Appendix Y

EXHIBIT D

The Immokalee Area Study
Stage II Technical Memorandum
Groundwater Issues

Updated September 2002 in Response to DCA ORC Report

Technical Memorandum

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Section 1
Introduction

A preliminary assessment of the natural resources and current land uses in the Immokalee area was provided for the Eastern Collier Property Owners (ECPO) in the Stage I report (WilsonMiller, 2000). As part of the Stage II study, this report provides an evaluation of current water use and identifies areas where additional water supply development may be feasible for agricultural, residential, or other uses. In Section 2, a description of the study area's hydrostratigraphy is presented using information provided from published reports with an emphasis placed on aquifer yield potential and recharge. A review of the South Florida Water Management District (SFWMD) water use permits is conducted in Section 3 to determine permitted water use within the ECPO boundary. A general assessment of potential impacts to water demand from changes in land use is discussed in Section 4. A map of the ECPO study area is provided as **Figure 1-1**. The study area does not include the Immokalee Urban Area, or the areas in Collier County known as the Rural Fringe, South Golden Gate Estates, or North Belle Meade.

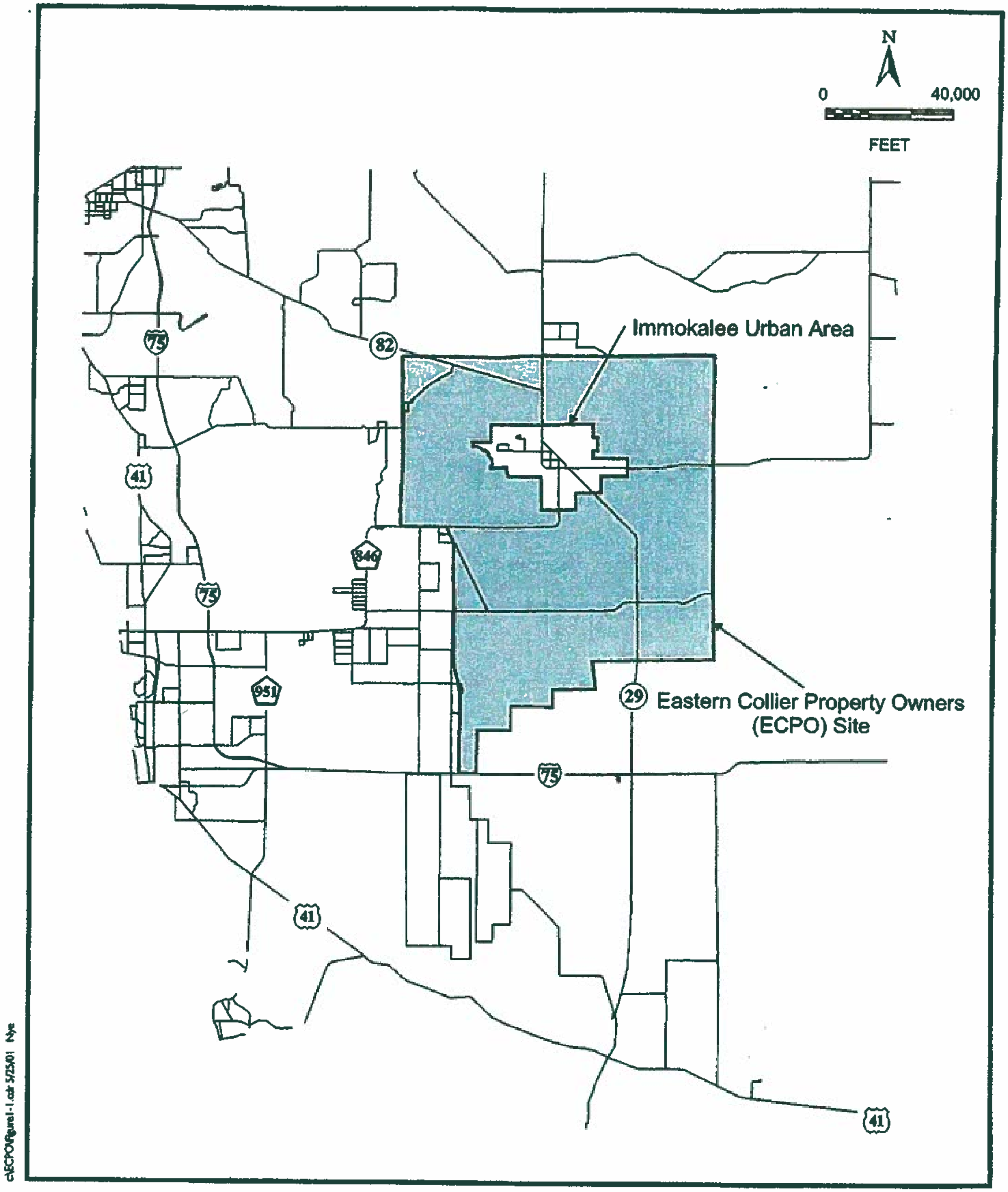

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Figure 1-1
ECPO Stage II
Site Map

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Section 2
Geology and Hydrogeology

2.1 Introduction

The Eastern Collier Property Owners (ECPO) study area (Figure 1-1) is located in the area of southwest Florida generally known as the Immokalee Rise. The rise is a plateau of land that lies predominantly in Hendry County but extends into eastern Lee County and northeastern Collier County with a range of elevations from approximately 25 to 40 feet above National Geodedic Vertical Datum (NGVD) dipping gently to the southwest (Campbell, 1988). Most of western Collier County has elevations ranging from 0 to 15 feet NGVD. The slope from the coastal areas of western Collier County to the rise is approximately one foot per mile. East of Immokalee is an area known as the Big Cypress Spur, which is a transition area between the Immokalee Rise and the Everglades. Elevations in the Spur are slightly higher than Western Collier and the Everglades but lower than the Immokalee Rise. The study area represents a source of recharge for both the urban areas of Collier County (western Collier County) and the Big Cypress Spur. A map of the topography within the ECPO study area is presented as **Figure 2-1**.

