conditions, ground water levels near the Boca Raton, Boynton Beach, and the Acme Improvement District wellfields increased by three to four feet due to surface water recharge. In addition, aquifer recharge from the Lake Worth Drainage District canals reduces the potential for coastal saltwater intrusion south of C-16 during droughts.

Despite the apparent abundance of surface water, there is little room for expanding its use. The major surface water systems are recharged by deliveries from Lake Okeechobee or the Water Conservation Areas and rainfall within their own basins. Past droughts have demonstrated that Lake Okeechobee is not always capable of meeting the demands placed upon it.

Ground Water

Everglades Agricultural Area. Ground water within the EAA is not of sufficient quality or quantity to be considered a significant source of supply. The ground water sources are used primarily to meet urban demand. The permeability of the surficial aquifer is low, and nearly impermeable marls almost completely prevent recharge from surface water. Water quality is also poor. During the ice ages, sea level rose and fell repeatedly, inundating and uncovering the Florida peninsula. Because of the structure of the EAA Basin, which greatly retards ground water flow, the sea water was not completely flushed from the aquifer and remains today. Miller (1988) reported chloride concentrations exceeding those acceptable for most agricultural uses, at depths of less than 100 feet below land surface.

The Floridan Aquifer System is capable of producing relatively large amounts of water. However, due to its high chloride content, it would require desalination treatment to be suitable for irrigation purposes. This treatment is not an economically feasible alternative for agricultural irrigation.

Eastern Palm Beach County. Ground water is the predominant source of supply. There are two aquifer systems: the deep Floridan Aquifer System (FAS) and the more shallow Surficial Aquifer System (SAS). The low permeability sediments of the Intermediate Confining Unit (Table V-2-11) separate these aquifer systems.

Although the FAS is capable of producing significant amounts of water, it is nonpotable without desalination treatment within Palm Beach County. The quality of water in the FAS deteriorates with depth, increasing in chloride and dissolved solids content; thus making the deeper producing zones of the aquifer less suitable for development. Due to the availability of less expensive fresh water in the SAS, there has been little incentive for development of the upper Floridan, but it has potential as a future source. In areas such as Jupiter, where there is insufficient water in the shallow aquifers to meet demands, water from the upper portions of the FAS is treated to potable standards.

Table V-2-11. Ground Water Systems in Eastern Palm Beach County.

Hydrogeologic System	Hydrogeologic Unit	Thickness (feet)	Water Resource Potential
Surficial Aquifer System	Biscayne Aquifer	O-110	Yields large amounts of water in the southern part of the county, but is absent north of Okeechobee Blvd. Yields potable quality water except where it has been impacted by saltwater intrusion.
	Unnamed Shallow Aquifer	115-400	Contains zones capable of yielding large-to-moderate quantities of water. Productivity varies with location, generally increasing from north to south. Potential for further ground water development is limited.
Intermediate Confining Unit	Hawthorn Confining Beds	500-700	Does not yield significant quantities of water in Palm Beach County. Slows migration of saline FAS water into the SAS.
Floridan Aquifer System	Floridan Aquifer	2,300-2,700	Capable of high yields in some areas but is nonpotable without desalination treatment. Water quality deteriorates with increasing depth.

The SAS is the primary source of potable water in eastern Palm Beach County. Within the county, the aquifer system can be divided into two zones: a high to moderately transmissive production zone used by almost all ground water users in eastern Palm Beach County, and a less transmissive, non-production zone. The production zone includes the northernmost extent of the high yielding Biscayne Aquifer, and a moderately transmissive unnamed interval. The Biscayne Aquifer is not present throughout the whole county, and its distribution is the major factor defining water supply for urban Palm Beach County. South of Okeechobee Boulevard (S.R. 802), the Biscayne Aquifer is present almost everywhere, but to the north, it narrows to a strip through the middle of the county. This strip begins to thin just south of the L-8 canal, and disappears altogether around C-18.

Water quality within the SAS varies greatly with location. In the Biscayne Aquifer and along the coastal ridge (except where it has been affected by saltwater intrusion), ambient water quality is within potable standards for salinity and dissolved solids. Water quality deteriorates to the west, becoming increasingly saline.

Broward County

Surface Water

Surface water systems in or adjacent to Broward County are so extensive that they control ground water levels to a large degree. A network of canals, operated by the District, carry water into Broward County from Lake Okeechobee and the Water Conservation Areas. These canals were originally built for drainage but also provide water for supply. This water is used to irrigate adjacent agriculture and landscapes, maintain a barrier against saltwater intrusion, and provide recharge to coastal wellfields. Water availability from the canal system is dependent on local rainfall, rainfall in the Kissimmee Basin, and storage in Lake Okeechobee and the conservation areas. There is no guarantee that the regional canal system will always be able to supply water in adequate amounts during drought periods.

Ground Water

Two major aquifer systems have been recognized in Broward County: the Floridan and the Surficial (Table V-2-12). The Floridan Aquifer System (FAS), though regionally very important, contains only nonpotable water within Broward County. The upper portion of the FAS contains brackish water in which salinity increases with increasing depth and distance down gradient, and southward from central Florida. Floridan water requires desalination treatment to be acceptable for either potable or irrigation uses. Due to the current availability of less expensive fresh water from the Biscayne Aquifer (in the SAS), there has been little incentive for development of the upper Floridan, but it has significant potential as a future source.

The Surficial Aquifer System (SAS) is currently the primary source of potable water within Broward County. Sediments within the SAS exhibit a wide range of permeability, and may be divided locally into one or more aquifers separated by semi-confining layers (Fish, 1988). Of these aquifers, only the Biscayne is formally named. This cavernous limestone aquifer is one of the most productive in the world. It is also the primary source of drinking water for all municipal water systems south of C-51 (which is in Palm Beach County).

The Biscayne Aquifer is recharged by direct infiltration of rainfall and canal inflow. During the dry season, canals bringing water from Lake Okeechobee and the Water Conservation Areas provide recharge to the aquifer. The Biscayne Aquifer produces good quality water in eastern Broward County, but because of its high permeability and proximity to land surface, it is highly susceptible to both saltwater intrusion and contamination from surface sources. East of the WCAs, Biscayne waters are higher in organics and color, requiring additional and more expensive treatment for potable use. Upconing of connate saline water is also a problem in the western section of eastern Broward County.

Table V-2-12. Ground Water Systems in Broward County.

Hydrogeologic System	Hydrogeologic Unit	Thickness (feet)	Water Resource Potential
Sutficial Aquifer System	Biscayne Aquifer	20-I 80	Most productive unit of the Surficial Aquifer System, and primary source of fresh water to Broward County. Produces large quantities of good quality water in the east, except where it has been contaminated by saltwater intrusion. In the west, the aquifer is thinner, and may have high organic content and chloride level.
Intermediate Confining Unit	Hawthorn Confining Beds	500-700	Does not yield significant quantities of water in Broward County. Slows migration of Floridan Aquifer water into the SAS.
Floridan Aquifer System	Tampa Formation	O-250	Capable of high yields in some areas, but not potable without desalination treatment. Best producing zones occur near the top of each formation. Water quality deteriorates with increasing depth.
	Suwanee Limestone	50-450	
	Ocala Limestone	O-500	
	Avon Park Formation	50-700	

Dade County

Surface Water

Surface water systems in or adjacent to Dade County are so extensive that they control ground water levels to a large degree. Most of these surface water systems are operated for both drainage and water supply purposes. A network of canals, operated by the District, carries water into Dade County from Lake Okeechobee and the Water Conservation Areas. This water is used to irrigate agriculture and landscapes, maintain a barrier against saltwater intrusion, and provide recharge to coastal wellfields. Water availability from the canal system is dependent on rainfall in the Kissimmee Basin, and storage in Lake Okeechobee and the Conservation Areas. There is no guarantee that the canal system will always be able to supply water in adequate amounts during droughts periods.

Ground Water

Two major aquifer systems have been recognized in Dade County: the Floridan and the Surficial (Table V-2-13). The Floridan Aquifer System, though regionally important, contains only nonpotable water within Dade County. The upper portion of the Floridan contains brackish water in which salinity increases with increasing depth and distance southward from central Florida. Floridan water requires desalination treatment to be acceptable for either potable or irrigation uses. Due to the current availability of less expensive fresh water from the Biscayne Aquifer (in the SAS), there has been little incentive for development of the upper Floridan, but it has potential as a future source.

The Surficial Aquifer System (SAS) is the sole source of potable water within Dade County. Sediments within the SAS exhibit a wide range of permeability, and may be divided locally into one or more aquifers separated by semi-confining layers (Fish, 1988). Of these aquifers, only the Biscayne is formally named. This cavernous limestone aquifer is one of the most productive in the world. It is also the primary source of drinking water for all municipal water systems south of C-51 (which is in Palm Beach County).

The Biscayne aquifer is recharged by direct infiltration of rainfall and canal inflow. During the dry season, canals bringing water from Lake Okeechobee and the Water Conservation Areas provide recharge to the aquifer. The Biscayne Aquifer produces good quality water in eastern Dade County, but because of its high permeability and proximity to land surface, it is highly susceptible to both saltwater intrusion and contamination from surface sources. In western Dade County, Biscayne waters are generally higher in organics and color, making them more expensive to treat for potable uses.

Table V-2-13. Ground Water Systems in Dade County.

Hydrogeologic System	Hydrogeologic Unit	Thickness (feet)	Water Resource Potential
Surficial Aquifer System	Biscayne Aquifer	20-l 80	Most productive unit of the surficial aquifer system, and the primary source of fresh water to Dade County. Produces large quantities of good quality water in the east, except where it has been contaminated by saltwater intrusion. In the west, the aquifer is thinner and may have high organic content.
Intermediate Confining Unit	Hawthorn Confining Beds	500-700	Does not yield significant quantities of water in Dade County. Slows migration of Floridan Aquifer water into the SAS.
Floridan Aquifer System	Tampa Formation	O-250	Capable of high yields in some areas, but not potable without desalination treatment. Best producing zones occur near the top of each formation. Water quality deteriorates with increasing depth.
	Suwanee Limestone	50-450	
	Ocala Limestone	O-500	
	Avon Park Formation	50-700	

Monroe County

Surface Water

There are no significant sources of fresh surface water in the populated portions of Monroe County (i.e., the Florida Keys). Although Key West possesses a sea water desalination plant, it is for backup purposes only. Due to the large amounts of energy required for sea water desalination, it is economically viable only when no other alternatives exist.

Ground Water

Two sources of ground water underlie Monroe County: the Floridan Aquifer System (FAS), and the Surficial Aquifer System (SAS) (Table V-2-14). The FAS is a confined artesian aquifer. In the Keys, wells tapping the FAS will flow at land surface at rates ranging from 75 to 1,000 gpm. Although available in

significant quantities, Floridan water requires desalination treatment before it is suitable for either potable or irrigation uses. Chloride concentrations in the FAS range from 1,600 to 20,000 mg/l, with concentrations generally increasing to the south.

Table V-2-14. Ground Water Systems in Monroe County.

Hydrogeologic System	Hydrogeologic Unit	Water Resource Potential
Surficial Aquifer System	Biscayne Aquifer	Largely saline, a lens of relatively fresh water floats above the salt water on some of the larger keys. Must be desalinated for potable use. No additional withdrawals will be permitted. Vulnerable to spills and contamination.
Intermediate Confining Unit	Hawthorn Confining Beds	Very low permeability, confining unit for the FAS.
Floridan Aquifer System	Floridan Aquifer	Wells yield from 75 to 1,000 gallons of saline water per minute. Requires desalination for all uses. Some zones may be suitable for ASR applications.

In the Florida Keys, water from the Biscayne Aquifer ranges from brackish to chloride levels associated with sea water, and requires desalination for potable use. On some of the larger keys, a lens of fresh water floats above the salt water. The largest of these freshwater lenses occur on Key West and Big Pine Key, but limited quantities also occur on Cudjoe and Sugar-loaf Keys. Chloride levels in these lenses are too high for human consumption, but are suitable for most irrigation purposes, and provide the major source of drinking water for wildlife. Some Monroe County residents provide their own water supply using home reverse osmosis plants to desalinate Biscayne Aquifer water, or collecting rain water in cisterns. However, due to the limited availability of fresh ground water, its vulnerability to saltwater intrusion, and importance to wildlife, no additional wells have been permitted in the shallow aquifer since February 1986.

The primary source of water to the Keys is from the Florida City wellfield, which pumps water from the Biscayne Aquifer in southeastern Dade County. The Florida Keys Aqueduct Authority (FKAA) is the agency responsible for

obtaining and delivering fresh water to the Keys. The FKAA treats the water in Florida City, then pipes it via aqueduct to Florida Keys residents.

Eastern Hendry County

Surface Water

Lake Okeechobee (directly or via the Caloosahatchee River) is a source of water for much of northern Hendry County. Water is drawn from the river or lake through a series of canals, which also provide drainage. These canals include the Townsend Canal, the Roberts Canal, Gerber Groves Canal (C-2), Collins Slough Canal (C-31, the Hendry-Hilliard Canal, the Forty-Foot Canal, and the Industrial Canal. The City of Clewiston's potable water supply is withdrawn from the Industrial Canal.

The Army Corps of Engineers operate the three water control structures on the Caloosahatchee River (S-77, S-78, and S-79). Stages in the river are maintained primarily for navigation. Water withdrawn for irrigation results in a lowering of the stage. The Corps releases water from Lake Okeechobee to restore the stage to navigable levels. Water is also periodically released to flush the system of saline water, entering the river as a result of the operation of the navigation locks.

Eastern Hendry County is also served by a canal network. Canals includes L-l, L-l east, L-2, L-2 west, L-3, the west and north feeder canals, and the L-28 interceptor canal. These are drainage canals and do not have the capability to support additional withdrawals.

Ground Water

All of southern Hendry County, and an increasing percentage of northern Hendry County, depend on ground water as its primary source. The southern portion of the county has always been dependent on ground water because of the lack of surface water sources. The northern portion of the county is becoming more dependent on ground water as irrigation demands increase and surface water supplies reach their capacity.

Three aquifer systems occur in the county: the SAS, the IAS, and the FAS (Table V-2-15). Water in the FAS is too saline for most uses, leaving the SAS and IAS as the primary sources of ground water in the county. Individual

aquifers used include the water table aquifer, the lower Tamiami aquifer, and the sandstone aquifer.

Table V-2-15. Ground Water Systems in Eastern Hendry County.

iydrogeologic System	Hydrogeologic Unit	Thickness (feet)	Water Resource Potential
Surficial Aquifer System	Water Table Aquifer	3-99	Extensive throughout Hendry County. Productivity varies widely. Heavily used in isolated areas where other aquifers do not exist, or are low yielding.
	Lower Tamiami Aquifer	o-1 35	Most productive aquifer in Hendry County. Heavily used in the southeast county area. Thin or nonexistent in the northern and western portions of the county.
Intermediate Aquifer System	Sandstone Aquifer	O-120	Occurs only in Western Hendry County.
	Mid-Hawthorn Aquifer	No Data	Limited occurrence in Hendry County. Very low productivity; water quality not suitable for most irrigation uses.
Floridan Aquifer System	Lower Hawthorn/ Suwanee Aquifer	No Data	Little is known about the Floridan in Hendry County. It is believed to be capable of producing large volumes of water through flowing wells. Water is not suitable for irrigation.

The SAS consists of two aquifers: the water table aquifer and the lower Tamiami aquifer, separated by the Tamiami confining zone. The water table aquifer is the only aquifer that occurs throughout all of Hendry County. Due to the system's variable water-bearing characteristics, its susceptibility to drought stress, and its potential impacts to wetlands, it is not heavily used throughout the county. However, there are some isolated areas where intensive use of the water table aquifer does take place.

The lower Tamiami aquifer is the most prolific aquifer in Hendry County. It supplies all of the ground water for irrigation in the southeast county area.

It is less prolific in the north county area, and is. absent in northwestern Hendry County. Because it is semi-confined in nature, it is less susceptible to drought stress than the water table aquifer. It is heavily developed in portions of southeastern Hendry County, however, and may be reaching its capacity there.

The IAS in Eastern Hendry County consists of two aquifers: the sandstone aquifer and the deeper mid-Hawthorn aquifer. The sandstone occurs in western Hendry County and not in the eastern portion of the county. The mid-Hawthorn aquifer yields very small quantities of poor quality water in Hendry County. Therefore, it is not used as a source of water.

The FAS contains a series of aquifers and producing zones. Some of these zones have the capability to produce large quantities of water through flowing wells. However, the quality of the water is quite poor. The FAS, therefore, is not used as a source of water in Hendry County.

Assessment Criteria Used

A Lower East Coast Water Supply Plan with a 2020 future horizon is now in development, and is scheduled for completion in the year 2000. In order to provide information on the state of the SFWMD regarding water supply planning in the Lower East Coast and to fulfill FDEP outline requirements for this Assessment, results from the Interim Plan for Lower East Coast Regional Water Supply (1998) are included. This is similar to the approach being used by other water management districts.

The assessment criteria (performance measures) used in planning process for the Interim Plan for LEC Regional Water Supply were designed to provide a reasonable estimate of predicted hydrologic patterns in the Everglades wetland areas, and to predict the frequency and severity of imposed water use restrictions on agricultural and urban water users in the study area.

The performance measures used in the LEC planning process were developed in conjunction with the LEC Regional Water Supply Plan Advisory Committee, the LEC Working Group, and public input. These performance measures were used in the South Florida Water Management Model (SFWMM) to forecast how wetland hydrologic patterns and agricultural and urban water use restrictions will be effected by projected increased demands.

The model was also instrumental in suggesting recommendations made to address these projected problems.

Natural Areas Protection and Criteria

Protection and enhancement of the environment was a major objective of the Interim Plan for LEC Regional Water Supply. In order to help protect ecosystems, a process was developed for evaluating the environmental water supply needs of the regional ecosystem. In August 1994, a Scientific Working Group was established to help identify initial hydrologic restoration targets for the Everglades. The working group reached a consensus that the Natural System Model (NSM) represents a reasonable estimate of the hydrologic patterns necessary to restore the Water Conservation Areas and Everglades National Park and provide improved flows toward Florida Bay.

In addition to the NSM, the water supply plan incorporated the SFWMM as a method for simulating both current and future surface and ground water conditions within the LEC Planning Region under various water supply planning scenarios. More than 40 environmental performance measures were developed as part of the plan to analyze and evaluate output generated from both the NSM and the SFWMM. In general, these performance measures represent hydrological surrogates for measuring how well a particular water supply alternative meets the environmental objectives of the plan for each identified natural area.

Evaluation tools include development of (1) wetland hydroperiod and surface water ponding difference maps, (2) wetland stage hydrographs and stage duration curves at key water management gages as compared to Natural System Model targets, (3) flow/salinity criteria to protect downstream estuaries, (4) calculation of flow volumes across model grid cell flow lines, and (5) minimum water level criteria to protect wetland peat and marl soils. These tools, criteria and performance measures have been successfully applied to evaluate numerous model runs and water supply alternatives. The majority of government agencies and local interest groups have accepted this methodology and approach.

In addition to the development of environmental performance measures, a set of preliminary estimates of minimum flows and levels (MFLs) was developed for several water bodies contained within the LEC Planning Region. Preliminary MFL targets were developed for Lake Okeechobee's

littoral zone, the Water Conservation Areas, Everglades National Park, and the St. Lucie and Caloosahatchee estuaries. These targets were incorporated into the planning effort as sets of environmental performance measures for these areas.

Water Supply Protection Criterion

The LEC planning goal relative to sea water intrusion is to prevent additional inland movement of the saltwater front that could threaten existing water supplies. During periods of drought, the water table may drop and increase the potential for the saltwater front to move further inland. To help prevent this movement, water suppliers are often required to reduce pumpage. The District's water restriction program consists of four phases, each requiring successively more reductions in pumpage depending on the potential for inland migration of the saltwater front. An objective in the planning process was to limit the predicted number of months of 2010 water restrictions to the same number predicted to occur in the 1990 base case or the l-in-10 year drought level of service. That is, even with predicted significant increase in demand in the year 2010, water users would expect the frequency and severity of restrictions in 2010 to be no worse than those in the 1990 base case.

Water supply constraints (supply-side management) are placed on agricultural users in the Everglades Agricultural Area around Lake Okeechobee during dry periods when lake levels drop. Similarly, the objective in the planning process is to limit the predicted level of 2010 supply-side management to the same level predicted to occur in the 1990 base case or to the l-in-10 level of service.

Hydrologic Impacts Due to Demands

During the Lower East Coast water supply planning process, two water demand levels for Palm Beach, Broward, Dade, and Monroe counties were examined. Population projections for 2010 were taken from the local comprehensive plans, and an irrigated agricultural acreage scenario for 2010 was developed based on the acreage trends at the time.

Table V-2-16 shows the populations and acres of irrigated agriculture simulated by county for the Interim Plan for LEC Regional Water Supply, and compares these with the population and acres of irrigated agriculture projected for the year 2020 in this Assessment.

Table V-2-16. Population and irrigated agricultural acreage comparison between the Interim Plan for Lower East Coast Regional Water Supply (2010) and the Districtwide Water Supply Assessment (2020).

County	Population IPLECRWS (2010)	Population DWSA (2020)	Irrigated agricultural acreage IPLECRWS (2010)	Irrigated agricultural acreage DWSA (2020)
Palm Beach	1597,535	1,464,000	468,695	354,412
Broward	1.773,034	1,926,600	7,155	4,918
Dade	2,547,285	2,587,400	80,919	64,893
Monroe	97,433	106,000	0	0

Interim Plan for Lower East Coast Regional Water Supply (1998) Results

The 1990 base case represents conditions in the area as they existed in 1990, including land use, population, and water management facilities and operating procedures. These conditions were used, along with a 26-year period of historical climatic conditions, to allow the South Florida Water Management Model (SFWMM) to simulate the response of the existing water management system. Performance measure output generated by the SFWMM was then used to assess how well water management goals would be met under the 1990 base case. Analyses of the 1990 base case provided some insight as to the extent of problems in the 1990 situation. These analyses helped to determine the timing and priority of needed improvements.

The 1990 base case included 1990 operational procedures that direct the use of the regional system primarily toward meeting urban and agricultural water supply needs. The operational procedures do not include minimum flows and levels or rainfall-driven water supply deliveries to environmental areas, except for the experimental schedule implemented for Everglades National Park in 1985. The operational procedures have a great effect on the performance of the system under the 1990 base case.

Key region-wide results for the 1990 base case reflect:

- Water shortages in major service areas were in effect in 14-21 percent of the months during the 26-year period of analysis (19651990). In almost all cases, they were Phase 1 restrictions, the mildest level of water shortage.

- Supply-side management based reductions in water deliveries to the Lake Okeechobee Service Area contributed to 11 percent of irrigation demands not being met for the EAA; 7 percent of irrigation demands for the other Lake Okeechobee Service Area Basins were not met.

- Average annual regional system deliveries to meet LEC Service Area demands were 194,600 acre-feet.

- Seepage losses from the Everglades to the coastal basins averaged 854,000 acre-feet per year.

- Regulatory releases from Lake Okeechobee occurred in 11 years of the 26-year period simulated in the model. For the 26-year simulation, regulatory releases to the St. Lucie Estuary totaled 2,600,000 acre-feet, while those to the Caloosahatchee Estuary totaled 6,000,000 acre-feet.

- Average annual canal flows to Lake Worth Lagoon were 478,000 acre-feet.

- Average annual canal flows to Biscayne Bay were 1,100,000 acre-feet.

- The Everglades that exists today represents a remnant ecosystem. Loss of more than 50 percent of the historic Everglades has significantly reduced the habitat options and long-term survival of many species of wildlife that have large spatial requirements.

- The 1990 base case simulation reflected,that in the Water Conservation Areas (WCAs), only 58.4 percent (-492,000 acres) of the area matched the Natural System Model hydroperiod target +/-30 days. Canal construction and impoundment of the WCAs has increased the flow of water south, which has created deep water, prolonged flooding at the southern portion of each WCA, and over-drained conditions at the north end.

- Under simulation conditions, the majority of water was routed through the WCAs via canals as channelized flow, rather than as overland sheet flow.

- There is documentation showing that these altered hydropatterns changed wetland plant communities and wildlife habitat, and altered the frequency, distribution and intensity of fire within the WCAs.

- The Holey Land and Rotenberger Wildlife Management Areas were experiencing excessive drying, repeated muck fires, soil subsidence, and tree island damage resulting from wildfires and low water levels. These areas were in need of hydrologic restoration.

- Under the 1990 base case, Shark River Slough (ENP) annually received an average of 782,000 acre-feet/year of water across Tamiami Trail. This is 29 percent less water than predicted for the natural, pre-drainage Everglades System.

- In terms of 1990 distribution, too much water (88 percent) was routed to western Shark River Slough.

- Under 1990 base case conditions, only 47.9 percent (-233,000 acres) of ENP wetlands matched the Natural System Model hydroperiod target +/- 30 days.

- Minimum flows and levels were not met at a number of interior marsh sites in both the ENP and the WCAs.

- The simulation of the 26-year period indicated that on two occasions, Lake Okeechobee's littoral zone was flooded for more than a 2-year duration.

- The simulation of the 26-year period also showed that on two occasions, the minimum level and duration criteria were not met in Lake Okeechobee; (four times are allowable).

In general, the 1990 base case analysis showed that the 1999 system could meet the human needs fairly well. However, large portions of the Everglades did not receive adequate quantity, timing, or distribution of water for the needs of the ecosystem.

In preparing the 2010 base case, it was assumed that a series of ongoing projects would have been implemented, including the Kissimmee River restoration (which would have slightly reduced inflows to Lake Okeechobee); the C-111 Canal project in south Dade County (which would have provided a series of marsh storage areas along the southeast side of ENP); the Modified Water Deliveries Project to ENP (an attempt to improve flows through WCA-3B to ENP); and the new WCA-1 regulation schedule (which will have incorporated the operation schedule that was implemented in 1995 for the Arthur R. Marshall Loxahatchee National Wildlife Refuge).