The hydrogeology of Collier County has been investigated through a number of studies conducted by the U.S. Geological Survey, the South Florida Water Management District (SFWMD), academic institutions, and various consulting firms (Boggess et al., 1981, Knapp, et al., 1986, and Missimer & Associates, 1983, 1986, 1988, and 1990). Three major aquifer systems have been identified in Collier County. They have been named, in descending order, the Surficial Aquifer System, the Intermediate Aquifer System, and the Floridan Aquifer System. The aquifer systems are typically well separated and pumpage from one system usually does not significantly affect the others. The Sandstone aquifer, which is described below, is considered part of the Intermediate Aquifer System. However, in portions of Collier County including parts of the ECPO study area, the Sandstone aquifer is hydraulically connected to the Lower Tamiami and water-table aquifers. It has been suggested that the Sandstone aquifer be moved into the Surficial Aquifer System (Missimer, Martin 2001). For the purposes of this report, this aquifer will be described as part of the Intermediate Aquifer System to coincide with current publications.

The aquifers within each system are separated by confining beds, which generally do not provide complete hydraulic separation, but to varying degrees, allow water to leak between the aquifers. The rate and direction at which leakage occurs depends on the vertical hydraulic conductivity of the confining unit and the potentiometric head differential between the adjacent aquifers, both natural and pumping induced.

A schematic diagram showing the formations and lithologies present within each of the aquifer systems is provided as Figure 2-2. Descriptions of the aquifer systems and of the individual aquifers with the most water supply potential in each system are provided in following subsections of this report. In addition, a brief discussion of the

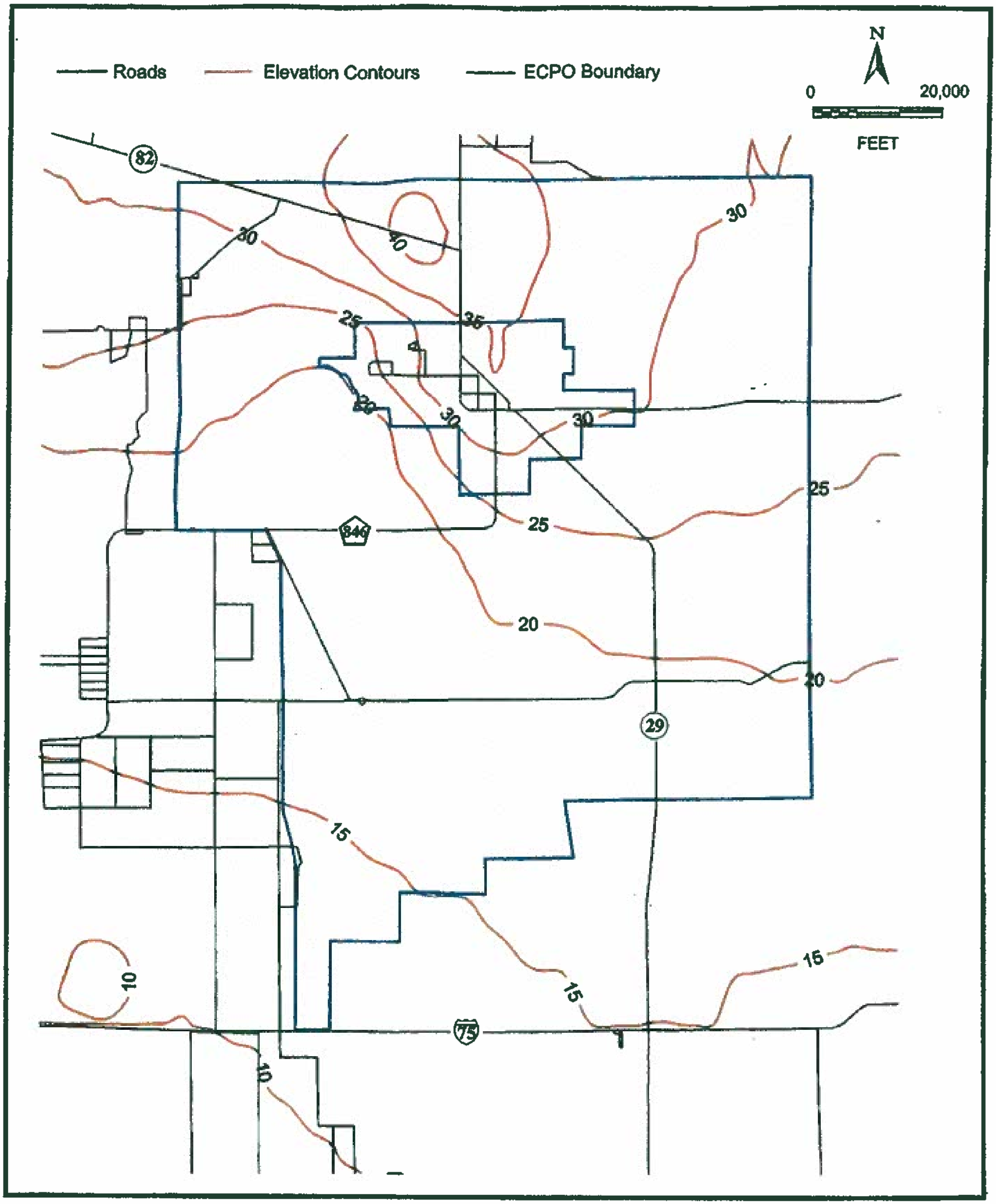

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Figure 2-1
ECPO Stage II
Topographic Map (Contour Interval is 5.0 feet)

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physiography and climatic conditions of the ECPO study area and how they relate to water resource availability is included.

2.2 Physiography and Rainfall

The Immokalee Rise separates the study area into two rainfall basins. The western portion of the study area is included within the West Collier Drainage Basin as defined by the SFWMD. The West Collier Drainage Basin topography is generally very flat, with land surface elevations sloping gradually from a high of approximately 40 feet (NGVD) at the top of the rise to sea level along the coastline. The eastern edge of the basin is designated to be approximately along State Route 29, which intersects the project area. The remainder of the study area falls on and to the eastern side of the rise and drains towards the Big Cypress Spur. Numerous wetland systems are present within the study area. These include marshes, cypress forests, wet prairies and low pinelands.

The ECPO study area is located on the Immokalee Rise, which represents the highest ground in Southwest Florida. The predominant land use in the area is for agriculture, which typically requires ditches and detention/retention areas to manage waters to facilitate production. These man-made structures partly control the flow of rainfall runoff which then outfalls to natural slough systems to the south, east, and west of the study area. Much of the natural system eventually drains to man-made canal systems such as the Golden Gate Canal System and the Faka-Union Canal System.

The ECPO site receives abundant rainfall with an average of approximately 55 inches of rain each year (SFWMD, 1986). Because of a relatively high water table and downstream drainage system, a large percentage of the rainfall is lost to evapotranspiration and runoff to surface water bodies. The amount of water lost exceeds 90% of the total rainfall. Nevertheless, rainfall and subsequent infiltration is the primary source of recharge to the Surficial Aquifer System in Collier County.

2.3 Surficial Aquifer System

2.3.1 Water-table Aquifer

The water-table aquifer in Collier County occurs within the Pleistocene-aged Pamlico Sand, Fort Thompson Formation, and the unnamed limestone facies or the Pinecrest Limestone member of the Pliocene-aged Tamiami Formation. The Pamlico Sand consists primarily of medium to fine-grained quartz sand with varying amounts of secondary constituents including shell, detrital clays, and organic material. Thickness of the unit ranges from 0 to 15 feet in the study area. Permeability is generally medium to low depending upon the quantity of secondary constituents (Missimer & Associates, 1986).

In areas where the Pamlico Sand is very thin or absent, a hard, sandy limestone or calcareous sandstone is frequently encountered. These lithologies are characteristic of

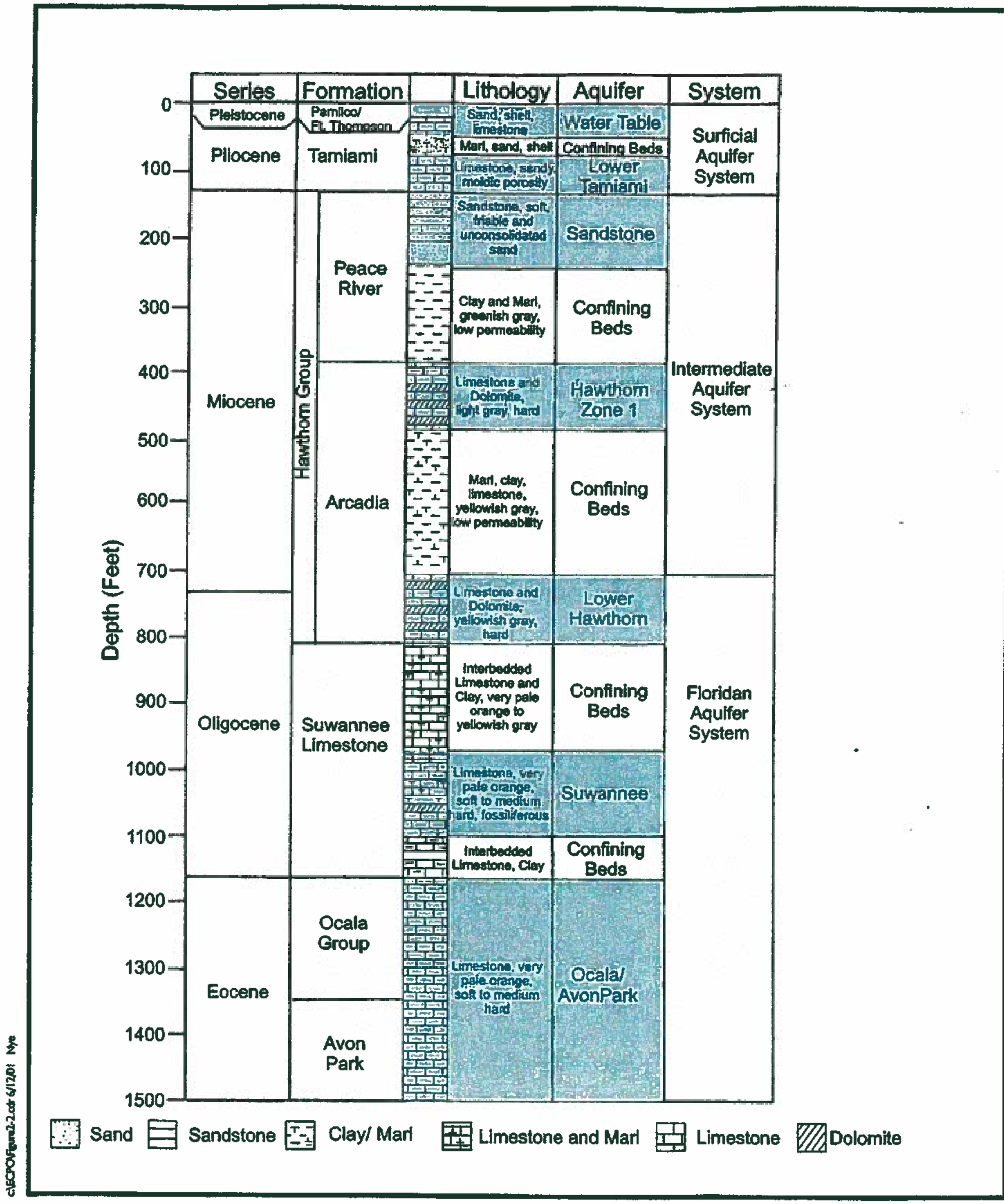

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Figure 2-2
ECPO Stage II
Generalized Hydrogeology Beneath Collier County