In preparing the 2010 base case, it was also assumed that the facilities mandated by the Everglades Forever Act would be operational. These include 40,000 acres of STAs, facilities to increase flows into the Everglades (water from the western portion of the C-51 Canal), and facilities to increase flows into Lake Okeechobee (Northern L-8 Canal basin improvements). The simulation also included the implementation of a program to deliver water to the Everglades from Lake Okeechobee to replace water diverted from the Everglades by on-farm operational changes (best management practices) that were made by EAA farmers to reduce water quality problems. (This replacement water delivery program, which was implemented in 1996, is sometimes called the Best Management Practice Make Up Water Rule.)

The 2010 base case further assumed that the 2010 population of six million people would be distributed across the region as projected by local government comprehensive plans, and that the population would be assigned to utility service areas. Future public water supply demands would be assigned to existing water withdrawal facilities, which were assumed to have been maintained at their 1990 locations. Irrigation requirements were also estimated based on the projected 2010 land use, as identified in local government comprehensive plans.

Key projected region-wide results for the 2010 base case simulation, which is based on the same 26-year period evaluated for the 1990 base case but which projects water supply demands based on anticipated changes by the year 2010, include:

- The proportion of months that water restrictions would be in effect in major service areas ranged from 21 percent to 58 percent of the months during the 26-year period of analysis. The number of months of more severe shortages would be greatly increased, compared to the 1990 base case.

- Due to supply-side management based reductions in water deliveries to the Lake Okeechobee Service Area, under 2010 conditions 22 percent of demands would not be met for the EAA and 19 percent would not be met for the other Lake Okeechobee Service Area basins.

- Average regional system deliveries to meet LEC Service Area demands would be 211,000 acre-feet, up slightly from the 1990 base case.

- Seepage from the Everglades to the east would average 1,051,000 acre-feet, almost 200,000 acre-feet more than the 1990 volume, primarily due to additional seepage from WCA-3B and ENP.

- Under the year 2010 base case conditions, regulatory releases from Lake Okeechobee would occur in 8 years of the 26-years. For the same period, discharges to the St. Lucie Estuary would total 2,026,000 acre-feet, while those to the Caloosahatchee Estuary would total 4535,000 acre-feet. These amounts are much less than occurred during the 1990 base case simulation, primarily due to anticipated lower levels in Lake Okeechobee caused by the additional demands on the lake.

- Average annual canal flows to the Lake Worth Lagoon would be 372,000 acre-feet, which is about 100,000 acre-feet per year less water than was discharged during the 1990 base case simulation, due largely to the Everglades Construction Project.

- Average annual canal flows to Biscayne Bay would be 979,000 acre-feet, which is about 80,000 acre-feet less flow than occurred in the 1990 base case.

- In the WCAs, 60.5 percent of the area would match Natural System Model hydroperiod targets +/-30 days. This is slightly. more than matched in the 1990 base case (58.4 percent). However, 26.4 percent of the remaining area still would have hydroperiods that were too short, whereas 13.1 percent would have hydroperiods that were too long.

- In the WCAs, performance related to minimum level criteria would be much better for WCA-1 and WCA-3B, and worse for northern WCA-3A and WCA-2, compared to the 1990 base case.

- In ENP, 54.7 percent of the area would match Natural System Model hydroperiods. This is significantly more than in the 1990 base case. However, 45.3 percent of the area would still have hydroperiods shorter than the Natural System Model.

- In ENP, performance related to minimum level criteria would be slightly better than occurred in the 1990 base case.

- In Lake Okeechobee, the littoral zone would be flooded twice for more than a two-year duration, the same frequency as in the 1990 base case.

- As in the 1990 base case, the minimum level and duration criteria would be exceeded twice.

In comparing the 1990 and 2010 base case results, a number of trends were observed. These trends include:

- Urban areas will experience more frequent and severe water shortages by 2010.

- In the EAA, agricultural irrigation demands will have to remain unmet twice as often as in the 1990 base case. In the Caloosahatchee Basin, demands will have to remain unmet more than twice as often.

- Although some improvements are noted over the 1990 base case, the overall environmental performance in the 2010 base case will fall short of the environmental water supply objectives developed in the LEC water supply planning process.

During the LEC water supply planning process, five alternatives were evaluated using the SFWMM. The options comprising each alternative are

described in the Interim Plan for LEC Regional Water Supply (1988). Overall, the options selected for Alternative 5 will work well in securing future water supply for the region, improving the level of service for urban users, protecting the agricultural users with adequate water supply, and allowing for further implementation of the Everglades Forever Act's mandate to restore hydropatterns in the Everglades.

A total of 14 options were included in Alternative 5, which form the backbone of the recommendations in the Lower East Coast planning process. The Alternative 5 options were broken into two major categories. "Phase 1" options are those that generally can be implemented in five to seven years, without significant federal assistance, by the SFWMD and local governments, potentially with some state participation. Phase 2 and other longer-term options are being evaluated in the Comprehensive Review Study (Restudy) of the C&SF Project.

The Phase 1 options will not significantly reduce the frequency or severity of demands not met as compared to the 2010 base case in the Lake Okeechobee Service Area. These results underscore the advantages of proceeding with Phase 2 options that will capture and store additional water until it is needed.

Under Phase 2 conditions, the water shortages in the Lake Okeechobee Service Area will be significantly reduced from the 2010 base case and will be close to, but somewhat above, the levels expected in the 1990 base case conditions. Public water suppliers dependent on Lake Okeechobee and the Caloosahatchee River will have less frequent water shortages than the Coastal Basin utilities discussed above. However, on a relative basis they would be subject to more frequent water shortages in the 2010 base case and Phase 1, but would see their water shortage frequency significantly reduced under Phase 2. If future operating decisions cause the stages in Lake Okeechobee to reach 10 feet, intakes for some utilities surrounding Lake Okeechobee may need to be modified.

The results of the analyses of Alternatives 1 through 5 (SFWMD, 1998) indicate that additional water beyond that provided by the Alternative 5, Phase 2 options would provide additional restoration benefits to the Everglades.

Adequacy of Regional Sources

The District concluded in its Interim Plan for Lower East Coast Regional Water Supply (1958) that the water supply needs of the region could best be met by substantially increasing water storage. This includes investing in technologies such as aquifer storage and recovery, which give added protection of supplies from prolonged periods of low rainfall. In addition, subregional plans are being developed for the urban areas; to better define available local resources, and to determine how regional resources can best be distributed.

Without steps to expand storage and provide alternative sources of water, the regional system faces severe stresses in the not too distant future. Competition for the supplies in the existing limited system will mean more severe water shortage restrictions, increased risk of economic impacts from water supply cutbacks, and potential roadblocks to restoration of hydropatterns in the Everglades.

Section V

Part 3

Upper East Coast Planning Region Assessment

The Upper East Coast Planning Region, which is shown on Plate 3, includes St. Lucie and Martin counties and the eastern portion of Okeechobee County. Water for urban and agricultural uses in the planning area comes from three main sources: the Floridan Aquifer System (FAS), the Surficial Aquifer System (SAS), and surface water.

Surface water from the C-23, C-24, and C-25 canals is used primarily for agricultural irrigation, with the FAS used as a backup source during periods of low rainfall. These canals are not connected to Lake Okeechobee. The SAS is the principal source for public water supply and urban irrigation. However, as the population in the planning area increases, the urban areas are anticipated to increase their use of the FAS as a source of drinking water.

The Upper East Coast Water Supply Plan (1998) concluded that historically used sources of water, especially the SAS in the coastal portions of the region, are not sufficient to meet projected water demands during a l-in-10 drought condition. Analyses indicated that the surficial aquifer has limited potential for expansion due to potential impacts on wetland systems, and increased vulnerability to saltwater intrusion in the vicinity of public water supply wellfields.

The Floridan aquifer appears to be the most promising source for future urban potable water needs. It will also continue to be source of water for agricultural operations, where it is used as a backup source when surface water supplies are limited. Analyses indicate that the Floridan aquifer has sufficient supplies to meet both existing and future urban and agricultural demands. Although the Floridan aquifer is productive, it is saline, and requires desalination prior to potable use, and must be blended with fresh surface water prior to agricultural use.

In western portions of the region where surface water from the regional canal system is heavily relied upon for agricultural needs, analyses showed that existing surface water supplies are inadequate to meet existing as well as future demands. Surface water availability is essentiaily a function of climate and storage; there are excess amounts during the summer wet season, and insufficient supplies during dry winter months. This problem of timing is particularly illustrated by the impacts of freshwater discharges to the St. Lucie Estuary and Indian River Lagoon. During periods of high rainfall, excessive discharges decrease the salinity of the estuary to essentially fresh water, resulting in the loss of historic seagrass and oyster bed systems. Conversely, during drought periods, insufficient freshwater discharges increase the salinity to essentially salt water, resulting in negative environmental impacts.

Several water source options were considered in the Upper East Coast Water Supply Plan to address the water supply issues identified. Surface water storage, aquifer storage and recovery, and the Floridan aquifer had the greatest potential to address several of the issues.

Surface water storage involves the capture and storage of excess surface water during rainy periods and subsequent release during drier periods for environmental and human uses. Regionally, surface water storage could be used to attenuate freshwater flows to the St. Lucie Estuary and the Indian River Lagoon during rainy periods and meet minimum flows during drier periods. In addition, these storage areas could increase surface water availability for current and projected agricultural uses, and decrease the demand on the Floridan aquifer.

Aquifer Storage and Recovery (ASR) technology shows great promise both for treated and untreated water by providing a storage option during periods of water availability. Other strategies, such as targeting particularly vulnerable areas for conservation programs and greater development of reclaimed water use, are important water source options.

In addition to the Upper East Coast Water Supply Plan, the SFWMD is committed to other planning efforts in the UEC. These efforts include the Indian River Lagoon Restoration Feasibility Study, which will be evaluating many options for addressing specific management of freshwater inflows to the St. Lucie Estuary and Indian River Lagoon.

Water Demand Projections

St. Lucie County

St. Lucie County has experienced substantial growth in the decade from 1985 to 1995, both in population and in agriculture. The permanent resident population has grown by 48 percent from 115,949 in 1985 to 171,914 in 1995 (Bureau of the Census, 1998) and is projected to grow to 281,500 by 2020 (BEBR, 1998). Coastal areas have experienced rapid urban development, which has given rise to increasingly significant public utility and domestic self-supplied demands. St. Lucie County has traditionally been agricultural, with citrus being the dominant crop. In 1995-6, St. Lucie County had more citrus acreage than any other county in Florida. After a period of rapid citrus acreage growth in the 1980s, the growth rate has declined in recent years in response to low prices.

Public Water Supply

Public water supply utilities in St. Lucie County had a combined population served of 97,895 in 1995, and are projected to serve 216,400 by 2020 (Table V-3-l). This increase in PWS served population had associated demands of 14.03 mgd (5,121 mgy) in 1995, has projected 2020 average demands of 31.96 mgd (11,665 mgy). The l-in-10 demands in 2020 are 34.75 mgd (12,684 mgy). Figure V-3-l shows the public water supply utility source locations in St. Lucie County.

Domestic Self-Supply and Small Public Supply Systems

A total of 74,019 residents of St. Lucie County were self-supplied or served by small public supply systems in 1995. This number is forecast to decrease to 65,100 by 2020 (Table V-3-l). Self-supplied residents had assessed demands of 9.11 mgd (3,325 mgy) in 1995, which is projected to decrease to 2020 average demands of 8.89 mgd (3,245 mgy). The l-in-10 demands in 2020 are 9.52 mgd (3,475 mgy). This reduction in self-supplied population is largely due to the opening of the St. Lucie County Utility (which is anticipated to serve almost 20,000 residents by 2020), and an aggressive retrofit program by the Port St. Lucie Utility.

Figure V-3-1. Public Water Supply Utility Source Locations in St. Lucie County.

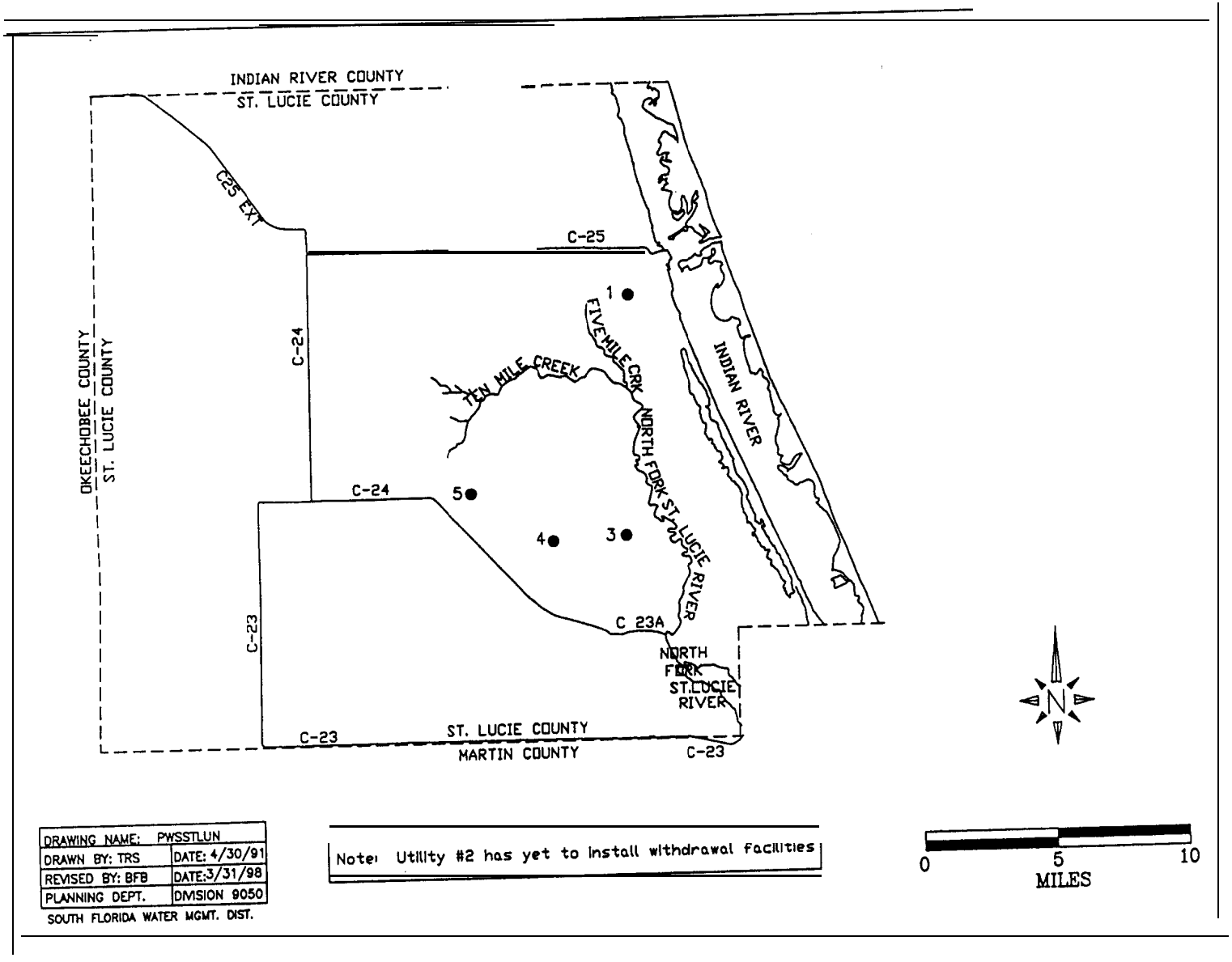


Table V-3-1 Public Water Supplied and Domestic Self-Supplied Demand Projections for St. Lucie County.

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
				PWS				PWS		PWS		DSS	DSS	DSS
		Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
#	Utility	1995	1995	1995	1995	use	factor	1995	factor	1995	1995	1995	1995	1995
1	Ft. Pierce	52,870	49,500	9.31	188	50%	1.318	10.79	1.167	11.69	3,370	0.63	0.73	0.80
2	St. Lucie County	12,350	0	0.00	93	50%	1.318	0.00	1.167	0.00	12,350	1.15	1.34	1.45
3	Port St. Lucie	64,318	43,769	4.09	93	50%	1.318	4.74	1.167	5.14	20,549	1.92	2.23	2.41
4	St. Lucie West	3,928	3,790	0.55	145	65%	1.318	0.66	1.167	0.74	138	0.02	0.02	0.03
5	Reserve	937	836	0.08	96	65%	1.318	0.10	1.167	0.11	101	0.01	0.01	0.01
	Rural Self Supplied	37,511			143	35%	1.318		1.167		37,511	5.38	5.97	6.32
	Totals	171,914	97,895	14.03				16.29		17.67	74,019	9.11	10.31	11.02
				PWS				PWS		PWS		DSS	DSS	DSS
#	Utility	Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
		2020	2020	2020	2020	use	factor	2020	factor	2020	2020	2020	2020	2020
1	Ft. Pierce	67,271	63,901	12.02	188	50%	1.318	13.93	1.167	15.09	3,370	0.63	0.73	0.80
2	St. Lucie County	19,810	7,460	0.70	93	50%	1.318	0.81	1.167	0.88	12,350	1.15	1.34	1.45
3	Port St. Lucie	138,883	118,334	11.06	93	50%	1.318	12.81	1.167	13.88	20,549	1.92	2.23	2.41
4	St. Lucie West	22,485	22,347	3.24	145	65%	1.318	3.91	1.167	4.34	138	0.02	0.02	0.03
5	Reserve	4,459	4,358	0.42	96	65%	1.318	0.50	1.167	0.56	101	0.01	0.01	0.01
	Rural Self Supplied	28,592			143	35%	1.318		1.167		28,592	4.10	4.55	4.82
	Totals	281,500	216,400	27.43				31.96		34.75	65,100	7.84	8.89	9.52

Commercial/Industrial Self-Supply

Commercial/Industrial self-supplied water use is projected to rise with the county population from 5.10 mgd (1,862 mgy) in 1995 to 8.24 mgd (3,008 mgy) by 2020. PWS supplied commercial and industrial demand is included with other public utility demands.

Recreational Self -Supply

The recreational self-supplied demand category includes self-supplied irrigation demands for large landscaped areas (as opposed to private homes) and for golf courses. Self-supplied large landscaped area is projected to increase from 5,554 acres in 1995 to 9,094 acres in 2020. Landscaping self-supplied average demand in St. Lucie County (not counting golf courses) is projected to increase from 6,476 mgy in 1995 to 10,604 mgy by 2020. The l-in-10 irrigation requirements in 2020 are 12,377 mgy.

In 1995, there were 16 golf courses in St. Lucie County. Since 1995 three more have opened and one has closed. In 1995, the golf courses in St. Lucie County had a total irrigated area of 1,208 acres, of which 612 acres were self-supplied. The rest were supplied with reclaimed water. Irrigated golf course acreage is projected to increase to 3,331 acres by 2020, of which it is estimated the 1,770 acres will be self-supplied. Self-supplied golf acreage in 1995 had average irrigation requirements of 749 mgy, and is projected to increase to 2,064 mgy by 2020. The l-in-10 irrigation requirement in 2020 for these self-supplied golf courses is 2,409 mgy

Combined recreational self-supplied average demands for St. Lucie County are equal to 7,225 mgy in 1995 and 12,668 mgy in 2020. The l-in-10 irrigation requirements in 2020 are 14,787 mgy

Agricultural Self-Supply

The commercially grown irrigated crops in St. Lucie County are citrus, vegetables, sod, and ornamental nursery. Improved pasture is very seldom irrigated, except for one ranch which irrigates about 10,000 acres, and there are some demands for cattle watering.

Citrus

St. Lucie County citrus acreage was relatively level from 1968 to 1982 (in a range between 70,462 and 76,863 acres). Since 1982, citrus acreage has grown from 76,863 acres to 107,224 acres in 1995-6, and is projected to increase to 117,900 acres by 2020. This growth in citrus acreage represents an increase in average irrigation requirement from 104,873 mgy in 1995 to 113,352 mgy in 2020. The l-in-10 demands in 2020 are 135,787 mgy.

Vegetables, Melons, and Berries

Crops in this category grown in St. Lucie County include potatoes, cabbage, zucchini, tomatoes, and strawberries. Different types of vegetables are often grown interchangeably. In 1995 there were 1,270 acres of land used for vegetable production, and this is forecast to remain constant through 2020. This acreage has an average irrigation requirement of 604 mgy, and a l-in-10 irrigation requirement of 737 mgy.

Sod

In 1995, there were 760 acres of irrigated sod production, and this is projected to remain constant through 2020. This acreage has average irrigation requirements of 886 mgy, and l-in-10 demands of 1,027 mgy.

Greenhouse/Nursery

In 1995, there were 112 acres of ornamental nursery in St. Lucie County, and this is projected to increase to 287 acres by 2020. This growth has increased average irrigation requirements from 196 mgy in 1995 to 502 mgy in 2020. The l-in-10 requirements for 2020 are 582 mgy.

Pasture

The vast majority of St. Lucie County's improved pasture is very rarely irrigated. However, there is one ranch on which irrigation is routinely carried out. This ranch irrigates 10,000 acres, and this is projected to remain the same throughout the projection period. This pastureland has an estimated annual average irrigation demand of 925 mgy, and a l-in-10 demand of 1,182 mgy.

Miscellaneous

Cattle Watering. In 1995, there were a total of 32,000 cattle and calves in St. Lucie County, with no significant amount of these for dairy use. Based on this number of cattle, the demand for cattle watering was 140 mgy. This is projected to decline to 115 mgy by 2020 as irrigated crops are planted on some areas of land formerly used for pasture.

Demand Summary

Urban demands are projected to grow by 74 percent between 1995 and 2020, and agricultural demands are projected to rise by 8 percent during that period. Total demands are projected to grow by 17 percent, from 125,157 mgy in 1995 to 146,970 mgy in 2020 (Table V-3-2).

Table V-3-2. Urban and Agricultural Demand for St. Lucie County.

Urban and Agricultural Demands	(a) Assessed 1995 (mgy)	(b) Average 2020 (mgy)	(c) Percent Change (a) to (b)	(d) 1 -in-l 0 2020 (mgy)
Urban				
Public Water Supply	5,121	11,665	128%	12,684
Domestic Self-Supply	3,325	3,245	- 2%	3,475
Commercial/Industrial Self-Supply	1,862	3,008	62%	3,008
Recreational Self Supply	7,225	12,668	75%	14,787
Total Urban	**17,533**	**30,586**	**74%**	**33,954**
Agricultural				
Citrus	104,873	113,352	8%	135,787
Vegetables, Melons, and Berries	604	604	0%	737
Sod	886	886	0%	1,027
Greenhouse/Nursery	196	502	156%	582
Pasture	925	925	0%	1,182
Miscellaneous (Cattle Watering)	140	115	-18%	115
Total Agricultural	**107,624**	**116,384**	**8%**	**139,430**
Total Urban and Agricultural Demands	**125,157**	**146,970**	**17%**	**173,364**

Agricultural irrigation demands make up 86 percent of the total demand in 1995, and 79 percent of the projected demand in 2020. Citrus irrigation makes up about 97 percent of the agricultural requirements through the year 2020. Although the acreage growth rate has slowed in recent years, the projected expansion in citrus is the main driving force behind increased agricultural demands.

The 1995 land use for St. Lucie County is shown in Plate 3. Urban land use is prevalent along the coast, while agriculture largely covers the interior region of the county. Continued growth of urban land use, and to some extent irrigated agricultural land use, is forecast over the projection period.

Martin County

Coastal areas in Martin County have experienced rapid urban development in the recent past, and this has given rise to increasingly significant public utility and self-supplied demands. The county's population rose by 35 percent between 1985 to 1995, from 81,835 to 110,495 residents (U.S. Bureau of the Census, 1998), and is projected to grow to 173,500 by the year 2020 (BEBR, 1998). Population and irrigated agriculture are projected to continue growing through 2020, as will associated water demands.

Public Water Supply

Public utilities in Martin County served 64 percent of the residents in Martin County in 1995. The PWS population served in 1995 has been assessed at 71,190 residents (Table V-3-3), and is projected to increase by 66 percent to 118,446 residents by 2020. This increase in population served had associated demands of 13.08 mgd (4,774 mgy) in 1995, has projected 2020 average demands of 22.42 mgd (8,183 mgy). The l-in-10 demands in 2020 are 24.43 mgd (8,917 mgy). Figure V-3-2 shows the public water supply utility source locations in Martin County.

Domestic Self-Supply and Small Public Supply Systems

A total of 39,305 Martin County residents were self-supplied or served by small public supply systems in 1995, and this is forecast to increase to 55,054 by 2020 (Table V-3-3). Self-supplied residents had assessed demands of 6.46 mgd (2,358 mgy) in 1995, and have projected 2020 average demands of 9.57 mgd (3,493 mgy). The projected l-in-10 demands in 2020 are 10.30 mgd (3,760 mgy).

Commercial/ Industrial Self Supply

Commercial/Industrial self-supplied water use is projected to rise with the county population from 1.66 mgd (606 mgy) in 1995 to 2.61 mgd (953 mgy) by 2020. PWS supplied commercial and industrial demand is included with other public utility demands.

Figure V-3-2. Public Water Supply Utility Source Locations in Martin County.