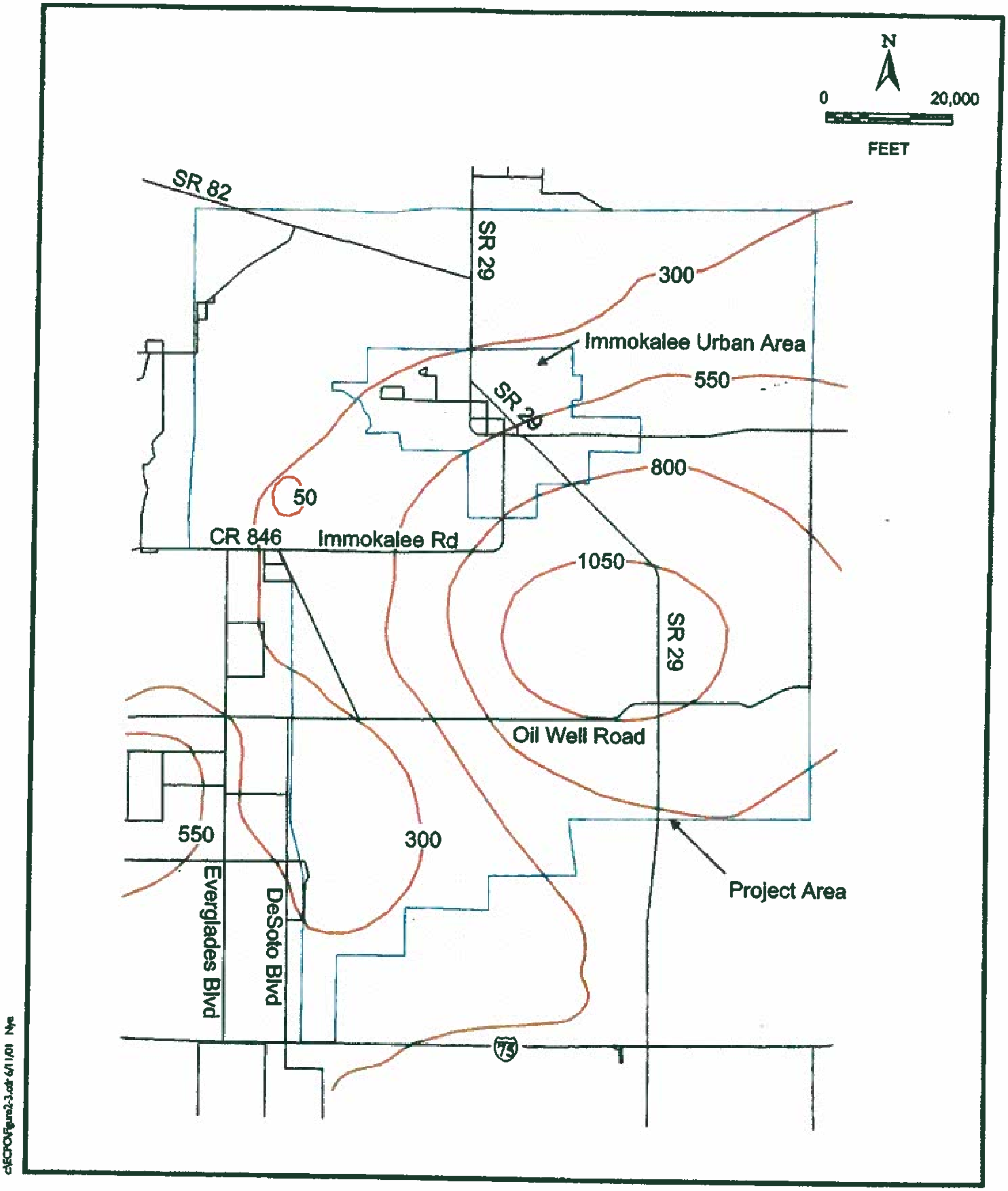

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Figure 2-3
ECPO Stage II
Transmissivity in the Water Table Aquifer (1,000 gpd/ft).

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the Fort Thompson Formation which also contains beds of quartz sand and thin beds of dense, hard, freshwater limestone in some locations (Missimer & Associates, 1991).

The lower section of the water-table aquifer lies within the upper part of the Tamiami Formation in most of Collier County. The predominant lithology is a sandy, highly fossiliferous limestone with varying quantities of mollusk shells, corals, bryozoans, and barnacles. The limestone unit is characterized by abrupt changes in thickness and often has a high permeability caused by the secondary dissolution of aragonitic shell material. This secondary dissolution creates an abundance of mold and cast type porosity, which greatly enhances the storage and flow of water. Thickness of this limestone unit increases to the north and east in Collier County where it exceeds 60 feet in parts of the ECPO study area. The overall thickness of the water-table aquifer generally ranges from 30 to 90 feet in the study area. Low permeability sediments consisting primarily of carbonate clays, fine sand, silt, and shell form the base of the water-table aquifer in most of the study area. This unit thins and thickens erratically and is absent in some areas (SFWMD 86-1). Where the confining unit is absent, the water-table aquifer is in direct hydraulic connection with the Lower Tamiami aquifer and both units are under unconfined conditions and should be termed the water-table aquifer. In this case, the water-table aquifer can exceed 100 feet in thickness.

The hydraulic characteristics of the water-table aquifer vary considerably depending on both thickness and lithologic character. A map showing the transmissivity of the water-table aquifer is provided as Figure 2-3. This map was generated using data input files from the SFWMD western Collier County groundwater flow model (April 1992). In the northwestern portion of the ECPO study area, where the limestone layers are thinner, transmissivity values range from 50,000 gpd/ft to 300,000 gpd/ft. In the southeastern parts of the study area where thick, highly permeable, reefal limestones occur, aquifer transmissivity values can exceed 1,000,000 gpd/ft (Missimer & Associates, 1986). The porosities in the reefal limestone areas can exceed 50 percent with correspondingly high specific yield values. The small area of lower transmissivity that is shown just north of Immokalee Road near Desoto Boulevard is likely due to one well or set of closely spaced wells that locally do not tap a limestone unit with high permeability. It is possible that other locations in the study area, which have not yet been explored, could also show lower permeabilities.

By definition, the water-table aquifer is unconfined or in direct contact with atmospheric pressure. However, the sediments in the upper part of the aquifer often have much lower permeabilities than the underlying limestone units, which causes the aquifer to respond to pumpage as a semi-unconfined unit in some locations (using the definitions of Kruseman and DeRidder, 1991).

The primary source of recharge to the water-table aquifer is direct infiltration and percolation of rainfall. Other minor sources include lateral inflow, percolation from septic tanks and holding ponds, and infiltration from canals and lakes when their stages exceed the altitude of the water table. Discharge from the water-table aquifer occurs by way of evaporation, transpiration by plants, lateral flow into canals, lakes, and the Gulf of Mexico, leakage into underlying aquifers, and from the pumping of wells.

The highest water levels in the ECPO study area occur where land surface elevations are highest. Water levels generally decrease to the south and southwest following the slope of the land (Figure 2-1). Water levels in the aquifer vary on a seasonal basis. During the summer rainy season, water levels often approach or exceed land surface. The natural difference in wet season and dry season water levels frequently exceeds 5 feet. Because the water-table aquifer is unconfined, it can be directly affected by alterations in drainage.

Water quality in the water-table aquifer in most of the study area is typically good with respect to salinity. However, the water generally has a dissolved iron concentration above the drinking water standard and significant concentrations of organic acids that often give the water a yellowish or brownish color. The presence of these compounds in the water can cause treatment problems because of the potential for trihalomethane (THM) or other disinfection-by-product (DBP) formation.

2.3.2 Lower Tamiami Aquifer

A low permeability, sandy, sometimes shelly, carbonate clay commonly referred to as the Bonita Springs Marl separates the water-table aquifer from the underlying Lower Tamiami aquifer in northwestern Collier County including portions of the ECPO study area. The thickness of the confining beds ranges between 0 and 50 feet and averages approximately 30 feet where present. The unit is absent in some areas particularly in the northeast portion of the study area. Where the confining beds are absent, the water-table aquifer extends to the Ochopee member of the Tamiami Formation. Wells immediately northeast of Lake Trafford do not indicate the presence of a confining layer between the water-table and the Lower Tamiami aquifers (**Figure 2-4**). This figure was developed using the thickness map in SFWMD Technical Publication 86-1. Although this area lies within the Immokalee Urban Area and is not technically part of the study, the area around Lake Trafford and the Immokalee Urban Area should be considered to have little or no confinement between these aquifers. CDM Missimer drilling logs also show a lack of confinement in east and southeast portions of the ECPO site, north of Oil Well Road and east of Route 29. In this area, confinement can be poor to the Sandstone aquifer indicating a hydraulic connection from the water-table to over 200 feet bls. However, there are large lateral variabilities in thickness and degree of confinement indicated in the well logs. In the central portion of the EPCO study area, the thickness of the confining unit increases to over 50 feet (SFWMD 86-1). Drawdown in the water-table due to pumpages of the Lower Tamiami aquifer will be dampened or eliminated with