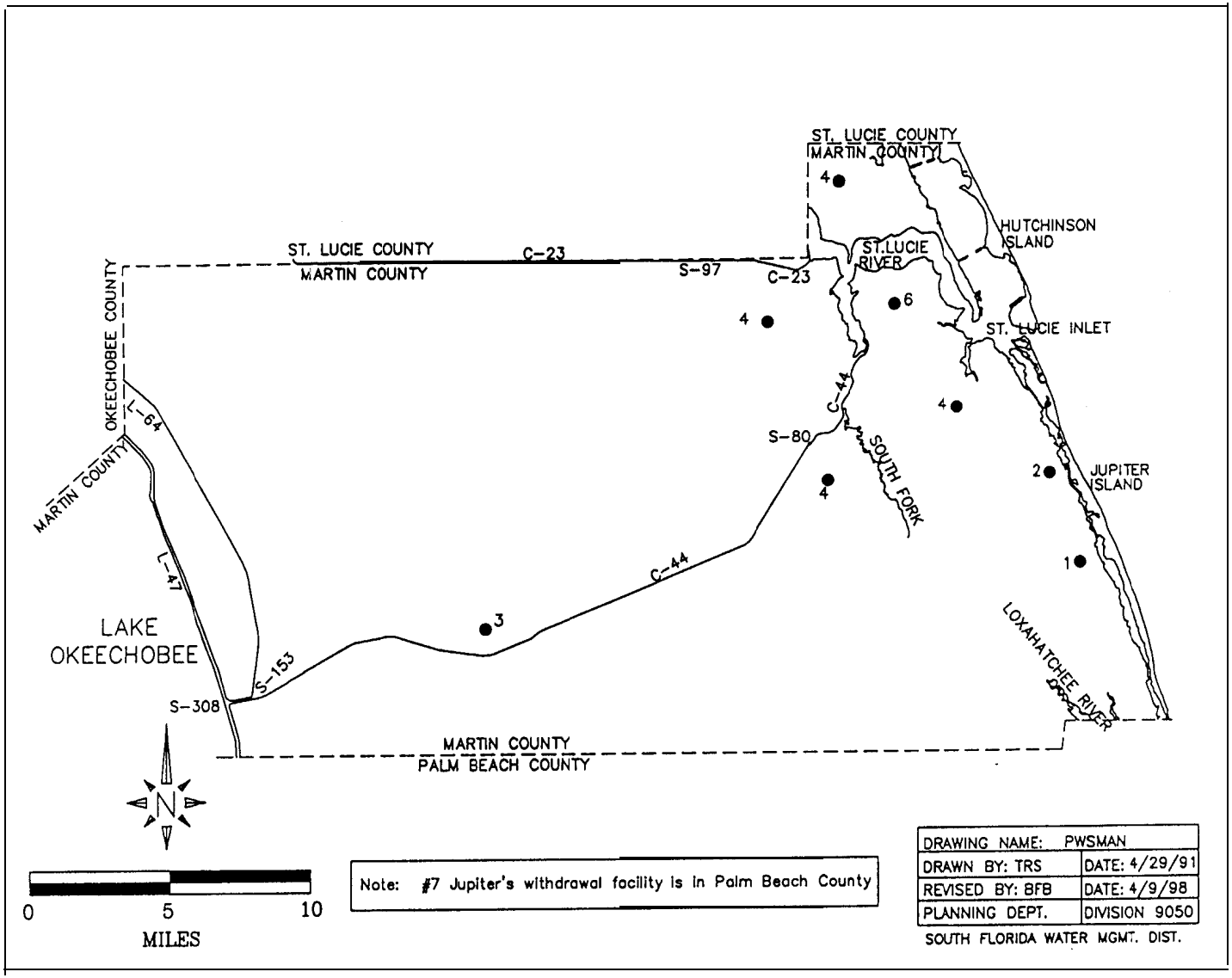


Table V-3-3. Public Water Supplied and Domestic Self-Supplied Demand Projections for Martin County.

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
				PWS				PWS		PWS		DSS	DSS	DSS
		Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
#	Utility	1995	1995	1995	1995	use	factor	1995	factor	1995	1995	1995	1995	1995
1	Hobe Sound	3,234	2,736	2.04	746	65%	1.059	2.12	1.190	2.38	498	0.37	0.39	0.43
2	Hydratech	13,073	9,804	1.40	143	50%	1.059	1.44	1.190	1.58	3,269	0.47	0.48	0.53
3	Indiantown	4,009	3,812	0.62	163	35%	1.059	0.63	1.190	0.67	197	0.03	0.03	0.03
4	Martin County	44,764	33,002	4.18	127	50%	1.059	4.30	1.190	4.71	11,762	1.49	1.53	1.68
5	Martin Downs	16,108	11,650	1.05	90	50%	1.059	1.08	1.190	1.18	4,458	0.40	0.41	0.45
6	Stuart	8,965	8,208	3.27	398	35%	1.059	3.34	1.190	3.56	757	0.30	0.31	0.33
7	Jupiter	2,246	1,978	0.52	263	50%	1.059	0.54	1.190	0.59	268	0.07	0.07	0.08
	Rural Self Supplied	18,096			184	35%	1.059		1.190		18,096	3.32	3.39	3.62
	Totals	110,495	71,190	13.08				13.45		14.67	39,305	6.46	6.62	7.15
				PWS				PWS		PWS		DSS	DSS	DSS
		Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
#	Utility	2020	2020	2020	2020	use	factor	2020	factor	2020	2020	2020	2020	2020
1	Hobe Sound	4,548	4,050	3.02	746	65%	1.059	3.13	1.190	3.52	498	0.37	0.39	0.43
2	Hydratech	19,259	15,990	2.28	143	50%	1.059	2.35	1.190	2.57	3,269	0.47	0.48	0.53
3	Indiantown	6,130	5,933	0.96	163	35%	1.059	0.98	1.190	1.05	197	0.03	0.03	0.03
4	Martin County	69,584	57,822	7.32	127	50%	1.059	7.54	1.190	8.25	11,762	1.49	1.53	1.68
5	Martin Downs	21,168	16,710	1.51	90	50%	1.059	1.55	1.190	1.70	4,458	0.40	0.41	0.45
6	Stuart	15,498	14,741	5.87	398	35%	1.059	5.99	1.190	6.39	757	0.30	0.31	0.33
7	Jupiter	3,468	3,200	0.84	263	50%	1.059	0.87	1.190	0.95	268	0.07	0.07	0.08
	Rural Self Supplied	33,845			184	35%	1.059		1.190		33,845	6.22	6.35	6.77
	Totals	173,500	118,446	21.81				22.42		24.43	55,054	9.35	9.57	10.30

Recreation Self-Supply

The recreational self-supplied demand category includes self-supplied irrigation demands large landscaped areas (as opposed to private homes) and for golf courses. Self-supplied large landscaped area is projected to increase from 1,382 acres in 1995 to 2,170 acres in 2020. Landscaping self-supplied average demand in Martin County (not counting golf courses) is projected to increase from 1,603 mgy in 1995 to 2,517 mgy by 2020. The l-in-10 irrigation requirements in 2020 are 2,995 mgy.

In 1995, there were 30 golf courses in Martin County. These golf courses had a total irrigated area 3,427 acres. Of the irrigated golf course acreage 1,888 acres were self-supplied in 1995, and rest were supplied with reclaimed water from wastewater utilities. Irrigated golf course acreage is projected to increase to 5,710 acres by 2020, and if the current (1998) ratio of self-supplied to reuse holds, it is estimated the 3,146 acres will be self-supplied. Self-supplied golf acreage in 1995 had average irrigation requirements of 2,190 mgy, and this is projected to increase to 3,649 mgy by 2020. The l-in-10 irrigation requirement in 2020 for these self-supplied golf courses is 4,341 mgy.

Combined recreational self-supplied average demands for Martin County are equal to 3,793 mgy in 1995 and 6,166 mgy in 2020. The l-in-10 irrigation requirements in 2020 are 7,336 mgy.

Agricultural Self-Supply

The irrigated commercially grown crops in Martin County are citrus, sugarcane, vegetables, and ornamental nursery. Improved pasture is very seldom irrigated, but there are some demands for cattle watering and fish farming (aquaculture).

citrus

Martin County citrus acreage remained relatively constant between 1968 and 1988, ranging from 38,361 acres to 41,385 acres. Between 1988 and 1995-6, citrus acreage grew to 47,090 acres. Some growth is anticipated in the future, although at a much more moderate rate than that recently experienced. Citrus acreage is projected to grow to 55,415 acres by 2020. This growth in citrus acreage has increased average irrigation requirements from

37,096 mgy in 1995 to 43,654 mgy in 2020. The l-in-10 demands in 2020 are 53,952 mgy.

Vegetables, Melons, and Berries

Vegetable crops grown commercially in Martin County include snap beans, cucumbers, cabbage, peppers, tomatoes, and Chinese vegetables. Different types of vegetables are often grown interchangeably. In 1995, there were 1,700 acres of land used for vegetable production, and this is forecast to remain relatively constant through 2020. This acreage has average irrigation requirements of 836 mgy and l-in-10 requirements of 1,059 mgy.

Field Crops

Sugarcane. Sugarcane acreage in Martin County grew from 3,000 acres in 1975 to 7,200 acres in 1984. Between 1984 and 1985, sugarcane acreage grew by 5,300 acres to 12,500 acres. Sugarcane acreage peaked in 1988 at 14,600 acres, and then slightly declined to 12,456 acres of production for sugar and seed by 1995. While sugarcane acreage increased significantly in the mid-1980s, it has leveled off, and is projected to continue at its 1995 level through the projection period. The average irrigation requirements, based on this level of production are 16,697 mgy, and the l-in-10 requirements are 20,624 mgy.

Sod

In 1995, there were about 1,200 acres of irrigated sod in Martin County, and this acreage is projected to increase to 4,000 acres by 2020. Some of this increase has already occurred since 1995. There is additional sod harvested from pastureland, which is not irrigated. This growth in sod acreage has increased average irrigation requirements from 2,088 mgy in 1995 to 6,959 mgy in 2020. The l-in-10 demands in 2020 are 8,285 mgy.

Greenhouse/Nursery

In 1995, there were 553 acres of ornamental nursery in Martin County and this is forecast to increase minimally to 578 acres by 2020. This represents an increase in average irrigation requirements from 962 mgy in 1995 to 1,006 mgy in 2020. In 2020 the l-in-10 demands are 1,197 mgy.

Miscellaneous

Cattle Watering. In 1995, Martin County had 36,000 head of cattle, of which 2,100 were dairy cows. Based on this number and type of cattle, the demand for cattle watering is 263 mgy, and is projected to decline to 242 mgy by 2026 as some land currently used as pasture is converted to irrigated crops.

Aquaculture. Aquacultural operations withdraw water for circulation purposes, and to replace evaporative losses. Aquacultural water demand was assessed for Martin County as 37 mgy in 1995. Demand is projected to remain at the 1995 level through 2020.

Demand Summary

Urban and agricultural demand estimates, presented in Table V-3-4, show that urban demand is projected to increase by 63 percent between 1995 and 2020. In 1995, urban demands made up 17 percent of the total and are projected to increase to 21 percent of the total by 2020.

Table V-3-4. Urban and Agricultural Demand for Martin County.

Urban and Agricultural Demands	(a) Assessed 1995 (mgy)	(b) Average 2020 (mgy)	(c) Percent Change (a) to (b)	(d) 1-in-10 2020 (mgy)
Urban				
Public Water Supply	4,774	8,183	71%	8,917
Domestic Self-Supply	2,358	3,493	48%	3,760
Commercial/Industrial Self-Supply	606	953	57%	953
Recreational Self-Supply	3,793	6,166	63%	7,336
Total Urban	**11,531**	**18,795**	**63%**	**20,965**
Agricultural				
Citrus	37,096	43,654	18%	53,952
Vegetables, Melons, and Berries	836	836	0%	1,059
Field Crops (Sugarcane)	16,697	16,697	0%	20,624
Sod	2,088	6,959	233%	8,285
Greenhouse/Nursery	962	1,006	5%	1,197
Miscellaneous (Cattle Watering, Aquaculture)	300	279	-7%	279
Total Agricultural	**57,979**	**69,431**	**20%**	**85,396**
Total Urban and Agricultural Demands	**69,510**	**88,226**	**27%**	**106,361**

The 1995 land use for Martin County is shown in Plate 3. Urban land use is prevalent along the coastal region, especially abutting the border with St. Lucie County, and to a lesser extent near the border with Palm Beach County. Agriculture largely covers the interior region of the county. Wetland areas are scattered throughout the county, but are most evident in the south-central portion of the county. Continued growth of urban land use, and to some extent irrigated agricultural land use, is forecast over the projection period.

Eastern Okeechobee County

Okeechobee County is divided between the SFWMD and the St. Johns River Water Management District. Eighty-seven percent of the county is in the SFWMD, along with 98 percent of the county's population and the majority of its irrigated agriculture. The portion of the county within the SFWMD is further divided between the Upper East Coast Planning Region (Eastern Okeechobee County) and Kissimmee Basin Planning Region (Western Okeechobee County). Demand estimates ar:l projections are presented here for Eastern Okeechobee County, which is shown in Plate 3.

Eastern Okeechobee County is predominantly agricultural and very sparsely populated. While the county as a whole has experienced a high rate of population growth, the eastern portion has very few residents. The only demands that can be classified as urban in Eastern Okeechobee County are self-supply for the few residents. Irrigated agricultural acreage is limited to citrus and sod.

Domestic Self-Supply and Small Public Supply Systems

There are no public water supply systems in Eastern Okeechobee County and all residents are self-supplied. The self-supplied population is forecast to increase from 1,048 in 1995 to 1,580 in 2020 (Table V-3-5). This increase in self-supplied population results in domestic self-supplied demands of 0.10 mgd (37 mgy) in 1995 and an average demand of 0.14 mgd (51 mgy) in 2020. The l-in-10 year requirements for 2020 are equal to 0.15 mgd (55 mgy).

Agricultural Self-Supply

The only irrigated commercially grown crops in Eastern Okeechobee County are citrus and sod. Improved pasture is very seldom irrigated, but there are some demands for cattle watering.

Citrus

Okeechobee County's citrus acreage grew slowly but steadily from 2,508 acres in 1966 to 4,281 acres in 1980. Since 1980 the rate of growth has accelerated, and citrus has increased to 12,206 acres by 1995-6 (Florida Agricultural Statistics Service, 1996).

Table V-3-5. Public Water Supplied and Dometic Self Supplied Demand Projections for Eastern Okeechobee County.

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
				PWS				PWS		PWS		DSS	DSS	DSS
	Utility	Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population1	Population1	MGD	GPCD	outdoor	Average	MGD	1-in-101	MGD	population1	MGD	MGD	MGD
		1995	1995	1995	19951	use	factor	1995	factor	1995	1995	1995	1995	1995
	Rural Self Supplied	1,048	0	0.00	92	35%	0.973	0.00	1.172	0.00	1,048	0.10	0.10	0.10
	Totals	1,048	0	0.00				0.00		0.00	1,048	0.10	0.10	0.10
				PWS				PWS		PWS		DSS	DSS	DSS
	Utility	Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	Population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
		2020	2020	2020	2020	use	factor	2020	factor	2020	2020	2020	2020	2020
	Rural Self Supplied	1,580	0	0.00	92	35%	0.973	0.00	1.172	0.00	1,580	0.15	0.14	0.15
	Totals	1,580	0	0.00				0.00		0.00	1,580	0.15	0.14	0.15

District land use maps show approximately 90 percent of the citrus acreage in Okeechobee County as within the District, and 32 percent of this acreage in the District as within the eastern portion (in the UEC Planning Region). These ratios were used to divide acreage projections. Based on these ratios, the citrus acreage in Eastern Okeechobee County was 3,515 acres in 1995-6, and is projected to be 6,750 acres in 2020. These acreages have average irrigation requirements of 2,868 mgy in 1995 and 5,508 mgy in 2020. The l-in-10 irrigation requirement for citrus in 2020 is 6,664 mgy.

Sod

In 1995, there were an estimated 100 acres of irrigated sod production in Eastern Okeechobee County, and production is projected to remain at that level through the year 2020. These 100 acres of sod have average irrigation requirements of 178 mgy and l-in-10 irrigation requirements of 208 mgy.

Miscellaneous

Cattle Watering. Historically, Okeechobee County has been famous for its cattle production. In recent times, however, there have been motivations and incentives for ranchers to sell out or diversify. Despite this pressure, Okeechobee County is still the number one county in Florida for total cattle and calves (Florida Agricultural Statistics Service, 1997). The dairy producing region is in the western portion of the county. From District land use maps (for pasture and rangeland), it was assessed that 11 percent of the non-dairy cattle in Okeechobee County were in the eastern portion in 1995. The 1995 water demand assessment for cattle watering is 65 mgy, and this is projected to decrease to 58 mgy as irrigated agricultural crops are planted on land currently being used for pasture.

Demand Summary

Urban demands are projected to grow by 38 percent between 1995 and 2020, and agricultural demand is projected to rise by 85 percent during that period. Total demand is projected to grow by 84 percent, from 3,148 mgy in 1995 to 5,795 mgy in 2020 (Table V-3-6).

Table V-3-6. Urban and Agricultural Demand for Eastern Okeechobee County.

Urban and Agricultural Demands	(a) Assessed 1995 (mgy)	(b) Average 2020 (mgy)	(c) Percent Change (a) to (b)	(d) 1 -in-l 0 2020 (mgy)
Urban				
Domestic Self-Supply	37	51	38%	55
Total Urban	37	51	38%	55
Agricultural				
Citrus	2,868	5,508	92%	6,664
Sod	178	178	0 %	208
Miscellaneous (Cattle Watering)	65	58	-11%	58
Total Aaricultural	3,111	5,744	85%	6,930
Total Urban and Agricultural Demands	3,148	5,795	84%	6,985

Eastern Okeechobee County is predominantly agricultural (Plate 3), and is forecast to remain so throughout the projection period. Agricultural demands are projected to make up 99 percent of the total demand throughout the projection period.

Source Evaluation

Overview of Hydrologic System

St. Lucie County

Surface Water

The C-23, C-24, and C-25 canals are important sources of irrigation water in St. Lucie County. These canals have no inflows from outside their own drainage basins, so the stage of each canal is totally dependent on rainfall. There is a prohibition on any additional water being allocated from these canals.

Ground Water

Ground water is an important source of supply to St. Lucie County. There are two major aquifer systems in St. Lucie County: the Floridan and the Surficial (Table V-3-7). The Floridan Aquifer System (FAS) is the primary source of irrigation water in St. Lucie County. Floridan wells, which flow without pumping, produce large volumes of relatively poor quality water. The quality of Floridan water varies. Chloride concentrations, measured in March 1990, ranged from less than 400 to more than 2,000 ppm. To address this problem, grove owners and ranchers tend to discharge the water from the flowing Floridan wells into ditches, where it mixes with surface water and ground water from the better quality Surficial Aquifer System (SAS). This dilutes the brackish Floridan water to a level acceptable for citrus irrigation, allowing growers to augment their surface water supplies when the canals are low. Desalination treatment is required to make the water suitable for potable use. Although the use of Floridan water for public water supplies is very limited at this time, it is expected to increase as St. Lucie County continues to develop.

The SAS is the primary source of potable water in St. Lucie County. Yields from the aquifer are low, with transmissivities seldom exceeding 20,000 gpd/ft. Water quality in the SAS is fair. Problems with water quality are usually associated with excess iron, and hardness, but high chloride content can also be a problem where abandoned Floridan wells have contaminated the surficial system.

Table V-3-7. Ground Water Systems in St. Lucie County.

Hydrogeologic System	Hydrogeologic Unit	Thickness (feet)	Water Resource Potential
Surficial Aquifer System	Surficial Aquifer	90-l 50	Principal source of water for domestic self - supply. Produces small quantities of fair to good quality water. Localized areas of high iron, chlorides, and/or dissolved solids.
Intermediate Confining Unit	Hawthorn Confining Beds	400-700	Does not produce significant quantities of water in St. Lucie County.
Floridan Aquifer System	Floridan Aquifer	2,800-3,000	Most important aquifer in St. Lucie County. Requires desalination treatment for potable use, but is suitable for most irrigation purposes when mixed with fresh surface water. Water quality deteriorates with increasing depth.

Martin County

Surface Water

The St. Lucie Canal (C-44) is the major source of surface water in Martin County. It is supplied by Lake Okeechobee as well as drainage from its own basin. The C-44 is heavily allocated. SFWMD permit holders are permitted to withdraw 48.84 billion gallons of water per year from the C-44, predominantly for citrus irrigation. During the wet season, flow in the canal is plentiful, but during some dry months, it is inadequate to meet demand. When a deficit occurs, supplemental water is needed from Lake Okeechobee. While the lake may be capable of supplying a greater percentage of Martin County's increasing demand much of the time, it cannot meet the total demand when the need is greatest, due to competing demands for Lake Okeechobee water.

Ground Water

Ground water is the predominant source of water for potable use and domestic irrigation in Martin County. There are two major aquifer systems in Martin County, the Floridan Aquifer System (FAS) and Surficial Aquifer System (SAS) (Table V-3-8).

Table V-3-8. Ground, Water Systems in Martin County.

Hydrogeologic System	Hydrogeologic Unit	Thickness (feet)	Water Resource Potential
Surficial Aquifer System	Surficial Aquifer	100-250	Principal source of freshwater in Martin County. Yields moderate amounts of water. Water quality is fair, with excess iron and hardness in some areas.
Intermediate Confining Unit	Hawthorne Confining Beds	400-650	Does not produce significant quantities of water within Martin County.
Floridan Aquifer System	Floridan Aquifer	2,600	Yields moderate-to-large quantities of water. Requires desalination for potable uses, but suitable for irrigation purposes in some areas. Contains some areas with potential for use in ASR projects.

The ability of the FAS to transmit water is relatively high. District studies in progress report transmissivities ranging from less than 50,000 gpd/ft to over 200,000 gpd/ft in Martin County. Although capable of relatively high yields, the quality of Floridan water is poor. Chloride concentrations measured in March 1990 ranged from 420 to 4,000 ppm (>250 ppm is unacceptable for drinking water). For this reason, most of the wells tapping the FAS in Martin County are used for irrigation. Citrus grove owners and ranchers discharge the water from flowing Floridan wells into ditches, where it mixes with surface water and ground water from the better quality SAS. This dilutes the brackish Floridan water to a level acceptable for irrigation, and allows growers to augment surface water supplies when the canals are low.

Desalination treatment is required to make the water suitable for potable use. Although the use of Floridan water for public water supplies is very limited at this time, it is expected to increase greatly as Martin County continues to develop. Martin County Utilities has constructed a desalination facility on the Jensen Beach Peninsula.

The SAS is the primary source of freshwater in Martin County. It is only moderately productive. The average transmissivity of the aquifer is around 30,000 gpd/ft. The water quality in the aquifer is good. Localized problems with water quality are usually associated with excess iron, and hardness.

Eastern Okeechobee County

Surface Water

This area of Okeechobee County is in the C-24 or C-25 basins. One of the major tributaries is Cow Creek, which runs from the Dark Hammock area into St. Lucie County. There is no county-wide stormwater plan for this area. Chambers landfill is on the easternmost fringe of Okeechobee County. This area lies within the Indian River Lagoon initiative.

Ground Water

Ground water is the primary source of supply to unincorporated Okeechobee County. There are two major ground water systems in Okeechobee County, the Floridan and the Surficial aquifer systems (Table V-3-9). The Floridan Aquifer System (FAS) is the principal source of irrigation and cattle water in Okeechobee County.

Transmissivities within the aquifer vary significantly throughout the county, ranging from 2,000 gpd/ft in the south to more than 500,000 gpd/ft in northern Okeechobee County. Water quality in the FAS declines with depth and distance to the south. In the central and northern portion of the county, Floridan water is of good quality, requiring little or no treatment for potable use. Waters in the southern and eastern portions of the county, however, may contain chloride concentrations in excess of 1,000 mg/l, and require desalination for potable use. Although Floridan waters are not potable in some areas, they are used extensively for irrigation throughout the county.

The Surficial Aquifer System (SAS) is the source of much of the potable ground water in Okeechobee County. It is used primarily to supply cattle and domestic users in the unincorporated portions of the county. Productivity in the aquifer tends to increase with depth, but most wells yield less than 100 gpm. Water from the surficial aquifer is generally potable with minimal treatment, except in the southeast portion of the county, where chloride concentrations in excess of 250 mg/l have been measured (Parker et. al., 1955).

Table V-3-9. Ground Water Systems in Eastern Okeechobee County.

Hydrogeologic System	Hydrogeologic Unit	Thickness (feet)	Water Resource Potential
Surficial Aquifer System	Sutficial Aquifer	10-180	Yields small quantities of good quality water. Wells commonly yield 100 gpm or less. The surficial aquifer is the primary source of potable water.
Intermediate Confining Unit	Hawthorn Confining Beds	200-600	Does not yield significant quantities of water within Okeechobee County.
Floridan Aquifer System	Floridan Aquifer	860-955	Produces large-to-moderate quantities of water, with productivity increasing to the north. Wells generally yield more than 200 gpm. Water quality varies, ranging from very good in the north to brackish in the south and east. The FAS is the primary source of supply for agricultural uses.

Assessment Criteria Used

Minimum Flows and Levels

Chapter 373, F.S. requires water management districts to establish minimum flows and levels (MFLs) for priority water bodies within their jurisdictions. Minimum flows represent the limit at which further withdrawals would be significantly harmful to the water resource or ecology of the area. Minimum levels are the level of ground water in an aquifer and the level of surface water at which further withdrawals would be significantly harmful to the water resources.

The UEC Planning Region contains one priority water body that has been previously identified by the SFWMD: the St. Lucie Estuary. The District Water Management Plan (1995) also indicates the Floridan aquifer as a priority water body with the year 2000 as a deadline to establish MFLs for both water bodies. The District removed the Floridan aquifer from the District's priority list in 1997 and revised the completion date for the St. Lucie Estuary to 2001.

The Floridan aquifer was originally listed as a priority for development of MFLs, due to concerns about the water quality impacts of sustained

substantial withdrawals from this source. During the planning process, a Floridan aquifer subcommittee was established to make recommendations associated with Floridan issues. Based on the subcommittee's and District staffs recommendation that the current restrictions on the use of pumps be maintained, and the belief on many subcommittee members' part that use of the Floridan aquifer is essentially self-regulating, the advisory committee concluded that the Floridan aquifer should no longer be included on the immediate list for development of MFLs.

The District will develop and adopt a minimum flow and level (which includes maximum discharges) for the St. Lucie Estuary, based on the salinity envelope concept. The desired salinity envelope will be met through managing freshwater discharges to the St. Lucie Estuary. Based on the analysis to date, this would equate to an inflow range of 350 cfs to 1,600 cfs. The salinity envelope and associated inflows are being refined in the Indian River Lagoon Restoration Feasibility Study (SFWMD and USACE, in progress) and in development of the minimum flow and level for the St. Lucie Estuary.