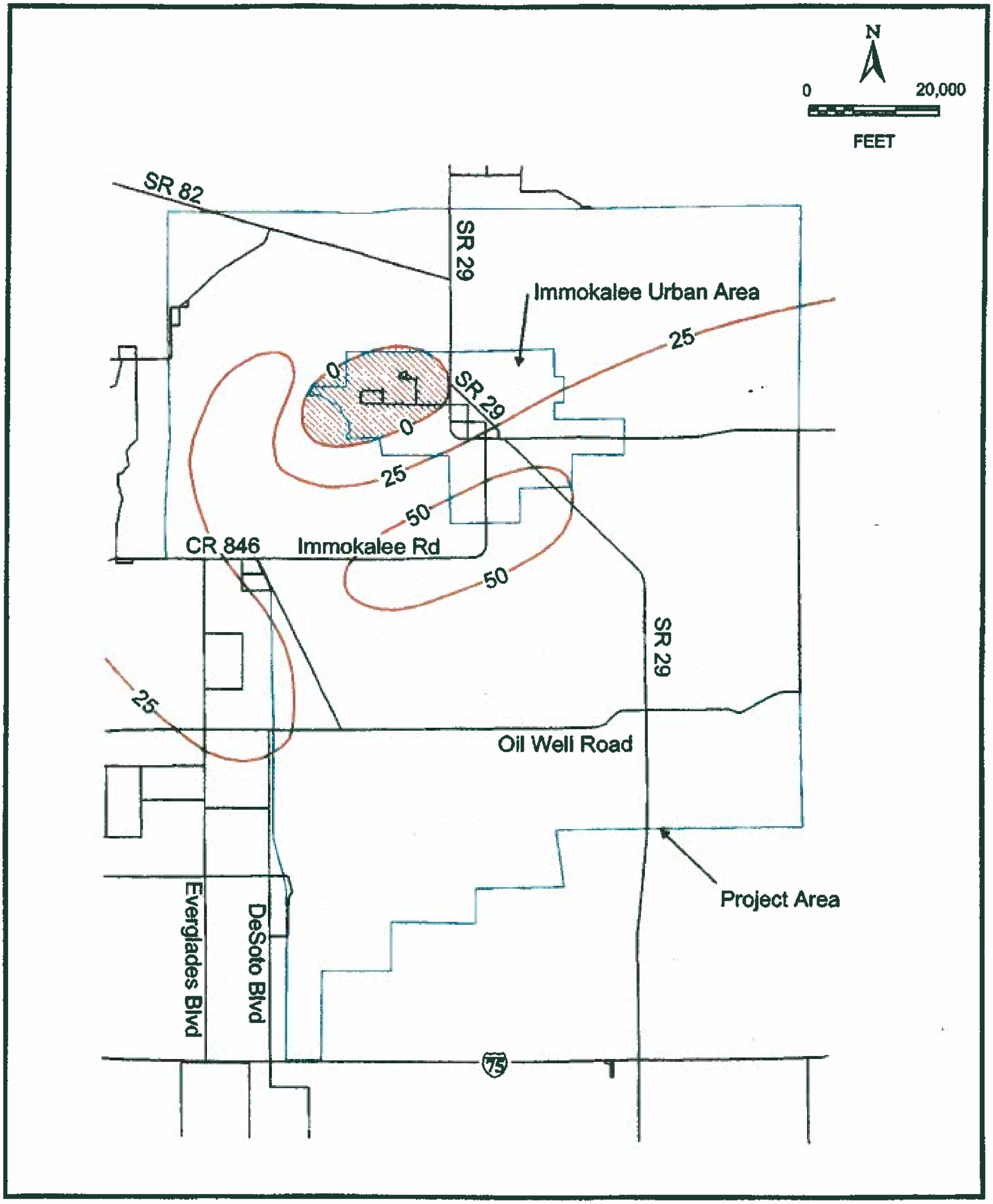

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Figure 2-4
ECPO Stage II
Thickness of the Tamiami Confining Layer.

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suitable confinement, however, where no confinement is present, drawdown in the water-table aquifer will be similar to that encountered in the Lower Tamiami aquifer.

The Lower Tamiami aquifer occurs within the Ochopee member of the Tamiami Formation. The Ochopee Member consists primarily of light gray to white, sandy, fossiliferous limestones. The dissolution of shell material creates large interconnecting shell molds that give the unit a high permeability. The thickness of the Ochopee ranges between approximately 40 and 150 feet in the study area.

The hydraulic characteristics of the Lower Tamiami aquifer are variable. Over 30 aquifer performance tests have been conducted on the aquifer in Collier County by the SFWMD and private consultants. Transmissivity values range from approximately 75,000 gpd/ft in the northwest corner of the ECPO study area to over 500,000 gpd/ft in the northeast corner. A contour map showing the transmissivity of the Lower Tamami aquifer is included as **Figure 2-5**. This map was generated using data input files from the SFWMD western Collier County groundwater flow model (April 1992). This figure shows the increasing transmissivity to the east in the northern part of the study area and a fairly consistent value of 300,000 gpd/ft in the southern half. The transmissivity increases greatly just to the southwest of the study area in Golden Gates Estates. The Lower Tamiami aquifer is currently the primary source for public water supply, agricultural, and industrial supply in Collier County.

The potentiometric surface of the Lower Tamami aquifer varies on a seasonal and regional basis in Collier County. Water levels range from near land surface during the wet season in undeveloped areas to 15 feet or more below land surface near centers of pumpage during the dry season. The regional flow direction is to the south and southwest, generally perpendicular to the land surface contours, with hydraulic gradients that approximately range from 0.25 to 1.25 feet per mile. Steeper hydraulic gradients and radial flow conditions are encountered near large centers of pumpage such as municipal or agricultural wellfields.

Recharge to the aquifer occurs primarily by downward leakage from the water-table aquifer through the overlying semi-confining beds. The potentiometric surface of the Lower Tamiami aquifer is generally lower than the surface of the water-table aquifer except very near major surface drainage features or where the confinement is absent. This results in continuous downward leakage from the water-table aquifer to the Lower Tamiami aquifer. The amount of leakage depends upon the overall vertical hydraulic conductivity of the confining unit and the magnitude of the difference in the potentiometric levels of the aquifers. Therefore, recharge to the Lower Tamiami aquifer is typically greatest near centers of pumpage from the aquifer. Discharge from the Lower Tamiami aquifer occurs primarily from lateral flow to the Gulf of Mexico and from the pumping of wells.

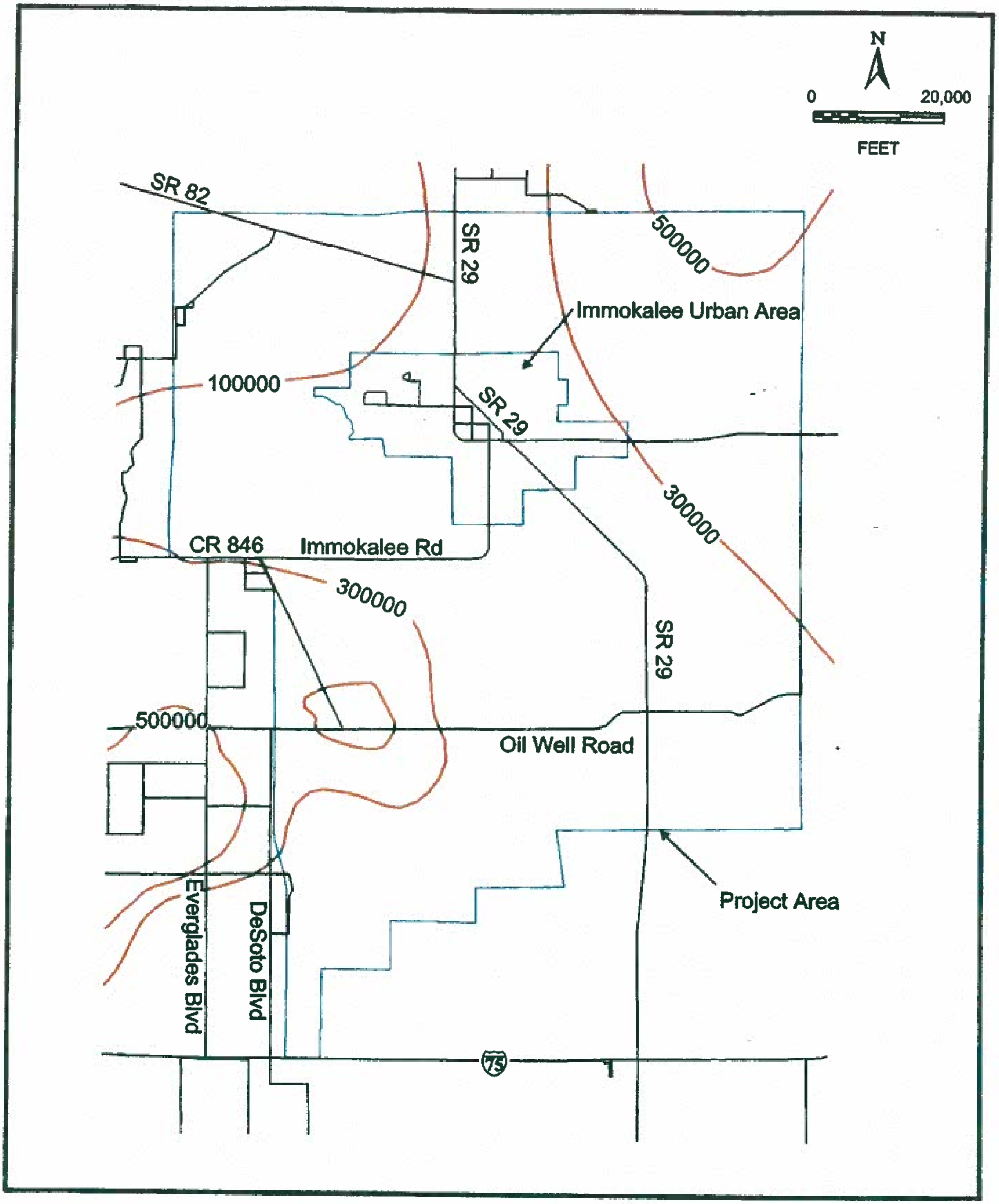

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Figure 2-5
ECPO Stage II
Transmissivity in the Lower Tamiami Aquifer (gpd/ft).

Water quality in the Lower Tamiami aquifer meets most state and federal drinking water standards in much of Collier County. Dissolved chloride concentrations typically range from less than 50 mg/l to 200 mg/l. Where confinement from the water-table aquifer is present, the Lower Tamiami contains water that is low in dissolved iron and color. Iron content is high in the Lower Tamiami aquifer in wells where confinement is poor. In most areas, water from the aquifer can be treated to meet the applicable drinking water standards with conventional treatment methods.

2.4 Intermediate Aquifer System

2.4.1 Sandstone Aquifer

In parts of the ECPO study area, the Lower Tamiami aquifer is hydraulically connected to the Sandstone aquifer, which is the uppermost hydrologic unit of the Intermediate Aquifer System. The Sandstone aquifer consists of moderate to low permeability calcareous cemented quartz sands, sandstone, and sandy limestone that belong to the upper part of the Peace River Formation of the Hawthorn Group. The aquifer is commonly used for agricultural irrigation in the ECPO study area (SFWMD, 1986). Within the study area, most of the Sandstone Aquifer wells in the SFWMD's data set are north of the Immokalee urban area. The transmissivity of the aquifer is high in the study area as shown on **Figure 2-6**. This figure was generated using data obtained from the SFWMD groundwater flow model of western Collier County (April 1992). The potentiometric surface of the Sandstone aquifer is similar to that of the Lower Tamiami aquifer because the two units are hydraulically connected. A confining unit separates the aquifers in Lee and northwestern Collier County so that a difference in the potentiometric surface exists between the aquifers in these areas. Water quality is generally good in the upper part of the aquifer with dissolved chloride concentrations of 250 mg/l or less. However, salinity levels typically increase with depth.

The base of the Sandstone aquifer is marked by an abrupt lithologic transition to the highly impermeable pale olive to greenish-gray clays and marls of the middle and lower Peace River Formation. These sediments form the upper Hawthorn confining zone. The upper Hawthorn confining unit ranges in thickness from approximately 100 to 150 feet in the county. The considerable thickness and low permeability of the clays and marls result in good confinement between the Sandstone aquifer and the underlying Hawthorn Zone I aquifer.

2.4.2 Hawthorn Zone I Aquifer

The Hawthorn Zone I aquifer occurs within permeable limestone units that belong to the upper Arcadia Formation of the Hawthorn Group. The upper contact of the Hawthorn Zone I aquifer is marked by a sharp contact of a pale olive clay of the upper Hawthorn confining unit with a very light gray limestone. The predominant