Optimization models were applied to develop estimates of the water storage required to meet desired salinity ranges for the estuary. This includes maintaining low flows. A conceptual model of the estuary was developed, and fieldwork for oyster bed and seagrass surveys was initiated. The seagrass mesocosm and transplant experiments being done for the Caloosahatchee Estuary will be reviewed for applicability to the St. Lucie Estuary.

Resource Protection Criteria

Analytical tools were used extensively to assist in development of the Upper East Coast Water Supply Plan (SFWMD, 1998). These tools included surface water budgets, numerical ground water models, and vulnerability mapping. Of these, the ground water models included assessment criteria to sustain natural systems.

Three regional ground water models were used to simulate the potential impacts of water use in the Upper East Coast Planning Region: (1) the Martin County Surficial Aquifer System Model; (2) the St. Lucie County Surficial Aquifer System Model; and, (3) the Floridan Aquifer System Model which encompasses the entire UEC Planning Region. In addition, two finer resolution subregional Surficial Aquifer System models were used for the

Jensen Beach Area and Martin Coastal Area to determine if the potential impacts were from water use or were an artifact of the scale of the regional models.

In order to assess the potential impacts of water use on the environment and ground water resources using the ground water modeling tools, the potential impacts must be defined in terms of water levels and durations and of frequency of drawdowns. These water levels are referred to as resource protection criteria.

The resource protection criteria are guidelines to identify areas where there is potential for cumulative water use withdrawals to cause harm to wetlands and ground water resources. Areas where simulations show the resource protection criteria are exceeded during the selected level of certainty are areas where the water resource may not be sufficient to support the projected demand under the constraints.

There were two resource protection criteria used in the Upper East Coast Water Supply Plan: the wetland resource protection criterion and the Floridan aquifer protection criterion. The resource protection criteria define the severity, duration, and frequency of declines in ground water levels as the result of water use withdrawals.

Wetland Protection Criterion

The wetland protection criterion is defined as follows: ***Ground water level drawdowns induced by cumulative pumping withdrawals in areas that are classified as a wetland should not exceed 1 foot at the edge of the wetland for more than 1 month during a 12-month drought condition that occurs as frequently as once every 10 years.*** For planning purposes, this criterion was applied to surficial aquifer drawdowns in areas that have been classified as a wetland according to the National Wetlands Inventory.

Floridan Aquifer Protection Criterion

The Floridan aquifer protection criterion is defined as follows: ***Ground water level drawdowns induced by water use withdrawals should not cause water levels in the Floridan aquifer to fall below land surface any time during a 12-month drought condition that occurs as frequently as once every 10 years.***

This protection criterion is established to protect the quality and sustainability of the upper portion of the Floridan aquifer (Upper Floridan aquifer), generally 800 feet below land surface in the UEC Planning Region, and to avoid impacts to existing users. The Upper Floridan aquifer is an artesian aquifer. The water quality in formations below the Upper Floridan aquifer is of lower quality (salinity is higher). If the water level in the Upper Floridan aquifer is allowed to decline below acceptable levels, the upconing of this underlying lower quality water could occur at an unacceptable rate, causing water quality degradation in the Upper Floridan aquifer. This could eventually lower the water quality in the Upper Floridan to a level unsuitable for current users.

Hydrologic Impacts Due to Demands

During the UEC water supply planning process, two water demand levels for St. Lucie and Martin counties were modeled: (1) the permitted irrigated agricultural acreage (as of 1990) in combination with county populations from the 1990 census count; and (2) the permitted irrigated agricultural acreage (as of 1995) in combination with population projections for 2010 from the respective county comprehensive plans. Initially, this scenario was designed to represent the year 2010. However, during the planning process it became evident that both population growth and irrigated agricultural acreage growth had slowed, and the scenario developed adequately represented a 2020 projected time horizon.

Permitted irrigated agricultural acreage is normally higher than the actual level due to the normal differences in time between permitting and planting. These time differences vary in length. Permitted acreage may run far ahead of the planted acreage in an area experiencing rapid growth in agricultural acreage. The late 1980s and early 1990s include high growth rates in the UEC in population and in citrus acreage. This led to high population projections by the counties, and permitted acreage running far ahead actual planted acreage. Table V-3-10 shows the populations and acres of irrigated agriculture simulated by county during the UEC water supply planning process, and compares these with the populations and acres of irrigated agriculture projected for the year 2020 in this Assessment. Pasture acreage was not included in the UEC Water Supply Plan simulation, and is not included in the Assessment numbers presented in Table V-3-10.

Table V-3-10. Population and irrigated agricultural acreage comparison between the Upper East Coast Water Supply Plan and the Districtwide Water Supply Assessment.

County	Population UECWSP	Population DWSA (2020)	Irrigated agricultural acreage UECWSP	Irrigated agricultural acreage DWSA (2020)
St. Lucie	290,100	281,500	134,924	120,217
Martin	154,200	173,500	62,520	74,149

Note: The UEC Water Supply Plan included only irrigated agricultural acreage that had ground water as a source (ground water alone or ground and surface water), while this Assessment includes acreage that has surface water as its only source.

Upper East Coast Water Supply Plan Results

Urban users have traditionally used water from the Surficial Aquifer System (SAS), while agricultural users have depended upon surface water and the Floridan Aquifer System (FAS). The results of the Upper East Coast Water Supply Plan (SFWMD, 1998) indicate that the traditional source for urban water needs, the SAS, has limited potential for expansion due to potential impacts on wetland systems, and increased vulnerability to saltwater intrusion in the vicinity of public water supply wellfields.

Subregional modeling results for St. Lucie County indicate there are about 150 acres of scattered exceedences to the surficial aquifer in the Fort Pierce area. These exceedences are due in part to public water supply, domestic self-supply, and agricultural water use. The water supply plan concluded that most of the exceedences are the result of individual users. This is a local situation and should be addressed through the permitting process, rather than the planning process.

In Martin County, two areas of particular concern are the surficial aquifers in Jensen Beach and the Martin Coastal Area. Martin County's North System wellfield in Jensen Beach is located in what is traditionally a wetland area. An earlier sub-regional ground water modeling effort (Hopkins, 1991) found that continued pumping from the wellfield had caused a considerable drop in the water table and impacted the wetlands. Since then, Martin County North has constructed a reverse osmosis plant to desalinate Floridan water, in an attempt to reduce its allocation from the surficial aquifer. Modeling results from the UEC Water Supply Plan indicate a

moderate decrease in the potential problem areas from 1990 due to Martin County's North System reducing its dependence on the SAS with development of the Floridan aquifer.

In the Martin Coastal Area, potential future wetland protection criterion exceedences are projected under 860 acres of wetlands during a 1-in10 year drought condition. Exceedences in the Martin Coastal Area are broken into four sub-regions: (1) Port Salerno Area, (2) West of Hobe Sound, (3) Hobe Sound, north of Bridge Road, and (4) Hobe Sound, south of Bridge Road. These exceedences are largely the result of cumulative impacts of multiple use withdrawals (public water supply, domestic self-supplied, and irrigation) in the Port Salerno Area and in Hobe Sound, north of Bridge Road. In Hobe Sound, south of Bridge Road, potential impacts are primarily the result of public water supply withdrawals, not the cumulative effect of multiple use categories. West of Hobe Sound, agriculture is the only water use in the area and uses a combination of ground water and surface water. These sub-regions demonstrate the need for alternative water sources for future water supply. Potential sources include increased use of the Floridan aquifer, reclaimed water, and increased surface water availability.

Because future expansion of the SAS is limited, many public water supply utilities in the UEC Planning Region are turning to desalinated or blended Floridan water to support the increase in population. In addition, the lack of available surface water for agricultural needs puts more demands on the Floridan aquifer. In western portions of the region, where surface water from the regional canal system is heavily relied upon for agricultural needs, analyses showed that existing supplies are inadequate to meet existing as well as future demands. SFWMD canals are currently operating at maximum capacity, and no new withdrawals or withdrawal increases are being permitted. This is problematic because the poor quality of Floridan water accelerates corrosion in the citrus industry's high efficiency irrigation systems.

In addition, the Upper Floridan aquifer is an artesian aquifer. The water quality in formations below the Upper Floridan aquifer is of lower quality (salinity is higher). If the water level in the Upper Floridan aquifer is allowed to decline below acceptable levels, the upconing of this underlying lower quality water could occur at an unacceptable rate, causing water quality degradation in the Upper Floridan aquifer. This could eventually lower the water quality in the Upper Floridan aquifer to a level unsuitable for current users.

The District's consumptive use permitting program currently prohibits pumps on all flowing Floridan wells in the UEC region because of concern of the potential for upconing of higher salinity water. The UEC Water Supply Plan supports continuing this prohibition of pumps.

Adequacy of Regional Sources

There are four primary drainage canals in the UEC Planning Region that are part of the Central and Southern Florida Flood Control Project. These canals (C-23, C-24, C-25, and C-44) are important sources of irrigation water within their respective basins.

The C-44 canal was constructed as a navigable flood control outlet for Lake Okeechobee. It is the only one of the four canals that receives inflow from outside its drainage basin. The C-23, C-24, and C-25 canals, by contrast, are solely dependent on rainfall as a source of inflow. As a result of the large demand for this limited surface water supply, there are prohibitions for any new or expanded water supply uses from these three canals.

The lack of available surface water makes growers increasingly dependent on the Floridan aquifer, which has poor quality water. To make Floridan water suitable for irrigation, growers must blend it with surface water. Agricultural users also depend on the artesian flow of the Floridan aquifer.

Because the SAS is incapable of supporting large withdrawals, public water supplies will have to use desalinated Floridan water to support the increase in population. Aquifer storage and recovery technology represents a potential augmentation alternative for water supplies. Water supply could also be augmented through the use of treated wastewater for golf course and landscape irrigation.

In addition, several options are being evaluated to attenuate freshwater flows to the St. Lucie Estuary and Indian River Lagoon in the Indian River Lagoon Restoration Feasibility Study (SFWMD and USACE, in progress). The UEC Water Supply Plan endorses increasing surface water availability for water supply purposes, after environmental needs are met. Construction of regional attenuation facilities is a potential option to meet both these needs.

Water conservation measures have only been moderately implemented in St. Lucie County. An irrigation hours ordinance has not been adopted by any of

the regional utilities and water conservation.. rate structures are. not widely used. In Martin County, urban conservation measures have been widely implemented. In both counties, an agricultural conservation initiative should emphasize conversion to irrigation systems with higher potential irrigation efficiencies and the proper scheduling and overall management of these systems. The UEC Water Supply Plan supports funding for a Martin County and St. Lucie County urban mobile irrigation laboratory.

Section V

Part 4

Kissimmee Basin Planning Region Assessment

The Kissimmee Basin Planning Region, which is shown in Plate 4, includes parts of Orange, Osceola, Polk, Highlands, Okeechobee, and Glades counties. The region has an extensive ground and surface water system that forms the headwaters of the Everglades. The northern portion of the region contains hundreds of lakes, including a series of interconnected lakes called the Kissimmee Chain of Lakes. The southern portion includes the tributary watersheds of the Kissimmee River between Lake Kissimmee and Lake Okeechobee.

In spite of the vast quantity of surface water in the Kissimmee Basin, a relatively small amount is withdrawn for urban or agricultural uses. Although there is variation throughout the planning area, most users rely on ground water. The ground water resources in the Kissimmee Basin are divided into the Surficial, Intermediate, and Floridan aquifer systems.

The interaction between the ground and surface water resources in the planning region include the downward movement of recharge and the upward movement of discharge to and from the Floridan aquifer. The amount of ground water movement between aquifers is controlled by the degree of connection between the aquifers and the difference and direction of aquifer head. Where the confining units between aquifers are thin or where sinkholes are numerous, the potential for aquifer recharge is enhanced. These conditions, along with a large downward gradient in aquifer head, exists in the northwestern portion of the Kissimmee Basin Planning Region and provides for the best recharge areas to the Floridan aquifer within the SFWMD. Drainage wells in the metropolitan Orlando area also significantly add to this recharge potential. Discharge areas within the planning region are limited to eastern Highlands and Polk counties between the Lake Wales Ridge and the Kissimmee River. However, due to the thick confining units in these areas, the upward movement of water from the Floridan aquifer is limited.

There are 26 surface water basins in the Kissimmee Basin Planning Region. The largest of these, the Lake Istokpoga-Indian Prairie Basin, has an area of 728 square miles. Lake Istokpoga is the largest lake in this basin, averaging about 43 square miles, and is a major source of water to the Seminole Tribe of Florida (Tribe) residing on the Brighton Reservation. A Water Rights Compact (Compact) between the Tribe, the SFWMD, the State of Florida, and the United States was executed in 1987. This Compact addresses all water resource related issues concerning the Tribe within the SFWMD, including the Tribe's entitlement to water rights for the Brighton Reservation. In 1992, the SFWMD and the Tribe executed an agreement that establishes the framework and procedures for the Tribe's use of their Brighton Reservation entitlement water. The Tribe has availed themselves of water through various Work Plan requests submitted since the Compact was executed in 1987.

The Kissimmee Basin Water Supply planning effort is currently underway and is scheduled for completion in the year 2000. A cooperative effort is being developed with neighboring water management districts to address potential adverse impacts located adjacent to the districts' mutual borders. During the water supply planning process demand projections will also be coordinated with neighboring water management districts.

Water Demand Projections

Southern Orange County

Orange County is divided between the SFWMD and the St. Johns River Water Management District. Twenty eight percent of the land area in Orange County (the southern portion) is in the SFWMD. This area contains about 25 percent of the county's population and 55 percent of its citrus. Citrus production has declined significantly following a succession of freezes in the 1980s. Southern Orange County is characterized by very rapid population growth, and many of the new residential areas are being located on the well-drained lands formerly used for citrus production. Total population for the area within the SFWMD is projected to rise from 186,131 permanent residents in 1995 to 349,453 in 2020 (Table V-4-l).

Public Water Supply

The public water supply (PWS) served population is forecast to rise from 171,729 in 1995 to 335,051 in 2020. The associated PWS demands are 47.82 mgd (17,454 mgy) in 1995, and average demands of 91.53 mgd (33,408 mgy) in 2020. The l-in-10 demands in 2020 are 94.26 mgd (34,405 mgy). These projections are presented in Table V-4-l. All three major utilities in Southern Orange County (Orlando, Orange County, and Reedy Creek) use the Floridan aquifer. Reedy Creek uses the L-405 Canal as an additional source. Figure V-4-l shows the PWS utility source locations in Southern Orange County.

Domestic Self-Supply and Small Public Supply Systems

The self-supplied population in Southern Orange County was assessed at 14,402 in 1995 and is projected to remain at the same level through 2020 (Table V-4-l). This self-supplied population had assessed demands of 2.48 mgd (905 mgy) in 1995, and average projected demands of 2.41 mgd (880 mgy) in 2020. The l-in-10 demands in 2020 are 2.48 mgd (905 mgy). Average demands in 2020 are less than 1995 demands, even though the population remains the same. This occurs because 1995 had slightly higher irrigation demands (for outdoor use) than an average year.

Figure V-4-l. Public Water Supply Source Locations in Southern Orange County.

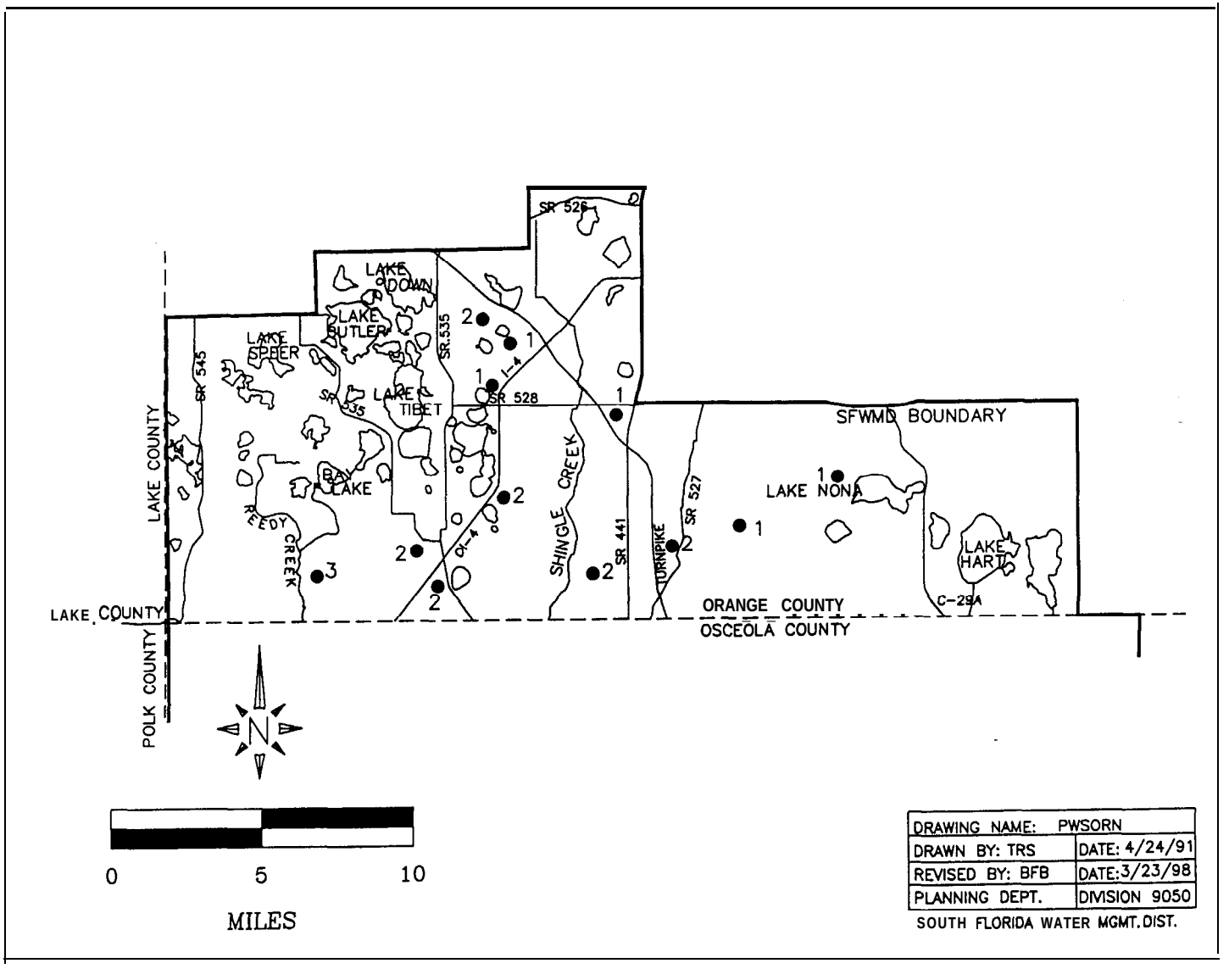


Table V-4-1. Public Water Supplied and Domestic Self-Supplied Demand Projections for Southern Orange County.

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
				PWS				PWS		PWS		DSS	DSS	DSS
		Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
#	Utility	1995	1995	1995	1995	use	factor	1995	factor	1995	1995	1995	1995	1995
1	Orlando-SF	131,530	127,842	27.29	213	20%	0.86	26.50	1.15	27.29	3,688	0.79	0.76	0.79
2	Orange County-SF	54,601	43,887	6.94	158	20%	0.86	6.74	1.15	6.94	10,714	1.69	1.65	1.69
3	Reedy Creek*	0	0	13.59	n/a	20%	0.86	13.20	1.15	13.59	0	0.00	0.00	0.00
	Totals	186,131	171,729	47.82				46.44		47.82	14,402	2.48	2.41	2.48
				PWS				PWS		PWS		DSS	DSS	DSS
		Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
#	Utility	2020	2020	2020	2020	use	factor	2020	factor	2020	2020	2020	2020	2020
1	Orlando-SF	210,827	207,139	44.22	213	20%	0.86	42.95	1.15	44.22	3,688	0.79	0.77	0.79
2	Orange County-SF	138,626	127,912	20.23	158	20%	0.86	19.65	1.15	20.23	10,714	1.69	1.64	1.69
3	Reedy Creek*	0	0	29.80	n/a	20%	0.86	28.94	1.15	29.80	0	0	0.00	0.00
	Totals	349,453	335,051	94.251				91.531		94.261	14,402	2.461	2.411	2.46

Notes:

Reedy Creek's self-supplied population of 43 is reallocated to the County

Reedy Creek's estimates incude them park attraction water use, day visitors, hotel and motel residents, and landscape irrigation

Rural in Orange County is part of the County service area

Commercial/Industrial Self-Supply

Commercial/Industrial water use in Southern Orange County was assessed at 799 mgy in 1995. The demand for commercial/industrial self-supplied water (as opposed to PWS supplied) is projected to increase to 1,263 mgy by 2020. PWS supplied industrial demand is included with other public utility demands.

Recreational Self-Supply

The recreational self-supplied demand category includes self-supplied irrigation demands for large landscaped areas (as opposed to private homes) and for golf courses. Landscaped self-supplied area is projected to increase from 908 acres in 1995 to 1,503 acres in 2020, with average demands increasing from 1,014 mgy in 1995 to 1,679 mgy by 2020. The l-in-10 irrigation requirements in 2020 are 1,928 mgy.

In 1995, there were 42 golf courses in Orange County of which 24 were in the southern portion, i.e., within the SFWMD. Of the 24 in the District, 16 were self-supplied and eight used reclaimed water for irrigation. These 16 courses included 3,592 acres of irrigated area. Self-supplied irrigated golf course acreage is projected to grow to 3,749 acres by 2020, with an associated increase in average irrigation requirements from 4,012 mgy in 1995 to 4,187 mgy in 2020. The l-in-10 irrigation requirements in 2020 are 4,809 mgy.

Combined recreational self-supplied average demands for Southern Orange County are equal to 5,027 mgy in 1995 and 5,866 mgy in 2020. The l-in-10 irrigation requirements in 2020 are 6,738 mgy.

Agricultural Self-Supply

The only irrigated commercially grown crops in Southern Orange County are citrus and greenhouse/nursery. There is some vegetable and sod production in Orange County, but all of this takes place in the St. Johns River Water Management District portion of the county. Improved pasture is rarely irrigated, and only about 10 percent of the county's cattle are within the SFWMD.

Citrus

Orange County citrus acreage declined gradually from 68,005 acres in 1968 to 48,527 acres in 1982. Since then, a series of freezes has driven acreage down to a low of 8,339 acres in 1990. Citrus has recovered slightly to 10,029 acres in 1995-6. The overall decline of citrus acreage in Orange County is forecast to continue through 2020, although some fluctuations are likely.

The ratio of citrus acreage in Orange County between the two water management districts is 5 to 4, with the greater portion in the SFWMD. This ratio was used to project future citrus acreage for Southern Orange County. Citrus in Southern Orange County is projected to decline from 5,572 acres in 1995 to 2,636 acres in 2020. This decrease in citrus acreage has an average irrigation requirement of 3,447 mgy for 1995 and 1,631 mgy for 2020. The l-in-10 demands for 2020 are 2,062 mgy.

Greenhouse/Nursery

In 1995, there were 1,307 acres of ornamental nursery in Orange County, about a quarter of which were within the District. Ornamental nursery acreage within Southern Orange County is forecast to grow from 327 acres in 1995 to 485 acres by 2020. These acreages have average irrigation requirements of 468 mgy in 1995 and 695 mgy in 2020. The l-in-10 requirement in 2020 is equal to 837 mgy.

Miscellaneous

Cattle Watering. In 1995 Orange County had 17,000 head of cattle and calves (FASS, 1997) none of which were dairy cows. Only about 10 percent of the cattle in Orange County are in the SFWMD. Using the District standard of 12 gal/cow/day, the annual estimated use is 7 mgy. While there may be some fluctuation in the county's cattle numbers over the projection period, this estimate represents the typical amount of water that will be needed for this purpose through 2020.

Demand Summary

Urban demands are projected to increase faster than the forecast decrease in agricultural water use, resulting in an overall increase in demand over the projection period. Urban demands are projected to grow by 71 percent between 1995 and 2020, and agricultural demand is projected to decline by 41 percent during that period. Total average demand is projected to grow by 56 percent, from 28,108 mgy in 1995 to 43,750 mgy in 2020. Urban demands made up 86 percent of the total average demands in 1995 and are projected to be 95 percent of the average demands in 2020 (Table V-4-2).

Table V-4-2. Urban and Agricultural Demand for Southern Orange County.

Urban and Agricultural Demands	(a) Assessed 1995 (mgy)	(b) Average 2020 (mgy)	(c) Percent Change (a) to (b)	(d) 1-in-10 2020 (mgy)
Urban				
Public Water Supply	17,454	33,408	91%	34,405
Domestic Self-Supply	905	880	- 3%	905
Commercial/Industrial Self-Supply	799	1,263	58%	1,263
Recreational Self Supply	5,027	5,866	17%	6,738
Total Urban	**24,186**	**41,417**	**71%**	**43,311**
Agricultural				
Citrus	3,447	1,631	- 53%	2,062
Greenhouse/Nursery	468	695	49%	837
Miscellaneous (Cattle Watering)	7	7	0%	7
Total Agricultural	**3,922**	**2,333**	**- 41%**	**2,906**
Total Urban and Agricultural Demands	**28,108**	**43,750**	**56%**	**46,217**

The 1995 land use for Southern Orange County is shown in Plate 4. Continued growth of urban land use and a decline in agricultural land use is anticipated over the projection period.

Western Osceola County

Osceola County is divided between the SFWMD and the St. Johns River Water Management District. Most of the county (60 percent) is in the SFWMD, along with the great majority of the county's population and irrigated agriculture. Osceola County's population grew by 70 percent between 1985 and 1995, from 77,015 residents in 1985 to 131,025 residents in 1995 (U.S. Bureau of the Census, 1998), and is projected to grow to 261,700 residents by 2020 (BEBR, 1998). Over 99 percent of the county's population reside within the District.

Public Water Supply

Public utilities in Western Osceola County served a combined population of 99,528 residents in 1995, and this is projected to more than double, to 202,432 residents by 2020 (Table V-4-3). This increase in population has an associated increase in demands from 18.06 mgd (6,592 mgy) in 1995 to average demands of 37.13 mgd (13,552 mgy) in 2020. The l-in-10 demands in 2020 are 37.75 mgd (13,779 mgy). The locations of public water supply sources in Western Osceola County are shown in Figure V-4-2.

Domestic Self-Supply and Small Public Supply Systems

In 1995, Western Osceola County had 31,077 residents that were self-supplied. This number is forecast to increase to 58,505 in 2020 (Table V-4-3). These residents have associated increased demands from 5.66 mgd (2,066 mgy) in 1995 to average demands of 8.70 mgd (3,176 mgy). The l-in-10 demands in 2020 are 8.97 mgd (3,274 mgy) in 2020.

Commercial/Industrial Self-Supply

Commercial/Industrial water use in Western Osceola County was assessed at 266 mgy in 1995. The demand for commercial/industrial self-supplied water (as opposed to PWS supplied) is projected to increase to 533 mgy by 2020. PWS supplied industrial demand is included with other public utility demands.

Figure V-4-2. Public Water Supply Source Locations in Western Osceola County.

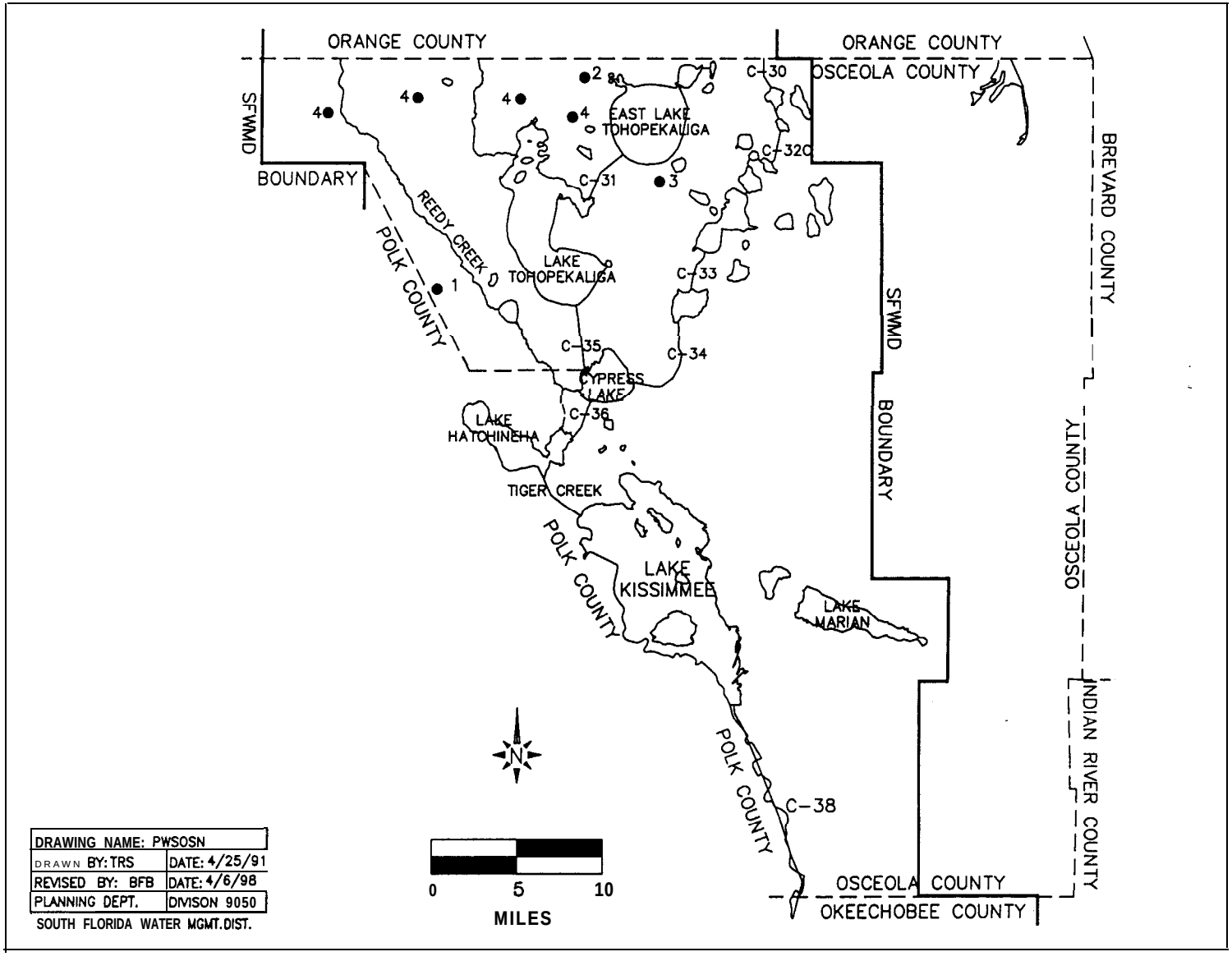


Table V-4-3. Public Water Supplied and Domestic Self Supplied Demand Projections for Western Osceola County.

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
				PWS				PWS		PWS		DSS	DSS	DSS
		Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
#	Utility	1995	1995	1995	1995	use	factor	1995	factor	1995	1995	1995	1995	1995
1	Poinciana	9,724	9,246	0.86	93	50%	0.911	0.82	1.065	0.85	478	0.04	0.04	0.04
2	Buenaventura Lakes	19,847	19,481	1.90	98	50%	0.911	1.82	1.065	1.88	366	0.04	0.03	0.04
3	St. Cloud	20,387	19,900	1.86	93	65%	0.911	1.75	1.065	1.83	487	0.05	0.04	0.04
4	Kissimmee	52,588	50,901	13.44	264	17%	0.911	13.24	1.065	13.38	1,687	0.45	0.44	0.44
	Rural Self Supplied	28,059			181	50%	0.911		1.065		28,059	5.09	4.87	5.03
	Totals	130,605	99,528	18.06				17.63		17.94	31,077	5.66	5.42	5.59
				PWS				PWS		PWS		DSS	DSS	DSS
		Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
#	Utility	2020	2020	2020	2020	use	factor	2020	factor	2020	2020	2020	2020	2020
1	Poinciana	37,607	36,718	3.42	93	50%	0.911	3.27	1.065	3.38	889	0.08	0.08	0.08
2	Buenaventura Lakes	20,380	19,564	1.91	98	50%	0.911	1.83	1.065	1.89	816	0.08	0.08	0.08
3	St. Cloud	35,788	34,735	3.25	93	65%	0.911	3.06	1.065	3.19	1,053	0.10	0.09	0.10
4	Kissimmee	114,787	111,415	29.42	264	17%	0.911	28.98	1.065	29.30	3,372	0.89	0.88	0.89
	Rural Self Supplied	52,375			181	50%	0.911		1.065		52,375	7.93	7.58	7.83
	Totals	260,937	202,432	38.00				37.13		37.75	58,505	9.08	8.70	8.97

Recreational Self-Supply

Recreational self-supplied demands in Western Osceola County are equal to the irrigation requirements for golf courses. In 1995, there were 11 golf courses in Osceola County, all within the western (SFWMD) portion. Of these courses, three were supplied with reclaimed water from wastewater utilities and eight were self-supplied. These self-supplied courses had a combined irrigated area of 907 acres. Self-supplied irrigated acreage is projected to increase to 2,704 acres by 2020. Self-supplied golf courses had irrigation requirements of 1,064 mgy in 1995 and are projected to have average demands of 3,172 mgy in 2020. The l-in-10 demands in 2020 are 3,613 mgy.

Agricultural Self-Supply

The irrigated commercially grown crops in Western Osceola County are citrus, vegetables, sod, and ornamental nursery. Improved pasture is very seldom irrigated, but there are some demands for cattle watering. Plate 4 shows the area currently used for agriculture. Acreage declines are projected for citrus and greenhouse/nursery, while the acreage outlook seems constant for vegetables and sod. This results in an overall decline in irrigation demand for agriculture over the projection period.

citrus

Osceola County's citrus acreage has exhibited a modest but evident overall decline, from a high of 19,363 acres in 1968 to 15,404 acres in 1995-6. This decline is forecast to continue through 2020 to 14,973 acres, although minor fluctuations are likely. All but 7.5 percent of this acreage lies within the SFWMD. Citrus in Western Osceola County is projected to decline from 14,249 acres in 1995 to 13,850 in 2020, with associated average irrigation requirements declining from 11,088 mgy in 1995 to 10,778 mgy in 2020. The l-in-10 demands in 2020 are 13,020 mgy.

Vegetables, Melons, and Berries

Vegetable production in Osceola County is limited. Crops grown commercially include squash, cucumbers, peppers, tomatoes, watermelons, and potatoes. Different types of vegetables are often grown interchangeably. In 1995, there were about 1,200 acres of land used for vegetable production, and this is forecast to remain relatively constant through the projection

period. This acreage is all within the SFWMD and has average demands of 590 mgy and l-in-10 demands of702 mgy.

Sod

In 1995, there were 500 acres of sod production in the county and this is projected to remain constant (as it has in recent years) through 2020. All this acreage is in the SFWMD. This acreage has average irrigation requirements of 859 mgy and l-in-10 demands of 1,004 mgy.

Greenhouse/Nursery

Ornamental nursery acreage has declined in recent years in Osceola County, from a high of 498 acres in 1989 to 99 acres in 1996. All the nursery acreage in Osceola County is in the SFWMD. In 1995, there were 106 acres of ornamental nursery, and this is projected to decrease to an insignificant level by 2020. Average irrigation requirements were 107 mgy in 1995, and are projected to be insignificant by 2020.

Miscellaneous

Cattle Watering. Osceola County ranks number three in beef cattle and number five in total cattle numbers in Florida (Florida Agricultural Statistics Service, 1997). About 60 percent of Osceola County's cattle are within the SFWMD. The 1995 water demand assessment for cattle watering based on cattle numbers and type was 273 mgy. While there may be some fluctuation in cattle numbers through the projection period, this estimate represents the typical amount of water that will be needed for this purpose through 2020.

Aquaculture. Aquacultural operations withdraw water for circulation purposes, and to replace evaporative losses. This replacement was assessed for Western Osceola County as 37 mgy in 1995. Demand was projected to remain at the 1995 level through 2020.

Demand Summary

Urban demands are projected to grow by 105 percent between 1995 and 2020, and agricultural demand is projected to decline by 3 percent during that period (Table V-4-4). Total demand is projected to grow by 44 percent, from 22,942 mgy in 1995 to 32,970 mgy in 2020. Urban demands are projected to increase in share of the total average demands, from 44 percent in 1995 to 62 percent by 2020. Citrus irrigation makes up about 86 percent of the agricultural requirements through the year 2020.

Table V-4-4. Urban and Agricultural Demand for Western Osceola County.

Urban and Agricultural Demands	(a) Assessed 1995 (mgy)	(b) Average 2020 (mgy)	(c) Percent Change (a) to (b)	(d) 1-in-10 2020 (mgy)
Urban				
Public Water Supply	6,592	13,552	106%	13,779
Domestic Self-Supply	2,066	3,176	54%	3,274
Commercial/Industrial Self-Supply	266	533	100%	533
Recreational Self Supply	1,064	3,172	198%	3,613
Total Urban	**9,988**	**20,433**	**105%**	**21,199**
Agricultural				
Citrus	11,088	10,778	- 3%	13,020
Vegetables, Melons, and Berries	590	590	0%	702
Sod	859	859	0%	1,004
Greenhouse/Nursery	107	INSIG	-100%	INSIG
Miscellaneous (Cattle Watering)	310	310	0%	310
Total Agricultural	**12,954**	**12,537**	**- 3%**	**15,036**
Total Urban and Agricultural Demands	22,942	32,970	44%	36,235

The 1995 land use for Western Osceola County is shown in Plate 4. Urban land use is prevalent in the north of the county in proximity to the large entertainment attractions, while agriculture largely covers the central and southern part of the county. Wetlands are found throughout the county, but are more prevalent in proximity to large lakes. Continued growth of urban land use, and a slight but continuous decline in irrigated agricultural land use, are anticipated over the projection period.

Eastern Polk County

Polk County is divided between the SFWMD, Southwest Florida Water Management District, and the St. John River Water Management District. About two-fifths of the county, the eastern portion, is in the SFWMD, but only one or two percent of the county's population.

Public Water Supply

The public utility in Eastern Polk County served 5,212 residents in 1995, and is projected to serve 12,238 residents by 2020 (Table **V-4-5).** The increase in population served had associated demands of 0.79 mgd (288 mgy) in 1995, and has projected average demands of 1.82 mgd (664 mgy) in 2020. The l-in-10 demands in 2020 are 1.97 mgd (719 mgy). Figure V-4-3 shows the location of the withdrawal source for the PWS utility in Eastern Polk County.

Domestic Self-Supply and Small Public Supply Systems

In Eastern Polk County, 1,163 residents were self-supplied in 1995 (Table V-4-5). This number is projected to rise to 1,594 by 2020, and associated demands are projected to rise from 0.18 mgd (66 mgy) in 1995 to average 2020 demands of 0.24 mgd (88 mgy). The l-in-10 demands in 2020 are 0.26 mgd (95 mgy).

Commercial/Industrial Self-Supply

Commercial/Industrial water use in Eastern Polk County was assessed at 234 mgy in 1995. The demand for commercial/industrial self-supplied water (as opposed to PWS supplied) is projected to increase to 321 mgy by 2020. PWS supplied industrial demand is included with other public utility demands.

Figure V-4-3. Public Water Supply Source Locations in Eastern Polk County.

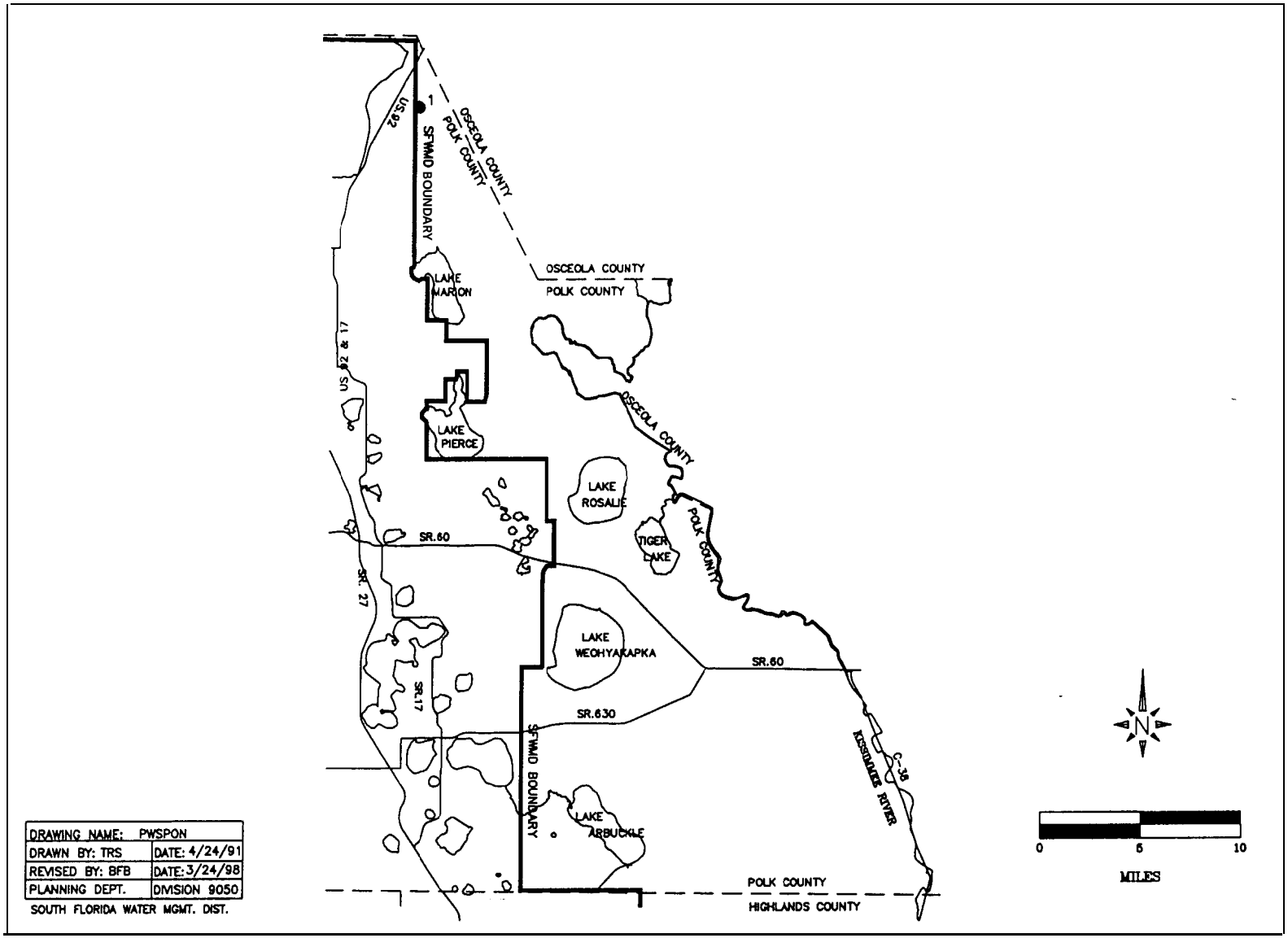


Table V-4-5. Public Water Supplied and Dometic Self-Supplied Demand Projections for Eastern Polk County.

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
				PWS				PWS		PWS		DSS	DSS	DSS
		Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	Population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
#	Utility	1995	1995	1995	1995	use	factor	1995	factor	1995	1995	1995	1995	1995
1	Oak Hills Estate	5,212	5,212	0.79	152	50%	0.964	0.78	1.158	0.84	0	0.00	0.00	0.00
	Rural Self Supplied	1,163			152	50%	0.964		1.158	0.00	1,163	0.18	0.17	0.19
	Totals	6,375	5,212	0.79				0.78		0.84	1,163	0.18	0.17	0.19
				PWS				PWS		PWS		DSS	DSS	DSS
		Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	Population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
#	Utility	2020	2020	2020	2020	use	factor	2020	factor	2020	2020	2020	2020	2020
1	Oak Hills Estate	12,238	12,238	1.85	152	50%	0.964	1.82	1.158	1.97	0	0.00	0.00	0.00
	Rural Self Supplied	1,594			152	50%	0.964		1.158	0.00	1,594	0.24	0.24	0.26
	Totals	13,832	12,238	1.85				1.82		1.97	1,594	0.24	0.24	0.26

Recreational Self-Supply

The recreational self-supplied demand category includes self-supplied irrigation demands for large landscaped areas (as opposed to private homes) and for golf courses. Self-supplied large landscaped area is projected to increase from 16 acres in 1995 to 22 acres in 2020. Landscaping self-supplied average demand in Eastern Polk County (not counting golf courses) is projected to increase from 18 mgy in 1995 to 26 mgy in 2020. The l-in-10 irrigation requirements in 2020 are 30 mgy.

In 1995, there were five golf courses in Eastern Polk County, all of which are self-supplied. These golf courses had a total area of 816 acres, of which 550 acres were irrigated. Irrigated golf course acreage is projected to increase to 775 acres by 2020. Golf acreage in 1995 had average irrigation requirements of 626 mgy, and is projected to increase to 883 mgy by 2020. The l-in-10 irrigation requirements for these golf courses in 2020 are 1,023 mgy.

Combined recreational self-supplied average demands for Eastern Polk County are equal to 644 mgy in 1995 and 909 mgy in 2020. The l-in-10 irrigation requirements in 2020 are 1,053 mgy

Agricultural Self-Supply

The irrigated commercially grown crops in Eastern Polk County are citrus, vegetables, and sod. Improved pasture is very seldom irrigated, but there are some demands for cattle watering.

Citrus

In 1995-6, Polk County had the second most citrus acreage of all the counties in Florida. There is, however, a declining trend caused by several severe freezes, from a high of 150,249 acres reported in the 1968 Commercial Citrus Inventory (Florida Agricultural Statistics Service, 1968). Acreage declined almost continuously following 1968, and then by a significant step following successive freezes in the 1980s. The low (since the first citrus summary in 1966) occurred in 1990, with 99,732 acres remaining. Although this acreage has recovered slightly to 103,884 acres in 1995-6, a long-range overall decline is forecast by 2020.

Although Polk County is a citrus center, very little of the county's citrus acreage is within the SFWMD. Appraisals from the local tax assessor's office and estimates from SWFWMD suggest that only 2-1/2 percent of Polk County's citrus is within the District's boundaries. The 1995-6 estimate for Eastern Polk County citrus acreage was 2,597 acres, and this is projected to decline to 2,159 acres by 2020. This decrease in acreage will lower the average irrigation requirement from 2,014 mgy in 1995 to 1,674 mgy in 2020. The l-in-10 demands for 2020 are 2,000 mgy.

Vegetables, Melons, and Berries

Watermelon is the only significant commercially grown crop in this category in Eastern Polk County. It is only grown in the spring, and production takes place on different land each year to avoid viral infestation. In 1995, there were approximately 500 acres of land used for watermelon production in Eastern Polk County, and this is forecast to remain relatively constant through 2020. These 500 acres of watermelon have an average irrigation requirement of 254 mgy and l-in-10 requirements of 295 mgy.

Sod

In 1995, there were an estimated 1,000 acres of irrigated sod in Eastern Polk County. This is projected to remain constant through 2020. These 1,000 acres of irrigated sod have an average irrigation requirement of 1,713 mgy and l-in-10 requirements of 1,984 mgy.

Miscellaneous

Cattle Watering. In 1995, there were a total of 110,000 total cattle and calves in Polk County (FASS, 1997), which includes 2,900 dairy cows. About one-third of the beef cattle in Polk County are within the District, plus about 500 dairy cattle. Based on this number and type of cattle, the demand for cattle watering is 182 mgy, and is projected to remain relatively constant throughout the projection period.

Demand Summary

Urban demands are projected to increase faster than the anticipated decrease in agricultural water use, resulting in an overall increase in demand over the projection period. Self-supplied golf course irrigation is the main urban use.

As shown in Table V-4-6, urban demands are projected to grow by 61 percent between 1995 and 2020, and agricultural demand is projected to decline by 8 percent during that period. Total average demand is projected to grow by 8 percent, from 5,395 mgy in 1995 to 5,805 mgy in 2020.

Table V-4-6. Urban and Agricultural Demand fo Eastern Polk County.

Urban and Agricultural Demands	(a) Assessed 1995 (mgy)	(b) Average 2020 (mgy)	(c) Percent Change (a) to (b)	(d) 1 -in-l 0 2020 (mgy)
Urban				
Public Water Supply	288	664	130%	719
Domestic Self-Supply	66	88	33%	95
Commercial/Industrial Self-Supply	234	321	37%	321
Recreational Self Supply	644	909	41%	1,053
Total Urban	**1,232**	**1,982**	**61%**	2,168
Agricultural				
Citrus	2,014	1,674	- 17%	2,000
Vegetables, Melons, and Berries	254	254	0%	295
Sod	1,713	1,713	0%	1,984
Miscellaneous (Cattle Watering)	182	182	0%	182
Total Agricultural	**4,163**	**3,823**	**- 8%**	**4,461**
Total Urban and Agricultural Demands	**5,395**	**5,805**	**8%**	**6,649**

The 1995 land use for Eastern Polk County is shown in Plate 4. The southeastern portion of this region is predominantly in the upland forest, rangeland or barren category, and includes the Avon Park Bombing Range. Wetlands are found throughout Eastern Polk County, but are more evident in the northern tip of the SFWMD portion of the county and in proximity to large lakes.

Eastern Highlands County

Highlands County is divided between the SFWMD and the Southwest Florida Water Management District. The eastern portion of the county (Plate 4) is in the SFWMD. There are no public water supply utilities that are projected to pump as much as the 0.5 mgd threshold through 2020, and all residents of the area are self-supplied.

Domestic Self-Supplied and Small Public Supplied Systems

The population of Eastern Highlands County is projected to grow from 7,700 in 1995 to 11,590 by 2020. All residents are self-supplied or receive water from very small utilities (Table V-4-7). Domestic self-supplied demand is projected to grow from 0.81 mgd (296 mgy) in 1995, to average demands of 1.28 mgd (467 mgy) in 2020, and 2020 l-in-10 demands of 1.35 mgd (493 mgy).

Recreational Self-Supply

The recreational self-supplied demand category includes self-supplied irrigation demands for large landscaped areas (as opposed to private homes) and for golf courses. Self-supplied large landscaped area is projected to increase from 989 acres in 1995 to 1,524 acres in 2020. Landscaping self-supplied average demand for Eastern Highlands County (not golf courses) is projected to increase from 1,203 mgy in 1995 to 1,853 mgy by 2020. The l-in-10 irrigation requirements in 2020 are 2,159 mgy. There are no golf courses in Eastern Highlands County.

Table V-4-7. Public Water Supplied and Domestic Self-Supplied Demand Projections for Eastern Highlands County.

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
				PWS				PWS		PWS		DSS	DSS	DSS
		Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
		1995	1995	1995	1995	use	factor	1995	factor	1995	1995	1995	1995	1995
	Rural Self Supplied	7,700	0	0.00	105	35%	1.138	0.00	1.165	0.00	7,700	0.81	0.85	0.90
	Total	7,700	0	0.00				0.00		0.00	7,700	0.81	0.85	0.90
				PWS				PWS		PWS		DSS	DSS	DSS
		Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
		2020	2020	2020	2020	use	factor	2020	factor	2020	2020	2020	2020	2020
	Rural Self Supplied	11,590	0	0.00	105	35%	1.138	0.00	1.165	0.00	11,590	1.22	1.28	1.35
	Total	11,590	0	0.00				0.00		0.00	11,590	1.22	1.28	1.35

Agricultural Self-Supply

The irrigated commercially grown crops in Highlands County are citrus, vegetables, blueberries, sod, and greenhouse/nursery (including caladiums). Improved pasture is very seldom irrigated, but there is some demand for cattle watering. There are also some water demands for aquaculture (fish farming).

Citrus

Citrus acreage in Highlands County was relatively constant from 1966 to 1982, staying within the range from 37,105 to 39,110 acres. Since 1982, acreage has continuously increased from 37,661 acres to 76,586 acres in 1995-6. This large increase in acreage is associated with the inter-regional movement of citrus acreage southward from central Florida following the severe freezes in the mid-1980s.

Approximately 35 percent of the citrus acreage in Highlands County is within the District's boundaries. The 1995-6 estimate for Eastern Highlands County citrus acreage was 26,805 acres, and this is projected to grow to 52,861 acres by 2020, as about three-quarters of the citrus acreage growth in Highlands County is anticipated to be in the portion within the SFWMD. The growth in acreage has increased average irrigation requirements, from 22,534 mgy in 1995 to 40,787 mgy in 2020. The l-in-10 demands in 2020 are 48,965 mgy.

Vegetables, Melons and Berries

In 1995, there were about 1,000 acres of land used for vegetable production, and this is forecast to increase significantly to 10,000 acres by 2020. This large projected increase is based on a large agri-business corporation initiating development of a significant vegetable production operation in Eastern Highlands County. In 1995, there were 200 acres of blueberries in Eastern Highlands County, and production is forecast to stay at that level through 2020.

The increase in combined acreage will increase the average irrigation requirement from 760 mgy in 1995 to 6,089 mgy in 2020. The l-in-10 demands for 2020 are 7,085 mgy.

Sod

In 1995, there were an estimated 3,500 acres of irrigated sod in Eastern Highlands County, and production is forecast to remain at that level through 2020. This acreage of sod has an average irrigation requirement of 6,398 mgy, and l-in-10 requirements of 7,457 mgy.

Greenhouse/Nursery

In 1995, there were 1,587 acres of ornamental nursery in Highlands County, which is projected to increase to 1,652 acres by 2020. Approximately 20 percent of this acreage is within the District. In addition to the ornamental nursery acreage reported by the Division of Plant Industry, Highlands County produces over 90 percent of the world's caladium bulbs. In 1995, there were 1,200 acres of caladiums in Highlands County (all within the SFWMD), and this is projected to remain constant through 2020.

The combined acreage of these greenhouse/nursery crops was 1,517 acres in 1995, and for 2020 is 1,530 acres. This combined acreage has average demands of 2,042 mgy in 1995 and 2,065 mgy in 2020. The 2020 l-in-10 demand projection is equal to 2,407 mgy.

Miscellaneous

Cattle Watering. In 1995, Highlands County had 9,000 dairy cows and 111,000 non-dairy cattle (Florida Agricultural Statistics Service, 1997). From contacts with the local IFAS extension office it was assessed that about 8,000 dairy cows and 80 percent of the non-dairy cattle in Highlands County were in the eastern portion in 1995. The 1995 water demand assessment for cattle watering is 827 mgy, and this is projected to decline to 766 mgy by 2020 as some former pastureland is used for irrigated crops.

Aquaculture. Aquacultural operations withdraw water for circulation purposes, and to replace evaporative losses. This replacement was assessed for Highlands County as 97 mgy in 1995. Demand was projected to remain at the 1995 level through 2020.

Demand Summary

Total demand is projected to grow by 71 percent, from 34,157 mgy in 1995 to 58,522 mgy in 2020. Agricultural irrigation demands make up from 96 percent of the total demand over the projection period. Expansion in citrus and vegetable acreage is a driving force behind increased demands. Urban demand, although increasing by 55 percent, still only makes up a minor portion of total demands throughout the projection period.

Table V-4-8. Urban and Agricultural Demand for Eastern Highlands Countv.

Urban and Agricultural Demands	(a) Assessed 1995 (mgy)	(b) Average 2020 (mgy)	(c) Percent Change (a) to (b)	(d) 1 -in-l 0 2020 (mgy)
Urban				
Domestic Self-Supply	296	467	50%	493
Recreational Self-Supply	1,203	1,853	54%	2,159
Total Urban	**1,499**	**2,320**	**55%**	**2,652**
Agricultural				
Citrus	22,534	40,787	81%	48,965
Vegetables, Melons, and Berries	760	6,089	701%	7,085
Sod	6,398	6,398	0%	7,457
Greenhouse/Nursery	2,042	2,065	1%	2,407
Miscellaneous (Cattle Watering, Aquaculture)	924	863	-7%	863
Total Agricultural	**32,658**	**56,202**	**72%**	**66,429**
Total Urban and Agricultural Demands	**34,157**	**56,522**	**71%**	**69,429**

The 1995 land use for Eastern Highlands County is shown in Plate 4. Agriculture largely covers the interior region of the county, and continued growth of irrigated agricultural land is forecast over the projection period.

Western Okeechobee County

Okeechobee County is divided between the SFWMD and the St. Johns River Water Management District. Eighty-seven percent of the county is in the SFWMD, along with 98 percent of the county's population and the majority of irrigated agriculture. The portion of Okeechobee County within the SFWMD is further divided between the Kissimmee Basin Planning Region (Western Okeechobee) and the Upper East Coast Planning Region (Eastern Okeechobee). Demand estimates and projections are presented here for Western Okeechobee County. This portion is shown in Figure V-4-5 and Plate 4.

Okeechobee County is mainly agricultural and sparsely populated. It has experienced a 28 percent population growth in the decade from 1985 to 1995, from 24,084 in 1985 to 30,825 in 1995 (U.S. Bureau of the Census, 1998), and is projected to have 48,200 residents in 2020. Most of the population, as well as the majority of the irrigated agriculture is in the western portion.

Public Water Supply

The population served by the public water supply (PWS) utility in Western Okeechobee County is projected to grow from 21,200 in 1995 to 33,258 by 2020. This increase in PWS served population had associated demands of 1.95 mgd (712 mgy) in 1995, and has projected 2020 average demands of 3.02 mgd (1,102 mgy). The projected l-in-10 demands in 2020 are 3.28 mgd (1,197 mgy). Figure V-4-4 shows the location of the withdrawal source for the PWS utility in Western Okeechobee County.

Domestic Self-Supply and Small Public Supply Systems

The self-supplied population in Western Okeechobee County for 1995 was assessed at 7,537 residents, and is forecast to increase to 11,976 residents by 2020 (Table V-4-9). Associated residential self-supplied demands are projected to increase from 0.69 mgd (252 mgy) in 1995 to average demands of 1.09 mgd (398 mgy) in 2020. The l-in-10 demands in 2020 are projected to be 1.16 mgd (423 mgy).

Figure V-4-4. Public Water Supply Utility Source Locations in Western Okeechobee County.

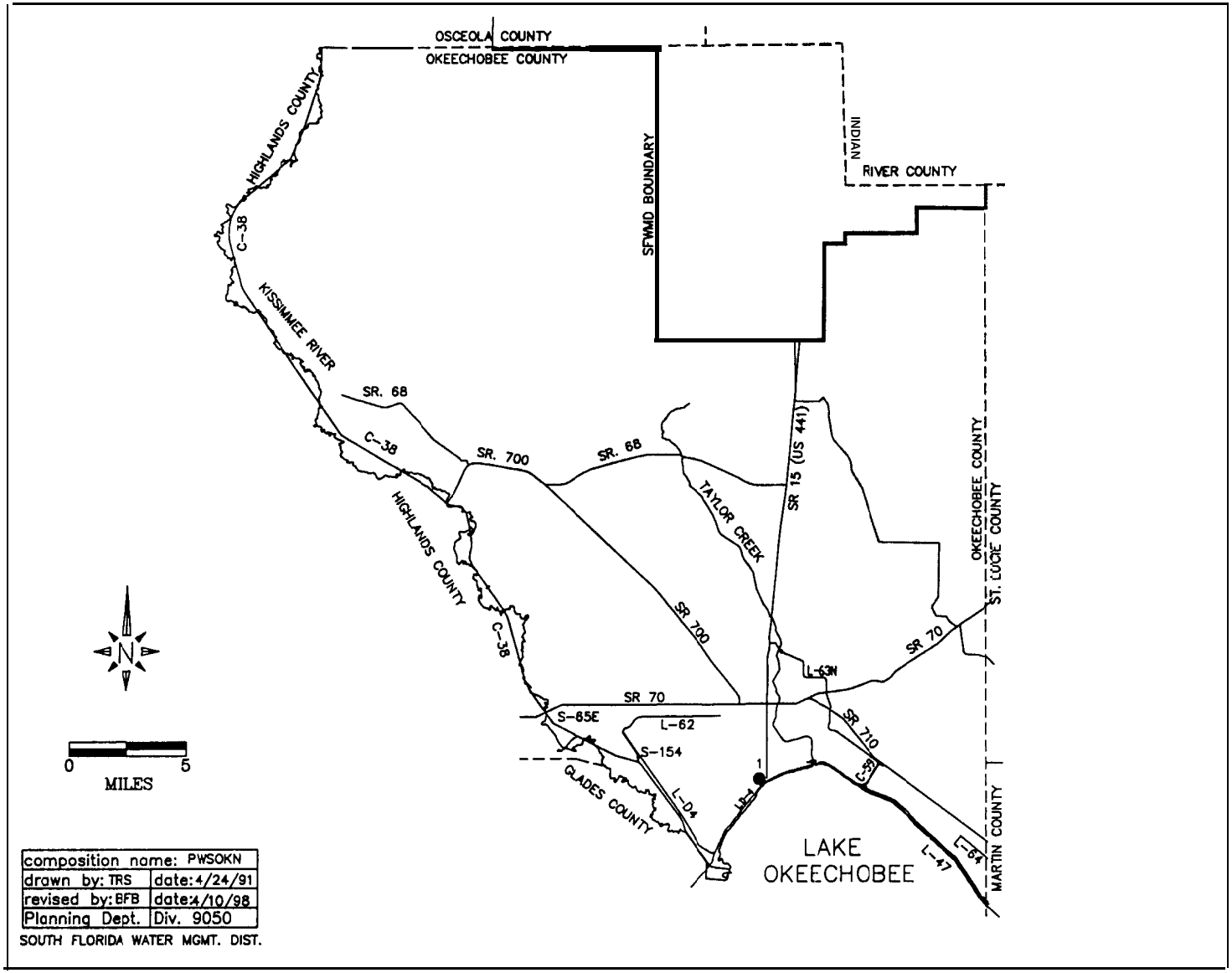


Table V-4-9. Public Water Supplied and Domestic Self Supplied Demand Projections for Western Okeechobes County.

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
				PWS				PWS		PWS		DSS	DSS	DSS
#	Utility	Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	Population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
		1995	1995	1995	1995	use	factor	1995	factor	1995	1995	1995	1995	1995
1	Okeechobee UA	21,200	21,200	1.95	92	50%	0.973	1.92	1.172	2.09	0	0.00	0.00	0.00
	Rural Self Supplied	7,537			92	35%	0.973		1.172		7,537	0.69	0.69	0.73
	Totals	28.7371	21,200	1.951				1.92		2.091	7,537	0.69	0.69	0.73
				PWS				PWS		PWS		DSS	DSS	DSS
#	Utility	Total	PWS	base		Percent		average		1-in-10	DSS	base	average	1-in-10
		population	Population	MGD	GPCD	outdoor	Average	MGD	1-in-10	MGD	population	MGD	MGD	MGD
		2020	2020	2020	2020	use	factor	2020	factor	2020	2020	2020	2020	2020
1	Okeechobee UA	33,258	33,258	3.06	92	50%	0.973	3.02	1.172	3.28	0	0.00	0.00	0.00
	Rural Self Supplied	11,976			92	35%	0.973		1.172		11,976	1.10	1.09	1.16
	Totals	45,234	33,258	3.06				3.02		3.28	11,976	1.10	1.09	1.16

Recreational Self-Supply

Self-supplied large landscaped area is projected to increase from 30 acres in 1995 to 47 acres in 2020. Landscaping self-supplied average demand in Western Okeechobee County (not counting golf courses) is projected to increase from 35 mgy in 1995 to 55 mgy by 2020. The l-in-10 irrigation requirements in 2020 are 65 mgy.

In 1995, there were three golf courses in Western Okeechobee County. These golf courses are all self-supplied, and combined have 222 irrigated acres. Irrigated golf course acreage is forecast to remain constant through 2020, with an associated average irrigation requirement of 262 mgy and a l-in-10 irrigation requirement of 307 mgy.

Combined recreational self-supplied average demands for Western Okeechobee County are equal to 298 mgy in 1995 and 318 mgy in 2020. The l-in-10 irrigation requirements in 2020 are 372 mgy

Agricultural Self-Supply

The irrigated commercially grown crops in Western Okeechobee County are citrus, vegetables, sod, and ornamental nursery. Improved pasture is very seldom irrigated, but cattle watering has significant demands.

Citrus

Okeechobee County's citrus acreage grew slowly but steadily from 2,508 acres in 1966 to 4,281 acres in 1980. Since 1980, the rate of growth has accelerated, and citrus has increased to 12,206 acres by 1995-6 (Florida Agricultural Statistics Service, 1996). District land-use maps show approximately 90 percent of the citrus acreage in Okeechobee County as within the District (SFWMD, 1988), and 68 percent of this acreage in the District as within the western portion (in the Kissimmee Basin Planning Region). These ratios were used to divide acreage projections. Based on these ratios, the citrus acreage in Western Okeechobee County was 7,470 acres in 1995, and is projected to be 14,344 in 2020. These acreages have average irrigation requirements of 6,095 mgy in 1995 and 11,705 mgy in 2020. The l-in-10 irrigation requirement for citrus in 2020 is 14,160 mgy.

Vegetables, Melons, and Berries

Watermelons, potatoes, and a small acreage of Latin vegetables are the only vegetable crops presently grown commercially in Okeechobee County. In 1995, there were 1,000 acres of land used for vegetable production, and vegetable acreage is forecast to remain at that level through 2020. These 1,000 acres of vegetable crops have an average irrigation requirement of 572 mgy, and a l-in-10 irrigation requirement of 685 mgy.

Sod

In 1995, there were 250 acres of irrigated sod production in Western Okeechobee County, and this is projected to remain constant through 2020. These 250 acres of sod have average irrigation requirements of 444 mgy and l-in-10 irrigation requirements of 521 mgy.

Greenhouse/Nursery

In 1995, Western Okeechobee County had 714 acres of ornamental nursery, and this is projected to grow to 1,741 acres by 2020. These acreages have average irrigation requirements of 1,269 mgy in 1995 and 3,095 mgy in 2020. The l-in-10 irrigation requirement in 2020 is 3,626 mgy.

Miscellaneous

Cattle Watering. Historically, Okeechobee County has been famous for its cattle production. In recent times, however, there have been motivations and incentives for ranchers to sell out or diversify. Despite this pressure, Okeechobee County is still the number one county in Florida for total cattle (Florida Agricultural Statistics Service, 1997). The dairy producing region is in the western portion of the county. From District land use maps (for pasture and rangeland), it was assessed that in addition to the dairy cows, 83 percent of the non-dairy cattle in Okeechobee County were in the western portion in 1995. The 1995 water demand assessment for cattle watering is 2,407 mgy, and this is projected to decline to 2,389 mgy as some former pastureland is used for irrigated crops.

Aquaculture. Aquacultural operations withdraw water for circulation purposes and to replace evaporative losses. This replacement was assessed for Western Okeechobee County as 182 mgy in 1995. Demand was projected to remain at the 1995 level through 2020.

Demand Summary

Urban demands are projected to remain at between 9 and 10 percent of the total demands in Western Okeechobee County through 2020. Agricultural demand is projected to rise by 68 percent during that period. Total average demand is projected to grow by 65 percent, from 12,231 mgy in 1995 to 20,205 mgy in 2020 (Table V-4-10).

Table V-4-10. Urban and Agricultural Demand for Western Okeechobee County.

Urban and Agricultural Demands	(a) Assessed 1995 (mgy)	(b) Average 2020 (mgy)	(c) Percent Change (a) to (b)	(d) l-in-10 2020 (mgy)
Urban				
Public Water Supply	712	1,102	55%	1,197
Domestic Self-Supply	252	398	58%	423
Recreational Self Supply	298	318	7%	372
Total Urban	**1,262**	**1,818**	**44%**	**1,993**
Agricultural				
Citrus	6,095	11,705	92%	14,160
Vegetables, Melons, and Berries	572	572	0%	685
Sod	444	444	0%	521
Greenhouse/Nursery	1,269	3,095	144%	3,626
Miscellaneous (Cattle Watering, Aquaculture)	2,589	2,571	-1%	2,571
Total Agricultural	**10,969**	**18,387**	**68%**	**21,563**
Total Urban and Agricultural Demands	**12,231**	**20,205**	**65%**	**23,556**

Western Okeechobee County is mostly agricultural (Plate 4), with the main urban area being around the City of Okeechobee. Upland forest and rangeland are found mostly in the northern portion of the county, as are most of the wetlands in Western Okeechobee County

Northern Glades County

Glades County is rural and sparsely populated. There are only two counties in Florida (Lafayette and Liberty) which have fewer residents. The county is divided between the Kissimmee Basin Planning Region (Northern Glades County) and the Lower West Coast Planning Region (Southern Glades County). Demand estimates and projections are presented here for Northern Glades County, which is shown in Plate 4. The only existing or anticipated urban use in Northern Glades County is for domestic self-supply.

Domestic Self-Supply and Small Public Supply Systems

Northern Glades County's population is all self-supplied, and is projected to grow from 3,289 in 1995 to 5,640 by 2020. Domestic self-supplied demand was assessed to be 0.42 mgd (153 mgy) in 1995 (Table V-4-11), and based on the projected self-supplied population, average demands are forecast to rise to 0.76 mgd (277 mgy) by 2020. The l-in-10 demands in 2020 are equal to 0.81 mgd (296 mgy).

Agricultural Self-Supply

The irrigated commercially grown crops in Northern Glades County are citrus, field crops (sugarcane), vegetables, and sod. Improved pasture is very seldom irrigated, but there is some demand for cattle watering. Greenhouse/nursery crops are also grown commercially in Glades County, however, these are all grown in the southern portion of the county (in the Lower West Coast Planning Region).

Citrus

Citrus acreage in Glades County was relatively constant from 1966 to 1978, ranging from 1,413 and 1,661 acres. From 1978 to 1995-6, however, acreage has continuously increased, from 1,613 acres in 1978 to 9,402 acres in 1995-6. This increase in acreage is associated with the interregional movement of citrus from central to southwest Florida following the severe freezes in the mid-1980s.

Table V-4-11. Public Water Supplied and Domestic Self-Supplied Demand Projections for Northern Glades County.

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
		Total population 1995	PWS population 1995	PWS base MGD 1995	GPCD 1995	Percent outdoor use	Average factor	PWS average MGD 1995	1-in-10 factor	PWS 1-in-10 MGD 1995	DSS population 1995	DSS base MGD 1995	DSS average MGD 1995	DSS 1-in-10 MGD 1995
	Rural Self Supplied	3,289	0	0.00	127	35%	1.182	0.00	1.163	0.00	3,289	0.42	0.44	0.47
	Total	3,289	0	0.00				0.00		0.00	3,289	0.42	0.44	0.47
		Total population 2020	PWS population 2020	PWS base MGD 2020	GPCD 2020	Percent outdoor use	Average factor	PWS average MGD 2020	I-in-10 factor	PWS I-in-10 MGD 2020	DSS population 2020	DSS base MGD 2020	DSS average MGD 2020	DSS 1-in-10 MGD 2020
	Rural Self Supplied	5,640	0	0.00	1271	35%	1.1821	0.001	1.1631	0.001	5,640	0.721	0.761	0.81
	Total	5,640	0	0.00				0.00		0.00	5,640	0.721	0.761	0.81

Citrus acreage in Northern Glades County was assessed at 4,513 acres in 1995, and is projected to grow to 8,421 acres by 2020. This increase in acreage has average irrigation requirements of 3,748 mgy in 1995 and 6,993 mgy in 2020. The l-in-10 irrigation requirement for citrus in 2020 is 8,374 mgy.

Vegetables, Melons, and Berries

Vegetable production in Northern Glades County was assessed at 290 acres in 1995. Production is forecast to remain at about the same level through 2020. This acreage has an average irrigation requirement of 175 mgy, and l-in-10 demands of 201 mgy.

Field Crops

Sugarcane. In 1995, there were 3,338 acres of sugarcane in Northern Glades County, and production is forecast to increase to 4,482 acres by 2020. This increase in acreage has average irrigation requirements of 4,737 mgy in 1995 and 6,362 mgy in 2020. The l-in-10 irrigation requirement for sugarcane in 2020 is 7,619 mgy. Because of the production practices used for sugarcane (ratoon and fallow), there is an additional 25 percent of land used for sugarcane production which is fallowed in any given year.

Sod

In 1995, sod production was assessed at 300 acres. Sod production is forecast to remain at that level through 2020. The associated average irrigation requirement is 541 mgy, and l-in-10 irrigation requirements are 629 mgy.

Miscellaneous

Cattle Watering. In 1995, Glades County had 76,000 non-dairy cattle (Florida Agricultural Statistics Service, 1997). From District land use maps (for pasture and rangeland), it was assessed that two-thirds of the cattle in Glades County were in the northern portion in 1995. The 1995 water demand assessment for cattle watering is 222 mgy, and this is projected to decline to 214 mgy as some former pastureland is used for irrigated crops.

Demand Summary

Urban demands are projected to remain at an extremely low level in Northern Glades County through 2020. Total average demand is projected to grow by 52 percent, from 9,576 mgy in 1995 to 14,562 mgy in 2020. As shown in Table V-4-12, agricultural irrigation demands make up practically all (98 percent) of the total demand over the projection period.

Table V-4-12. Urban and Agricultural Demand for Northern Glades Countv.

Urban and Agricultural Demands	(a) Assessed 1995 (mgy)	(b) Average 2020 (mgy)	(c) Percent Change (a) to (b)	(d) l-in-10 2020 (mgy)
Urban				
Domestic Self-Supply	153	277	81%	296
Total Urban	153	277	81%	296
Agricultural				
Citrus	3,748	6,993	07%	8,374
Vegetables, Melons, and Berries	175	175	0%	201
Field Crops (Sugarcane)	4,737	6,362	34%	7,619
Sod	541	541	0%	629
Miscellaneous (Cattle Watering)	222	214	-4%	214
Total Agricultural	9,423	**14,285**	**52%**	17,037
Total Urban and Agricultural Demands	9,576	**14,562**	**52%**	17,333

Northern Glades County is predominantly agricultural (Plate 4). In recent years, there has been an increase in the acreage of irrigated crops. These crops are usually planted on land that was formerly used for non-irrigated pasture.

Source Evaluation

Overview of Hydrologic System

Southern Orange County

Surface Water

Orange County lies within two major drainage basins: the St. Johns River Basin and the Kissimmee River Basin. The eastern and northern portions of the county drain to the St. Johns River through the Wekiva, Econlockhatchee, and Little Econlockhatchee Rivers. These areas are not within the SFWMD. The southern and western portions of the county drain to the Kissimmee River.

Ground Water

Three aquifer systems exist in Orange County: the Surficial Aquifer System (SAS), the Intermediate Aquifer System (IAS), and the Floridan Aquifer System (FAS) (Table V-4-13).

The SAS consists of the water table aquifer. This aquifer occurs throughout Orange County, and is capable of producing small to moderate amounts of water. The water table aquifer can extend to depths in excess of 200 feet below land surface. It is used as a source of domestic self-supply.

The IAS acts as a confining zone for the underlying FAS. There are a few locally occurring artesian aquifers within this unit. These aquifers are used as a source for domestic use. However, the aquifers are not aerially extensive and only produce moderate amounts of water; therefore, they are not widely used. In the northwestern corner of the county (an area not in the SFWMD), the confining sediments of the IAS are not present.

The FAS is the most productive ground water source in Orange County. It provides almost all of the ground water used within the county. It contains two producing zones separated by a confining zone. Both producing zones are capable of yielding very large amounts of good quality water. The upper zone is

somewhat vulnerable to contamination because it receives surface water runoff through hundreds of drainage wells.

Table V-4-13. Ground Water Systems in Southern Orange County.

Hydrogeologic System	Hydrogeologic Unit	Thickness (Feet)	Water Resource Potential
Sutficial Aquifer System	Water Table Aquifer	40-225	Yields low to moderate amounts of water to wells. Used sporadically as a source of individual domestic supply in a few areas. Water quality varies widely.
Intermediate Aquifer System	Hawthorn Confining Area	O-200	Acts as a confining zone for the underlying FAS. A few locally occurring artesian producing zones exist, but they do not produce large amounts of water. Some limited domestic use occurs.
	Upper Producing Zone	Approx. 450	Capable of producing large amounts of water. Supplies approximately 35% of the ground water used in the county. Susceptible to pollution as a result of receiving surface runoff through drainage wells.
Floridan Aquifer System	Confining Zone	Approx. 500	Acts as a confining zone for the lower producing zone, although capable of producing significant amounts of water in some areas of the county.
	Lower Producing Zone	Approx. 400	Capable of producing large amounts of water. Supplies approximately 65% of the ground water used in the county. Less susceptible to contamination due to the presence of the confining zone.

Western Osceola County

Surface Water

Osceola County lies within two major drainage basins (the St. Johns River Basin and the Kissimmee River Basin). The eastern portion of the county drains to the St. Johns River through Blue Cypress Creek, Taylor Creek, and

several other small creeks. The western half of the county drains to the Kissimmee River through a system of sloughs, creeks, and canals, and is characterized by the existence of numerous lakes. These lakes range is size from small sinkholes, to Lake Kissimmee, which is one of the largest lakes in the state.

The Kissimmee River has been channelized by the Army Corps of Engineers and has functioned mainly as a drainage system. A restoration program is underway. The restoration effort will require increasing storage in the headwaters to restore year-round flows in the river. Approximately 10,000 acre-feet of additional surface water storage will be necessary for this effort. Surface water is not a significant source of water supply in Osceola County despite the many existing surface water bodies.

Ground Water

Three aquifer systems occur in Western Osceola County: the Surficial Aquifer System (SAS), the Intermediate Aquifer System (IAS), and the Floridan Aquifer System (FAS) (Table V-4-14).

Table V-4-14. Ground Water Systems in Western Osceola County.

Hydrogeologic System	Hydrogeologic Unit	Thickness (Feet)	Water Resource Potential
Surficial Aquifer System	Water Table Aquifer	50-250	Yields low-to-moderate amounts of water to wells. Not a major water source in Osceola County. Water quality varies widely.
Intermediate Aquifer System	Hawthorne Confining Zone	100-400	Acts as a confining zone for the underlying FAS. Some productive limestones exist in contact with the FAS and are considered part of that aquifer.
Floridan Aquifer System	Upper Producing Zone	100-350	Capable of producing large amounts of water. In general, the upper zone produces more water than the lower zone.
	Confining Zone	100-300	Acts as a confining zone for the lower producing zone, although capable of producing significant amounts of water in some areas of the county.
	Lower Producing Zone	200-800	Capable of producing large amounts of water.

The SAS consists of the water table aquifer. It occurs in thicknesses of up to 250 feet. This aquifer occurs throughout Osceola County, and is capable of producing small amounts of water. The water table aquifer is not a significant source of water in Osceola County.

The IAS, consisting mainly of silts and clays of the Hawthorn Group, acts as a confining zone for the underlying FAS. There are some limestone units at the base of the Hawthorn Group that are capable of producing moderate amounts of water. However, these limestones are in hydraulic contact with the FAS, and are considered part of the Floridan.

The FAS is the primary source of ground water throughout Osceola County. It is capable of yielding large quantities of good quality water. Generally, the water quality is best in the western portions of the county and decreases towards the east. In portions of extreme eastern Osceola County, the water quality is not acceptable for potable use. The permitted utilities are concentrated in the northwest area of the county.

Eastern Polk County

Surface Water

Eastern Polk County lies within the Kissimmee River drainage basin. In addition to the Kissimmee River, Eastern Polk County contains many large natural lakes. These include lakes Marion, Hatchineha, Pierce, Rosalie, Tiger, Weohyakapka, and Arbuckle. Only Lake Pierce and Lake Marion supply uses large enough to require individual SFWMD permits. Lake levels fluctuate in response to rainfall, ground water inflow, evaporation, downward leakage, surface inflow and outflow, and pumping. Because of the abundance of high quality, accessible water from the Floridan Aquifer System, and the desire to protect the recreational values of the lakes, there has been little incentive to develop surface water as a source of water supply.

Ground Water

Ground water is the predominant source of supply. Three major aquifer systems are recognized in Polk County: the Floridan, Intermediate, and Surficial (Table V-4-15).

Table V-4-15. Ground Water Systems in Eastern Polk County.

Hydrogeologic System	Hydrogeologic Unit	Thickness (Feet)	Water Resource Potential
Surficial Aquifer System	Surficial Aquifer	O-300	Produces small quantities of relatively good quality water. Most wells yield less than 50 gpm. Use is restricted to domestic self-supply, lawn irrigation and small scale agricultural irrigation.
Intermediate Aquifer System	Confining Beds Intermediate Aquifer Confining Beds	1 O-200	Used primarily for domestic self-supply, cattle watering, and small public water supplies. Produces small-to-moderate quantities of potable quality water. Most productive in the central and southern portions of Polk County.
Floridan Aquifer System	Upper Floridan Aquifer	800-l 000	Principal aquifer in Polk County. Supplies all major municipal, industrial, and irrigation water demands. Produces large quantities of good quality water.

The Upper FAS is the principal source of all major municipal, industrial, and irrigation water supplies. Large wells tapping the Floridan aquifer have yielded as much as 8,000 gpm of potable quality water. The largest use of Floridan water is for citrus irrigation in the centrai and east-central Highlands Ridge region, and phosphate mining in the southwest portion of the county. Polk County is an important recharge area for the FAS. Primary recharge areas occur along a linear band directly associated with the sandy Highlands Ridge.

The IAS consists of the limestones and dolostones of the Hawthorn and Tampa Formations. It is confined by low permeability sediments. In Eastern Polk County, where the lower confining beds are thin or absent, the IAS and FAS appear to be directly connected. Water from the IAS is used primarily for domestic self-supply, but may also be used for cattle watering, small public supplies, and agricultural irrigation. Most irrigation wells penetrating

the upper Floridan are open to the Intermediate aquifers as well. Average well yields range from 25 gpm in small domestic wells, to more than 200 gpm in large diameter irrigation wells. Water quality is generally within potable standards, except for isolated areas with excessive hardness. Some areas may show elevated concentrations of natural radiation, which result from weathering of phosphorite deposits.

The SAS produces small quantities of good-to-fair quality water. Wells tapping the surficial aquifer rarely yield more than 100 gpm, and average closer to 25 gpm. Generally, surficial water is moderately to highly acidic, high in iron, and highly colored. Isolated areas may also contain elevated levels of natural radiation from the weathering of phosphorite deposits. Though hundreds of wells tap the surficial aquifer, its use is limited to domestic self-supply, lawn irrigation, and small-scale agricultural irrigation along the central ridge areas where the aquifer is thickest.

Eastern Highlands County

Surface Water

The county's surface water resources include lakes, rivers, creeks and canals, with lakes comprising the majority. Almost all of these fall within the Lake Istokpoga/Arbuckle Creek drainage basin, which discharges through the C-41A and Lake Istokpoga canals to the Kissimmee River, and ultimately into Lake Okeechobee. Both Lake Istokpoga and the canals are important sources of water for agricultural irrigation east of the upland ridge.

Lake levels fluctuate with the water table. Along the upland ridge, many of these lakes, which were formed by sinkholes, are believed to be recharge conduits to the FAS. Because of their importance as recharge areas, it is essential that the quality and quantity of water be maintained in Eastern Highland County's lakes.

Ground Water

Ground water is the major source of supply for both agricultural and domestic uses in Highlands County. There are three major aquifer systems in Highlands County: the Floridan, Intermediate (Hawthorn), and Surficial (Table V-4-16).

The FAS is the single most important source of water in Highlands County. The FAS is composed ofseveral aquifers of varying productivity. As a general rule, transmissivity increases with depth. Wells tapping the most productive zones of the FAS are capable of yielding 500 to 1,500 gpm. Water quality varies with depth and location, becoming increasingly mineralized with depth and distance to the south. With the exception of the southeast corner of the county, however, water of a quality suitable for most uses can be found as deep as the Lake City limestone. The FAS is the predominant source of water for citrus irrigation. Since most growth in the county is expected to take place along the upland ridge, any increases in water usage are expected to be from the FAS as well.

Table V-4-16. Ground Water Systems in Eastern Highlands County.

Hydrogeologic System	Hydrogeologic Unit	Thickness (Feet)	Water Resource Potential
Surficial Aquifer System	Water Table Aquifer	40-200	Except for isolated areas with high iron and organics, produces small-to-moderate amounts of good quality water. Furnishes domestic and cattle watering supplies locally throughout Highlands County.
Intermediate Aquifer system	Hawthorne Confining Beds	300-600	Confining unit for the FAS. Isolated beds of sand and gravel yield large amounts of water locally along the ridge, but they are discontinuous. Not an important source of water over most of Highlands County.
Floridan Aquifer System	Suwanee Limestone	O-80	Most important source of water in Highlands County. Productivity tends to increase with depth. Water quality deteriorates with depth, and distance to the south, but water of a quality acceptable for most uses can be found as deep as the Lake City Limestone.
	Ocala Limestone	150-250	
	Moody's Branch Formation	50-150	
	Avon Park Limestone	200-350	
	Lake City Limestone	400±	
	Oldsmar Limestone	670±	Water is too highly mineralized for most purposes.
	Cedar Keys Limestone	1,670±	

The IAS contains isolated beds of sand and gravel that yield large amounts of good quality water. These beds are important sources to localized areas along the upland ridge. Since these producing zones are discontinuous, however, the IAS is not an important source of supply.

Yields from the SAS vary considerably with location, but are generally less than 100 gpm. This aquifer furnishes drinking water for cattle and domestic self-supplied individuals throughout the county. Except for isolated areas with high iron and organic content, the SAS produces potable quality water.

Western Okeechobee County

Surface Water

The Kissimmee River and the other Lake Okeechobee tributaries are the primary sources of surface water in Western Okeechobee County. With the exception of the City of Okeechobee, which uses water from Lake Okeechobee for public water supply, surface water is used solely for agricultural irrigation and cattle watering. Lake Okeechobee suffers from water quality problems associated with nutrient-rich runoff from agricultural and rangeland areas. The runoff flows rapidly into Lake Okeechobee through the canal system in the watershed. Many wetlands have been ditched and drained that accelerate water movement into this system.

For these wetlands and some of the smaller canal systems, a program has been initiated to restore these wetlands, which will add water storage in the watershed. These restored wetlands will also reduce nutrient loading to the system. Research is also being conducted on beef cattle best management practices, the major land use in this area. The Kissimmee River restoration, which involves returning part of this channelized system back to its original meandering course, will also improve water quality entering the lake.

Ground Water

Ground water is the primary source of supply to unincorporated Okeechobee County. There are two major ground water systems in Okeechobee County, the Floridan and the Surficial aquifer systems (Table V-4-17). The FAS is the principal source of irrigation and cattle water in Okeechobee County, accounting for 74 percent of SFWMD permitted use.

Table V-4-17. Ground Water. Systems in Western Okeechobee County.

Hydrogeologic System	Hydrogeologic Unit	Thickness (feet)	Water Resource Potential
Surficial Aquifer System	Surficial Aquifer	10-180	Yields small quantities of good quality water, except near Lake Okeechobee where chloride concentrations exceed potable standards. Wells commonly yield 100 gpm or less. The surficial aquifer is the primary source of potable water in unincorporated areas.
Intermediate Confining Unit	Hawthorn Confining Beds	200-600	Does not yield significant quantities of water within Okeechobee County.
Floridan Aquifer System	Floridan Aquifer	860-955	Produces large-to-moderate quantities of water, with productivity increasing to the north. Wells generally yield more than 200 gpm. Water quality varies, ranging from very good in the north to brackish in the south and east. The FAS is the primary source of supply for agricultural uses.

Transmissivities within the FAS vary significantly throughout Okeechobee County, ranging from 2,000 gpd/ft in the south to more than 500,000 gpd/ft in northern Okeechobee County. Water quality in the Floridan aquifer tends to decline with depth and distance to the south. In the central and northern portion of the county, Floridan water is of good quality, requiring little or no treatment for potable use. Waters in the southern and eastern portions of the county, however, may contain chloride concentrations in excess of 1,000 mg/l, and require desalination for potable use. Although Floridan waters are not potable in some areas, they are used extensively for irrigation throughout the county.

The SAS is the source of much of the potable ground water in Western Okeechobee County. It is used primarily to supply cattle and domestic users in the unincorporated portions of the county. Productivity in the aquifer tends to increase with depth, but most wells yield less than 100 gpm. Water from the surficial aquifer is generally potable with minimal treatment, except in the southeast portion of the county, where chloride concentrations in

excess of 250 mg/l have been measured (Parker et. al., 1955). Transmissivities within the aquifer vary significantly throughout the county, ranging from 2,000 gpd/ft in the south to more than 500,000 gpd/ft in northern Okeechobee County.

Northern Glades County

Surface Water

Major surface water features include Lake Okeechobee, Fisheating Creek, Nicodemus Slough, Indian Prairie Canal (C-40), Harney Pond Canal (C-41), and the Kissimmee River. Rainfall driven systems without a large storage capacity are used as sources of water to a lesser extent. C-40 and C-41 are located in the Indian Prairie-Istokpoga Basin, which has been designated as a Water Resource Caution Area and a Reduced Allocation Area.

Ground Water

Three aquifer systems are present in Northern Glades County: the Surficial Aquifer System (SAS), the Intermediate Aquifer System (IAS), and the Floridan Aquifer System (FAS) (Table V-4-18). Little data exists on the water-bearing characteristics of these aquifer systems in Glades County.

The SAS has fairly low productivity throughout the majority of the county. One small area of relatively high SAS productivity is in north-central Glades County, near where U.S. 27 crosses into Highlands County. This production interval is from a clean quartz gravel that appears to be a continuation of Lake Wales Ridge sediments from Highlands County.

Near Lake Okeechobee, the permeability of the aquifer is especially low due to the presence of finer grained sediments. This low permeability and consequently slow movement of groundwater is related to the poorer quality SAS groundwater near Lake Okeechobee. The lower permeability has limited flushing of the shallow ground water by infiltrating rainwater. The slower flow rate also increases the residence time of the water within the aquifer allowing the water more time to dissolve minerals from the aquifer matrix, which, in turn, contributes to poorer quality water.

Table V-4-18. Ground Water Systems in Northern Glades County.

Hydrogeologic System	Hydrogeologic Unit	Thickness (feet)	Water Resource Potential
Surficial Aquifer System	Surficial Aquifer	20-100	Adequate in most areas for private domestic self-supply. Poor quality water near Lake Okeechobee.
Intermediate Aquifer System	Carbonate Producing Intervals Within the Hawthorn Formation	90-230	Adequate in most areas for private domestic self-supply and small to moderate sized irrigation systems.
Floridan Aquifer System	Floridan Aquifer	490-1200	Aquifer is under flowing artesian condition throughout Glades County. The aquifer is highly productive. Productivity generally increases with depth; however, chloride, TDS, and sulfate concentrations increase with depth throughout the county. Aquifer is potable in the northern portion of Glades County but unsuitable for irrigation in the southern portion of the county.

Very little data exists on the IAS in Northern Glades County. However, it is likely that IAS sediments that are present in Highlands County extend south into Northern Glades County. These sediments may produce moderate quantities of potable water, especially in north-central Glades County south of the Lake Wales Ridge. These sediments likely decrease in thickness and permeability with distance from the ridge, and are not as productive in Glades County as they are in Highlands County.

The FAS is present throughout all of Glades County. It consists of several producing zones that are capable of yielding large volumes of water. Floridan wells flow at land surface throughout the county. Water quality in the FAS is of potable quality in Northern Glades County, but quality declines with depth and distance to the south (TDS, chlorides and sulfates).

Assessment Criteria Used

The Kissimmee Basin Water Supply Plan is currently under development. Although topics to be addressed by this plan will be finalized during the public participation process, several potential issues have been identified which this planning effort should consider, along with the main tool, type of analysis, or resource that could be used to address each topic. These issues are described in Table V-4-19, and are grouped into the categories of: intergovernmental agreements, ground water analysis, and surface water analysis.

Anticipated assessment criteria include:

a) Impacts to Natural Systems – Criteria include assessments of possible impacts to wetland systems and exceedences of established minimum flows and levels. The specific criteria triggers for wetland impacts are currently being developed, and minimum flows and levels are scheduled to be established within the Kissimmee Basin by 2004.

b) Ground Water Quality - Criteria include assessing the movement of saline or saltwater and/or any contaminated water into freshwater zones. Specific impact criteria for poor quality water movement will be limited where the change in water quality (chlorides or other contaminates) may potentially change the water treatment requirements to a system.

c) Impacts to Existing Legal Users - Criteria include an impact determination of anticipated future water use on existing legal users. Impact criteria for existing legal users will be judged based upon a significant reduction in the users' ability to withdraw adequate volumes of water.

The following ground water models have been proposed for evaluation of the ground water resources of the Kissimmee Basin Planning Region (counties with portions within model domains are shown in parentheses):

1) Orlando Metropolitan Area (Orange County)
2) Osceola County (Osceola, Polk, and Okeechobee)
3) Okeechobee County (Okeechobee, Highlands, Glades, and Osceola)
4) Revised East Central Florida (Orange, Osceola, Polk, portions of SJRWMD and SWFWMD)
5) Lake Wales Ridge (Highlands, Polk, portions of SWFWMD)

The SFWMD is also developing a surface water balance and statistical model to evaluate the water availability from the Lake Istokpoga/Indian Prairie Canal system.

Table V-4-19. Proposed initial topics for the Kissimmee Basin Water Supply Plan.

Intergovernmental Agreements	Main Tool/Resource
Increased consistency/coordination with SJRWMD	Memorandum of Understanding
Increased consistency/coordination with SWFWMD	Memorandum of Understanding
Availability of water at the Brighton Reservation	Seminole Compact & Entitlement
Ground Water Analysis	
Water supply in the Orange County Area	Orlando Metropolitan Area Model
Drainage well policy impacts on water supply	Orlando Metropolitan Area Model
Competing utilities in the Orange Area/Cocoa wellfield problems	Orlando Metropolitan Area Model
Sinkhole formation in the Orange/Osceola Area	FSRI report # 87-88-3; USGS map series # 110
Floridan Recharge	SFWMD Tech. Publication 95-02
Impacts to spring flow	Orlando Metropolitan Area Model
Water supply in the non-Orange County area	GIS overlay analysis
Future model needs	MODFLOW/Qualitative analysis
Water shortage triggers	MODFLOW/Qualitative analysis
Surface/ground water interactions	GIS overlay analysis
Designation of additional Critical Water Supply Problem Areas	Rule 40E-23.053, F.A.C.
PWS level of service demand levels	Pumpage records
Wetland and aquifer protection criteria	MODFLOW post-processing
Surface Water Analysis	
Impact on water supply of changing lake schedules	UKISS Model/Chain of Lakes Management Plan
Impact of river restoration on delivery to Lake Okeechobee	UKISS Model /USACE Restudy
Lake Istokpoga/Indian Prairie Canal	Water Budget and HEC-1 modeling

Hydrologic Impacts Due to Demands

Neighboring water management districts (SWFWMD and SJRWMD) have completed preliminary assessments of the adjoining basins, and have indicated that possible violations of their respective impact criteria may be due in part to withdrawals occurring within the Kissimmee Basin Planning Region. The identified possible criteria violations are related to saltwater intrusion and reductions in spring flow within the SJRWMD and wetland impacts within both the SWFWMD and the SJRWMD. The SFWMD is working with both neighboring water management districts in a cooperative effort to verify the previous assessment results and to develop a comprehensive approach for the avoidance of the projected impacts.

Historically the Lake Istokpoga/Indian Prairie Canal system has been identified as a water supply concern within the Kissimmee Basin. This system has been identified as a Water Resource Caution Area and a Restricted Allocation Area under water use regulations. No increases beyond the currently permitted withdrawal rates are permitted from this system.

Adequacy of Regional Sources

The Kissimmee Basin water supply planning effort is currently underway and is scheduled for completion in the year 2000. A preliminary review of the region's water resources has identified concerns related to the availability of water from the Lake Istokpoga/Indian Prairie Canal system and the ground water resources in the metropolitan Orlando area. Work is continuing with the development of surface and ground water models to evaluate and form solutions to these concerns. A cooperative effort is taking place with neighboring water management districts to address potential adverse impacts located adjacent to the districts' mutual borders.

Section VI

Conclusions

The South Florida Water Management District is committed to a cycle of water supply plan preparation for each of its four planning regions. These regions, which are outlined in Section II and shown in plates 1 through 4, cumulatively cover the entire District area. To date, water supply plans have been completed for the Lower West Coast (1994), and the Upper East Coast (1998) planning regions. The Interim Plan for Lower East Coast Regional Water Supply was completed in 1998. The Kissimmee Basin Water Supply Plan Draft Background Document and Appendices were published in 1996. It is scheduled that updated water supply plans will be completed for each region every five years with a projection horizon of at least 20 years. Water supply planning processes are presently active for the Lower West Coast, Lower East Coast, and the Kissimmee Basin.

This Districtwide Water Supply Assessment has included: demands for 1995 and projections for 2020 for six categories of water use, hydrologic system overviews, and source evaluations by planning region. A brief summary is provided here that includes: assessed and projected urban and agricultural water demands under average and l-in-10 year drought conditions, populations, and irrigated agricultural acreage. Rates of change in urban and agricultural use do not exactly equal population and irrigated agricultural acreage rates of change due to the mix of: categories of use - each with its own trend; crop types with differing evapotranspiration rates; irrigation systems with varying efficiencies; soil types with a range of usable soil water capacities; and dissimilar weather patterns as evidenced by historical records from rainfall stations.

The amount by which l-in-10 year drought demands exceed average rainfall year demands varies by use category and county (which in turn include other variables such as rainfall station, soil type, and irrigation system type). Table VI-l shows the regional and District averages (weighted by demand levels) of increased requirement from an average rainfall year to a l-in-10 year drought (everything else being equal) for the six categories of water use projected in this Assessment.

Table VI-l. Increased requirements from an average to a l-in-10 year drought.

	Planning Regions' Averages				District
Categories of Use	LWC	LEC	UEC	KISS	Average
Public Water Supply	7%	10%	9%	3%	9%
Domestic Self-Supply	6%	10%	7%	4%	8%
Commercial/Industrial Self-Supply	0%	0%	0%	0%	0%
Recreational Self-Supply	15%	22%	17%	15%	19%
Thermoelectric Self-Supply	0%	0%	0%	0%	0%
Agricultural Self-Supply	18%	42%	21%	19%	28%
Total Demand	15%	23%	19%	13%	20%

Summations of 1995 and projected 2020 total water demands, populations, and irrigated agricultural acreages are presented in tables VI-2 through VI-4 at the back of this section. Table VI-2a shows comparisons between assessed 1995 and projected 2020, with 2020 receiving average rainfall District-wide in 2020. Table VI-2b compares 1995 and 2020, assuming a l-in-10 year drought District-wide in 2020.

Population in the South Florida Water Management District is projected to increase by 43 percent, from 5,755,634 in 1995 to 8222,781 in 2020. Urban demands are projected to rise by 49 percent from 521,011 mgy in 1995 to 777,394 mgy (assuming average rainfall) in 2020. Coastal areas that are not protected for environmental purposes, and the extreme north of the District (Orlando and northern Osceola) are the most urbanized (plates 1 through 4).

Irrigated agricultural acreage in the SFWMD is projected to rise by 5 percent from 1,075,993 acres in 1995 to 1,124,552 acres in 2020. Agricultural demands (under average rainfall conditions) are projected to rise by 9 percent from 847,699 mgy in 1995 to 920,678 mgy in 2020. Anticipated regional shifts in irrigated agricultural acreage include: increases in the Lower West Coast, Upper East Coast, and southern Kissimmee Basin; and decreases in the Lower East Coast and northern Kissimmee Basin.

As shown in Table VI-2a, total combined urban and agricultural demands for the entire District are projected to increase by 24 percent, from 1,368,710 mgy in 1995 to 1,698,072 mgy in 2020, assuming 2020 experiences average rainfall conditions. However, assuming a l-in-10 year drought District-wide in 2020, then the projected combined urban and agricultural increase in demand from 1995 is about 49 percent (Table VI-2b), to 2,035,092 mgy.

Lower West Coast

Population in the Lower West Coast Planning Region is projected to increase by 68 percent, from 590,939 in 1995 to 992,805 in 2020. Urban demands are projected to rise by 84 percent from 68,412 mgy in 1995 to 126,123 mgy in 2020 (Table VI-2a). Concurrently, irrigated agricultural acreage is projected to rise by 20 percent from 244,070 acres in 1995 to 292,578 acres in 2020. Agricultural demands are projected to rise by 21 percent, from 219,778 mgy in 1995 to 265,031 mgy in 2020. Total demands are projected to increase by 36 percent, from 288,190 mgy in 1995 to 391,154 mgy in 2020 (under average rainfall conditions in 2020). If the LWC experiences a l-in-10 year drought in 2020 instead of an average year, then the projected combined urban and agricultural increase in demand from 1995 to 2020 is about 57 percent (Table VI-2b), to 451,047 mgy.

Modeling results included in the Lower West Coast Water Supply Plan (1994), which are outlined in Section V, indicate that increasing demands for water in the LWC are projected to cause ground water levels to decline. Continued development of the Surficial Aquifer System as the principal source of future needs may cause adverse impacts to wetlands, particularly in Collier County. Saline water intrusion into the water table and lower Tamiami aquifers along the Lee and Collier county coastlines has also been projected during the modeling process. There were also small areas of the Sandstone aquifer in eastern Lee and western Hendry counties (outlined in the LWC Water Supply Plan) which may be impacted by projected demand levels.

Alternative water supply development will be needed to supplement conventional sources of water in the Lower West Coast. Alternative sources include aquifer storage and recovery, use of deeper aquifers with desalination treatment, and the increased use of reclaimed water.

Eighty-seven percent of the LWC Planning Region is included in a Water Resource Caution Area (WRCA). Areas within the LWC Planning Region and not in a WRCA include the portion of Charlotte County within the District, and a small portion of central Glades County (see Figure 11-3). Based on SFWMD analysis, there is no need to change that designation at this time. In April 1998, the SFWMD initiated the second iteration of the Lower West Coast Water Supply Plan which will have a projection horizon of the year 2020. This plan is scheduled for completion in the year 2000.

Lower East Coast

Population in the Lower East Coast planning region is projected to increase by 35 percent, from 4518,401 in 1995 to 6,086,700 in 2020. Urban demands are projected to rise by 39 percent from 385,179 mgy in 1995 to 533,590 mgy in 2020. During the same period, irrigated agricultural acreage is projected to decline by 11 percent from 568,995 acres in 1995 to 503,852 acres in 2020. Agricultural demands are projected to decline by 7 percent from 385,118 mgy in 1995 to 356,521 mgy in 2020. Total combined urban and agricultural demands are projected to increase by 16 percent, from 770,297 mgy in 1995 to 890,111 mgy in 2020 (under average rainfall conditions in 2020). If however, the LEC experiences a l-in-10 year drought in 2020, then the projected combined urban and agricultural increase in demand from 1995 to 2020 is about 43 percent (Table VI-2b), to a level of 1,097,897 mgy.

Modeling results included in the Interim Plan for Lower East Coast Regional Water Supply (1998), indicate anticipated: increases in frequency and severity of water shortages in urban areas; increases in agricultural irrigation demands not met in the Everglades Agricultural Area and the Caloosahatchee Basin; and deficiencies in meeting water supply objectives developed in the LEC water supply planning process. It is however, possible to reduce the impacts of increased demands in the LEC Planning Region by substantially increasing water storage capability. This includes investing in technologies such as aquifer storage and recovery, which give added protection of supplies from prolonged periods of low rainfall. In addition, sub-regional plans are being developed for the urban areas within the region. These plans will better define available local resources, and to determine how the regional resources can best be distributed. The interim plan is currently being revised to incorporate a l-in-10 year drought level of certainty planning goal, a 2020 future time horizon, and water supply and water resource development components.

The Interim Plan for Lower East Coast Regional Water Supply (1998) also presented preliminary minimum flows and levels for Lake Okeechobee's littoral zone, the Water Conservation Areas, Everglades National Park, and the St. Lucie and Caloosahatchee estuaries. These targets were incorporated into the planning effort as sets of environmental performance measures for these areas. The LEC Planning Region is entirely within a Water Resource Caution Area. Based on SFWMD analysis, there is no need to change that designation at this time.

Upper East Coast

Population in the Upper East Coast planning region is projected to increase by 61 percent, from 283,457 in 1995 to 456,580 in 2020. Urban demands are projected to rise by 70 percent from 29,101 mgy in 1995 to 49,433 mgy in 2020 (Table VI-2a). Contemporaneously, irrigated agricultural acreage is projected to rise by 14 percent from 185,980 acres in 1995 to 211,216 acres in 2020. Agricultural demands are projected to rise by 14 percent from 168,714 mgy in 1995 to 191,559 mgy in 2020. Total Upper East Coast demands are projected to increase by 22 percent, from 197,815 mgy in 1995 to 240,992 in 2020 (under average rainfall conditions in 2020). If however, the UEC experiences a l-in-10 year drought in the year 2020, then the projected combined urban and agricultural increase in demand from 1995 is about 45 percent (Table VI-2b), to 286,730 mgy.

The Upper East Coast Water Supply Plan (1998) concluded that historically used sources of water, especially the Surficial Aquifer System in the coastal portions of the region, are not sufficient to meet projected water demands during a l-in-10 drought condition. Analyses indicated that the Surficial aquifer has limited potential for expansion due to potential impacts on wetland systems, and increased vulnerability to saltwater intrusion in the vicinity of public water supply wellfields. However, with appropriate management and diversification of water supply sources, there is sufficient water to meet the needs of the region.

Several water source options were considered in the UEC Water Supply Plan to address the water supply issues identified. Surface water storage, aquifer storage and recovery, and the Floridan aquifer had the greatest potential to address several of the issues. Based on the analysis of the UEC Water Supply Plan, it is recommended that the Water Resource Caution Area designation in the UEC Planning Region be reduced to cover only the coastal areas in Martin and St. Lucie counties (46 percent of the region). This area generally reflects the current and planned public water supply utility service areas of the coastal utilities in the region. Potential problems are projected in these areas if historically used sources of water are used to meet the growing water needs of the region. The proposed recommendation to reduce the Water Resource Caution Area designation must be implemented through a subsequent rulemaking effort. Rulemaking is scheduled to begin in April 1999. The final rule is scheduled to be presented to the Governing Board by April 2000.

Kissimmee Basin

Population in the Kissimmee Basin Planning Region is projected to increase by 89 percent, from 362,837 in 1995 to 686,696 in 2020 (Table VI-3). Urban demands are projected to rise by 78 percent from 38,319 mgy in 1995 to 68,248 mgy in 2020. The majority of the urban demands in the Kissimmee Basin pertain to the highly populated urban areas in Orange and northern Osceola counties. Southern Orange County is projected to have a 71 percent increase in urban demands. In Western Osceola County, a 105 percent increase in urban demands is projected. Plate 4, which displays generalized 1995 land uses in the Kissimmee Basin Planning Region, shows that urban areas are concentrated in the Orlando area of Orange County and the northern part of Osceola County.

Irrigated agricultural acreage in the Kissimmee Basin is projected to rise by 52 percent from 76,948 acres in 1995 to 116,906 acres in 2020 (Table VI-4). Increases in irrigated agricultural area are anticipated in the portions of Highlands, Okeechobee, and Glades counties within the Kissimmee Basin (Plate 4). Irrigated agriculture in the northern three county areas within the Kissimmee Basin (Orange, Osceola, and Polk) is projected to decline. Total Kissimmee Basin agricultural demands are projected to rise by 45 percent from 74,089 mgy in 1995 to 107,567 mgy in 2020.

Total demands are projected to increase by 56 percent (Table VI-2a), from 112,408 mgy in 1995 to 175,815 mgy in 2020 (under average rainfall conditions in 2020). Instead of an average rainfall year, if the Kissimmee Basin experiences a l-in-10 year drought in 2020, then the projected combined urban and agricultural increase in demand from 1995 is about 77 percent (Table VI-2b), to 199,418 mgy.

Within the Kissimmee Basin Planning Region the designation of Water Resource Caution Area (WRCA) applies only to 15 percent of the region (see Figure 11-3). The Lake Istokpoga/Indian Prairie Canal system has been identified as a WRCA, and is also a Restricted Allocation Area. No increases beyond the currently permitted withdrawal rates are permitted from this system. A review of the needs of removing or establishing WRCAs within the Kissimmee Basin will be completed as part of the ongoing planning efforts within the basin. These efforts will be coordinated with neighboring water management districts.

Table VI-2a. Assessed (1995) and Projected (2020) Total Water Demands Under Average Rainfall Conditions (for 2020) in the SFWMD.

	Lower West Coast	LWC % of SFWMD	Lower East Coast	LEC % of SFWMD	Upper East Coast	UEC % of SFWMD	Kissimmee Basin	Kissimmee % of SFWMD	Total District
Urban demands mgy (1995)	68,412	13%	385,179	74%	29,101	6%	38,319	7%	521 ,011
Agricultural Demands mgy (1995)	219,778	26%	385,118	45%	168,714	20%	74,089	9%	847,699
Regional total demands mgy (1995)	288,190	21%	770,297	56%	197,815	14%	112,408	8%	1,368,71C
Urban percent of regional total (1995)	24%		50%		15%		34%		38%
Agricultural percent of regional total (1995)	76%		50%		85%		66%		62%
Urban demands mgy (2020 average)	126,123	16%	533,590	69%	49,433	6%	68,248	9%	777,394
Agricultural Demands mgy (2020 average)	265,031	29%	356,521	39%	191,559	21%	107,567	12%	920,678
Regional total demands mgy (2020 average)	391,154	23%	890,111	52%	240,992	14%	175,815	10%	1,698,072
Urban percent of regional total (2020 average)	32%		60%		21%		39%		46%
Agricultural percent of regional total (2020 average)	68%		40%		79%		61%		54%
Urban demand growth (1995 to 2020 average)	84%		39%		70%		78%		49%
Agricultural demand growth (1995 to 2020 average)	21%		-7%		14%		45%		9%
Total demand growth (1995 to 2020 average)	36%		16%		22%		56%		24%
Population (1995)	590,939	10%	4,518,401	79%	283,457	5%	362,837	6%	5,755,634
Population (2020)	992,805	12%	6,086,700	74%	456,580	6%	686,696	8%	8,222,781
Population growth	68%		35%		61%		89%		43%
Irrigated agricultural acreage (1995)	244,070	23%	568,995	53%	185,980	17%	76,948	7%	1,075,993
Irrigated agricultural acreage (2020)	292,578	26%	503,852	45%	211,216	19%	116,906	10%	1,124,552
Irrigated agricultural acreage growth	20%		-11%		14%		52%		5%

Table Vi-2 b. **Assessed (1995) and Projected (2020) Total Water Demands Under I-in-10 Year Drought (for 2020) Rainfall Conditions in the SFWMD.**

	Lower West Coast	LWC % of SFWMD	Lower East Coast	LEC SFWMD	Upper East Coast	UEC % of SFWMD	Kissimmee Basin	Kissimmee % of SFWMD	Total District
Urban demands mgy (1995)	68,412	13%	385,179	74%	29,101	6%	38,319	7%	521,011
Agricultural demands mgy (1995)	219,778	26%	385,118	45%	168,714	20%	74,089	9%	847,699
Regional total demands mgy (1995)	288,190	21%	770,297	56%	197,815	14%	112,408	8%	1,368,710
Urban percent of regional total (1995)	24%		50%		15%		34%		38%
Agricultural percent of regional total (1995)	76%		50%		85%		66%		62%
Urban demands mgy (2020 1-in-10)	138,941	16%	590,964	69%	54,974	6%	71,638	8%	856,517
Agricultural demands mgy (2020 1-in-10)	312,106	26%	506,933	43%	231,756	20%	127,780	11%	1,178,575
Regional total demands mgy (2020 1-in-10)	451,047	22%	1,097,897	54%	286,730	14%	199,418	10%	2,035,092
Urban percent of regional total (2020 1-in-10)	31%		54%		19%		36%		42%
Agricultural percent of regional total (2020 1-in-10)	69%		46%		81%		64%		58%
Urban demand growth (1995 to 2020 1 -in-l 0)	103%		53%		89%		87%		64%
Agricultural demand growth (1995 to 2020 1 -in-l 0)	42%		32%		37%		72%		39%
Total demand growth (1995 to 2020 1 -in-l 0)	57%		43%		45%		77%		49%

Table VI-3. Assessed (1995) and Projected (2020) population in the South Florida Water Management District.

Counties/Regions	1995	2020	Percent growth
Lee	375,238	594,300	**58%**
Collier	182,933	349,200	**91%**
Western Hendry	27,714	39,999	**44%**
Southern Glades	4,409	7,560	**71%**
Southeastern Charlotte	645	1,746	**171%**
Lower West Coast total population	**590,939**	**992,805**	**68%**
Palm Beach	976,358	1,464,000	**50%**
Broward	1,412,942	1,926,600	**36%**
Dade	2,046,078	2,587,400	**26%**
Monroe	81,152	106,000	**31%**
Eastern Hendry	1,871	2,700	**44%**
Lower East Coast total population	**4,518,401**	**6,086,700**	**35%**
St. Lucie	171,914	281,500	**64%**
Martin	110,495	173,500	**57%**
Eastern Okeechobee	1,048	1,580	**51%**
Upper East Coast total population	**283,457**	**456,580**	**61%**
Southern Orange	186,131	349,453	**88%**
Western Osceola	130,605	260,937	**100%**
Eastern Polk	6,375	13,832	**117%**
Eastern Highlands	7,700	11,590	**51%**
Western Okechobee	28,737	45,244	**57%**
Northern Glades	3,289	5,640	**71%**
Kissimmee Basin total population	**362,837**	**686,696**	**89%**
District total population	**5,755,634**	**8,222,781**	**43%**

Table VI-4. Irrigated Agricultural Acreage in the South Florida Water Management District (acres)

	1995 Citrus	1995 Other Fruit	1995 Vegetables	1995 Field Crops	1995 Sod	1995 Nursery	1995 Pasture	1995 Total acres
Lee	12,155	1,930	10,689	0	650	1,303	0	26,727
Collier	36,583	0	32,200	0	0	1,288	0	70,071
W. Hendry	71,834	0	5,600	36,167	0	1,800	0	115,401
S. Glades	4,889	0	473	16,495		1,431	0	23,288
S.E. Charlotte	3,177	0	2,306	3,100	0	0	0	8,583
LWC total acres (1995)	**128,638**	**1,930**	**51,268**	**55,762**	**650**	**5,822**	**0**	**244,070**
Palm Beach	12,746	0	43,245	347,192	6,000	5,045	200	414,428
Broward	108	0	579	0	0	2,668	0	3,355
Dade	2,618	8,200	49,348	3,500	0	8,403	0	72,069
Monroe	0	0	0	0	0	0	0	0
E. Hendry	27,936	0	5,600	41,240	4,100	267		79,143
LEC total acres (1995)	**43,408**	**8,200**	**98,772**	**391,932**	**10,100**	**16,383**	**200**	**568,995**
St. Lucie	107,224	0	1,270	0	760	112	10,000	119,366
Marlin	47,090	0	1,700	12,456	1,200	553	0	62,999
E. Okeechobee	3,515	0	0	0	100	0	0	3,615
UEC total acres (1995)	157,829	0	2,970	12,456	2,060	665	10,000	185,980
S. Orange	5,572	0	0	0	0	327	0	5,899
W. Osceola	14,249	0	1,200	0	500	106	0	16,055
E. Polk	2,597	0	500	0	1,000	0	0	4,091
E. Highlands	26,805	0	1,200	0	3,500	1,517	0	33,022
W. Okechobee	7,470	0	1,000	0	250	714	0	9,434
N. Glades	4,513	0	290	3,338	300	0	0	8,441
KB total acres (1995)	61.206	0	4.190	3.338	5.550	2.664	0	76.948
District total acres (1995)	391,081	10,130	157,200	463,488	18,360	25,534	10,200~	1,075,993

Table VI-4contd. Irrigated Agricultural Acreage in the South Florida Water Management District (acres)

	2020 Citrus	2020 Other Fruit	2020 Vegetables	2020 Field Crops	2020 Sod	2020 Nursery	2020 Pasture	2020 Total acres	% change 95 to 20
Lee	16,150	3,180	11,758	0	650	2,484	0	34,222	28%
Collier	49,384	0	35,420	0	0	1,965	0	86,769	24%
W. Hendry	81,909	0	6,160	36,167	0	2,428	0	126,664	10%
S. Glades	9,122	0	473	22,680	0	2,641	0	34,916	50%
S.E. Charlotte	4,601	0	2,306	3,100	0	0	0	10,007	17%
LWC total acres (2020)	**161,166**	**3,180**	**56,117**	**61,947**	**650**	**9,518**	**0**	**292,578**	20%
% change (1995 to 2020)	**25%**	**65%**	**9%**	**11%**	**0%**	**63%**	**0%**	**20%**	
Palm Beach	10,121	0	23,874	304,042	6,000	10,175	200	354,412	-14%
Broward	0	0	0	0	0	2,668	0	2,668	-20%
Dade	1,667	8,650	34,023	4,275	0	16,278	0	64,893	-10%
Monroe	0	0	0	0	0	0	0	0	N/A
E. Hendry	31,853	0	6,160	39,290	4,100	476	0	81,879	- 3%
LEC total acres (2020)	**43,641**	**8,650**	**64,057**	**347,607**	**10,100**	**29,597**	**200**	**503,852**	-11%
% change (1995 to 2020)	**1%**	**5%**	**-35%**	**-11%**	**0%**	**81%**	**0%**	**-11%**	
St. Lucie	117,900	0	1,270	0	760	287	10,000	130,217	9%
Martin	55,415	0	1,700	12,456	4,000	578	0	74,149	18%
E. Okeechobee	6,750	0	0	0	100	0	0	6,850	89%
UEC total acres (2020)	**180,065**	**0**	**2,970**	**12,456**	**4,860**	**865**	**10,000**	**211,216**	14%
% change (1995 to 2020)	**14%**	**N/A**	**0%**	**0%**	**136%**	**30%**	**0%**	**14%**	
S. Orange	- 2,636	0	0	0	0	485	0	3,121	-47%
W. Osceola	13,850	0	1,200	0	500	0	0	15,550	-3%
E. Polk	2,159	0	500	0	1,000	0	0	3,659	-11%
E. Highlands	48,518	0	10,200	0	3,500	1,530	0	63,748	93%
W.Okeechobee	14,344	0	1,000	0	250	1,741	0	17,335	84%
N. Glades	8,421	0	290	4,482	300	0	0	13,493	60%
KB total acres (2020)	**89,928**	**0**	**13,190**	**4,482**	**5,550**	**3,756**	**0**	**116,906**	52%
% change (1995 to 2020)	**47%**	**N/A**	**215%**	**34%**	**0%**	**41%**	**N/A**	**52%**	
District total acres (2020)	474,800	11,830	138,334	426,492	21,160	43,736	10,200	1,124,552	5%
% change (1995 to 2020)	21%	17%	-13%	-8%	15%	71%	0%	5%	

Glossary

Acre-foot. Volume that would cover one acre to a depth of one foot; 43,560 cubic feet; 1,233.5 cubic meters; 325,872 gallons.

Application Efficiency. The ratio of the volume of irrigation water available for crop use to the volume delivered from the irrigation system. This ratio is always less than 1.0 because the losses due to evaporation, wind drift, deep percolation, lateral seepage (inter-flow) and runoff that may occur during irrigation.

Artesian Conditions. When ground water is confined under pressure greater than atmospheric pressure by overlying relatively impermeable strata.

Average Irrigation Requirement. Irrigation requirement under average rainfall as calculated by the District's modified Blaney-Criddle model.

Aqueduct. A conduit for carrying large quantities of water.

Aquifer. A geologic formation or series of formations which yield water in sufficient quantities to be a valuable source of supply.

Aquifer Storage and Recovery (ASR). The injection of freshwater into a confined saline aquifer during times when supply exceeds demand (wet season), and recovering it during times when there is a supply deficit (dry season).

Aquifer System. A series of geologic formations, which consist of two or more aquifers, divided by lower permeability units.

Backpumping. The practice of pumping water that is leaving the area back into a surface water reservoir.

Basin (Ground Water). A hydrologic unit containing one large aquifer or several connecting and interconnecting aquifers.

Basin (Surface Water). A tract of land drained by a surface water body or its tributaries.

BEBR. Bureau of Economic and Business Research; a division of the University of Florida with programs in population, forecasting, policy research, and survey.

Best Management Practices (BMPs). Agricultural management activities designed to achieve an important goal, such as reducing farm runoff, or optimizing water use.

Brackish. Water with a chloride level greater than 250 mg/l and less than 19,000 mg/l.

C-21, C-22, C-##, L-5, L-6, L-##. Prominent canals in the Central and South Florida Flood Control Project.

Cistern. A tank (often underground) for storing rainwater.

Cone of Influence. The area around a producing well which will be affected by its operation.

Control Structure. A man-made structure designed to regulate the level and/or flow of water in a canal (e.g., weirs, dams).

Conservation Bate Structure. A water rate structure that is designed to conserve water. Examples include but are not limited to increasing block rates, seasonal rates, and quantity-based surcharges.

Demand. The quantity of water needed to be withdrawn to fulfill a requirement.

Demand Management. Reducing the demand for water through activities that alter water use practices, e.g., improving efficiency in water use, reducing losses of water, reducing waste of water, altering land management practices and/or altering land uses.

DERM. Department of Environmental Resource Management.

Desalinization. A process that treats saline water to remove chlorides and dissolved solids.

Drawdown. When a well is pumped, water is removed from the aquifer surrounding the well, and the water table or piezometric surface is lowered. The drawdown at a given point is the distance the water level is dropped.

Effective Rainfall. The portion of rainfall that infiltrates the soil and is stored for plant use in the crop root zone.

Everglades Agricultural Area. The area of histosols (muck) predominantly to the southeast of Lake Okeechobee which is used for agricultural production.

Exotic Nuisance Plant Species. A non-native specie which tends to out compete native species and become quickly established, especially in areas of disturbance or where the normal hydroperiod has been altered.

FAS. Floridan Aquifer System.

FASS. Florida Agricultural Statistics Service; a division of the Florida Department of Agriculture and Consumer Services.

FDACS. Florida Department of Agriculture and Consumer Services.

FDEP. Florida Department of Environmental Protection.

gpd. Gallons per day.

gpm. Gallons per minute.

Ground Water. All water found beneath the surface of the earth in the voids, fractures, and pores or other openings of soil and rock material.

Hydroperiod. The frequency and duration of inundation or saturation of an ecosystem. In the context of characterizing wetlands, the term hydroperiod describes that length of time during the year that the substrate is either saturated or covered with water.

IFAS. The Institute of Food and Agricultural Sciences; the agricultural branch of the University of Florida, including research, education, and extension.

Infiltration. The movement of water through the soil surface into the soil under the forces of gravity and capillarity.

IAS. Intermediate Aquifer System.

Irrigation. The application of water by artificial means. Purposes for irrigating may include, but are not limited to, supplying evapotranspiration needs, leeching of salts, and environmental control.

Irrigation Audit. A procedure in which an irrigation system's application rate and uniformity are measured.

Irrigation Efficiency. This may be calculated by multiplying the efficiencies of the components. This can also be calculated without addressing the component efficiencies, but rather by defining the target use, determining the volume of water delivered for this use, and dividing that value by the volume of water withdrawn from the source.

Irrigation Uniformity. A measure of the spatial variability of applied or infiltrated water over the field.

Levee. An embankment to prevent flooding, or a continuous dike or ridge for confining the irrigation areas of land to be flooded.

Metro Government. A county charter which supersedes municipalities.

mg. Million gallons.

mgd. Million gallons per day.

mgy. Million gallons per year.

Micro-irrigation. The application of water directly to, or very near to the soil surface in drops, small streams, or sprays.

Mobile Irrigation Laboratory. A vehicle furnished with irrigation evaluation equipment that is used to carry out on site evaluations of irrigation systems and to provide recommendations on improving irrigation efficiency.

NGVD. National Geodetic Vertical Datum; reference sea level from which elevations are measured.

NRCS. The Natural Resources Conservation Service; a federal agency that provides technical assistance for soil and water conservation, natural resource surveys, and community resource protection management.

Overhead Sprinkler Irrigation. A pressurized system where water is applied through a variety of outlet sprinkler heads or nozzles. Pressure is used to spread water droplets above the crop canopy to simulate rainfall.

Permeability. Defines the ability of a rock or sediment to transmit fluid.

Potable Water. Water that is suitable for drinking, culinary, or domestic purposes. The maximum chloride concentration is 250 mg/l.

Potentiometric Head. The level to which water will rise in a well piercing a confined aquifer.

Potentiometric Surface. An imaginary surface in a confined aquifer that coincides with the hydrostatic pressure level of the water in the aquifer.

Projection Period. The period over which projections are made. In the case of this document, the 25 year period from 1995 to 2020.

PWS Supplied Water. This refers to potable water and not reclaimed water.

Reclaimed Water. Water that has received at least secondary treatment and is reused after flowing out of a wastewater treatment facility.

Reduced Allocation Areas. Areas in which a physical limitation has been placed on use.

Reduced Threshold Areas (RTAs). Areas established by the District for which the threshold separating a General Permit from an Individual Permit has been lowered from the maximum limit of 3 mg per month (100,000 gpd) to 600,000 gallons per month (20,000 gpd). These areas are typically resource-depleted areas where there have been an established history of sub-standard water quality, saline water movement into ground or surface water bodies, or the lack of water availability to meet projected needs of a region,

Reservoir. An manmade or natural lake where water is stored.

Restricted Allocation Areas. Areas designated within the District for which allocation restrictions are applied with regard to the use of specific sources of water. The water resources in these areas are managed in response to specific sources for which there is a lack of water availability to meet the needs of the region from that specific source of water.

Retrofitting. The replacement of existing water fixtures, appliances and devices with more efficient fixtures, appliances and devices for the purpose of water conservation.

Reuse. The deliberate application of water that has received at least secondary treatment, in compliance with the Florida Department of Environmental Protection and water management district rules, for a beneficial purpose.

Reverse Osmosis (RO). The process of pressurizing a saline solution to force it through a semi-permeable membrane and separate water from solutes.

SAS. Surficial Aquifer System.

Saline Water. Water with a chloride concentration greater than 250 mg/l. The term saline water includes brackish water and seawater.

Saline Water Interface. The hypothetical surface of chloride concentration between fresh water and seawater where the chloride concentration is 250 mg/l at each point on the surface.

Saline Water Intrusion. This occurs when more dense saline water moves laterally inland from the seacoast, or moves vertically upward, to replace fresher water in an aquifer.

Sea water. Water which has a chloride concentration equal to or greater than 19,000 mg/l.

Seepage Irrigation Systems. Irrigation systems, which convey water from the source, and distributes it to the crop through open ditches. Water is either applied to the soil surface (possibly in furrows) and held for a period of

time to allow infiltration, or is applied to the soil subsurface by raising the water table to wet the root zone.

Semi-closed Irrigation Systems. Irrigation systems that convey water from the source through closed pipe, and distribute it to the crop through open furrows between crop rows. Overall efficiency is improved as transportation losses to the furrows are minimized.

Semi-confining Layers. Layers in which horizontal flow is small, but is great enough that it can not be ignored. The rate of vertical flow is dependent on the head differential between the semi-confining beds and those above and below them.

Slough. A channel in which water moves sluggishly, or a place of deep muck, mud or mire. Sloughs are wetland habitats that serve as channels for water draining off surrounding uplands and/or wetlands

Stage. The elevation of the surface of a surface water body.

Storm Water. Surface water resulting from rainfall that does not percolate into the ground or evaporate.

Subsidence. Lowering of the soil level caused by the shrinkage of organic layers. This shrinkage is due to desiccation, consolidation and biological oxidation.

Surface Water. Water that flows, falls or collects above the surface of the earth.

SWIM Plan. Surface Water Improvement and Management plan.

Traffic Analysis Zone (TAZ). A geographic area used in transportation planning.

Transmissivity. This is the rate at which water is transmitted through a unit width of aquifer under a unit hydraulic gradient. It is a function of the permeability and thickness of the aquifer, and is used to judge its production potential.

Turbidity. The measure of suspended material in a liquid.

Ultra-low-volume Plumbing Fixtures. Water conserving plumbing fixtures that meet the following standards at a test pressure of 80 psi:

Toilets	1.6 gal/flush
Shower Heads	2.5 gal/min
Faucets	2.0 gal/min

Uplands. An area with a hydrologic regime that is not sufficiently wet to support vegetation typically adapted to life in saturated soil conditions; non-wetland.

USACE. United States Army Corps of Engineers.

USGS. United States Geological Survey.

Water Conservation Areas (WCAs). That part of the original Everglades ecosystem that is now diked and hydrologically controlled by man for flood control and water supply purposes. These are located in the western portions of Dade, Broward, and Palm Beach counties, and preserve a total of 1,337 square miles, or about 50 percent of the original Everglades.

Wastewater. The combination of liquid and waterborne pollutants from residences, commercial buildings, industrial plants and institutions together with any ground water, surface runoff or leachate that may be present.

Water Supply Plans. These plans are regional water resource and demand analyses. They are District generated, and provide a detailed evaluation of available water supply and projected demands.

Wetlands. Areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions.

Xeriscape. The use of landscaping techniques to conserve water and reduce maintenance. Techniques include the use of drought tolerant plants, landscape layout, irrigation system design, and irrigation system management.

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