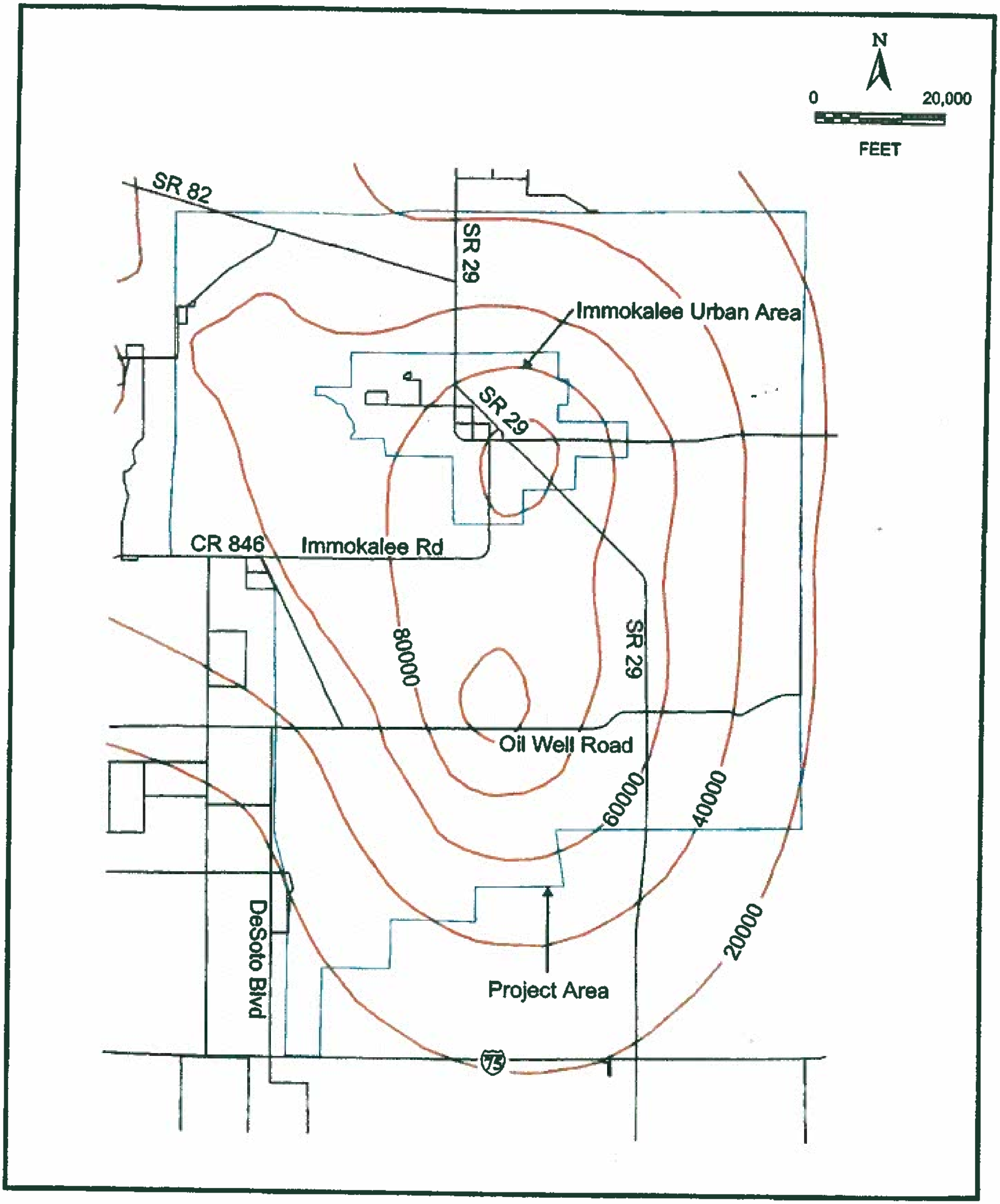

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Figure 2-6
ECPO Stage II
Transmissivity in the Sandstone Aquifer (gpd/ft).

lithologies within the aquifer are very light gray to pale olive limestone layers, partially separated from each other by thin layers of dolomitic limestone. The limestones consist mostly of fine-grained wackestones that are cemented to varying degrees. The limestones are moderately hard to hard, and usually have moderate to high porosity (both intergranular and moldic porosity). Sand-sized phosphate grains are present throughout the aquifer, usually at volumetric abundances on the order of 1 to 3%. The Hawthorn Zone I aquifer occurs at depths of approximately 290 to 420 feet below land surface in the study area and ranges in thickness from approximately 100 to 135 feet. The aquifer tends to thin toward the north.

At the base of the Hawthorn Zone I aquifer is a sequence of interbedded marls, clays, and limestone units that belong to the Miocene-aged, middle Arcadia Formation. These generally low permeability sediments form the Mid-Hawthorn confining zone, which separates the Hawthorn Zone I aquifer from the underlying Lower Hawthorn aquifer of the Floridan Aquifer System. The thickness of the Mid-Hawthorn confining zone averages over 150 feet in the ECPO study area and the overall vertical hydraulic conductivity of the unit is very low. Transmissivities of the Hawthorn Zone I aquifer range from 20,000 to approximately 100,000 gpd/ft (SCRWTP report, CDM Missimer, 2000).

Water quality in the Hawthorn Zone I aquifer is quite variable in Collier County. Dissolved chloride concentrations range from less than 200 mg/l in the northeastern section of the county to between 2000 and 3000 mg/l to the west and south. Although there is not an abundance of data in the study area, water quality trends indicate that dissolved chloride concentrations on the order of 200 mg/l are likely at the ECPO site.

2.5 Floridan Aquifer System

2.5.1 Lower Hawthorn Aquifer

The Lower Hawthorn aquifer lies beneath the Mid-Hawthorn confining zone and is the uppermost unit in the Floridan Aquifer System. The Floridan Aquifer System is regionally extensive and underlies all of Florida and parts of Alabama, Georgia, and South Carolina. It is used for potable and irrigation water supply in many parts of Florida.

The upper boundary of the Lower Hawthorn aquifer is marked by a sharp decrease in the marl and clay content in the lower Arcadia Formation. The Lower Hawthorn aquifer consists predominantly of interbedded yellowish-gray fossiliferous limestones and pale olive dolomites. The limestones consist mostly of wackestones with secondary porosity and a minor amount of very fine to medium-grained carbonate sand that is lithified to varying degrees. The Lower Hawthorn aquifer limestones are generally moderately hard and have a moderate to high porosity. The Lower Hawthorn dolomites have a microsucrosic texture, are very hard, and have variable porosity. The top of the Lower Hawthorn aquifer occurs at depths ranging from less than 600 to over 800 feet in the county, dipping to the southeast. The thickness of the Lower Hawthorn aquifer ranges from approximately 100 to 200 feet.

The hydraulic characteristics of the Lower Hawthorn aquifer are variable in Collier County. Transmissivity values for the Lower Hawthorn aquifer can range from 10,000 gpd/ft to over 2,000,000 gpd/ft over relatively short lateral distances (SCRWTP Report, CDM Missimer, 2000). A hydraulic trend cannot accurately be evaluated given the high variability and lack of data; however, the general tendency seems to be a set of ridges running from northwest to southeast, which alternate with high and then low transmissivity.

The potentiometric surface of the Lower Hawthorn aquifer is highest in the northeastern part of the county and decreases to the southwest. The direction of groundwater flow within the aquifer is therefore towards the southwest. Recharge to the aquifer is due primarily to direct infiltration of precipitation where the aquifer is close to land surface in the northern and central part of the state and leakage from other aquifers.

Water quality in the Lower Hawthorn aquifer varies greatly across Collier County. Salinity in the Lower Hawthorn aquifer generally increases to the south and west in Collier County. Dissolved chloride concentrations are likely greater than 1000 mg/l in the ECPO study area and generally from 2000-3000 mg/l in other areas of Collier County. The water is generally not suitable for individual, agricultural or industrial uses without desalination treatment.

2.5.2 Underlying Units

The Lower Hawthorn aquifer is underlain by yellowish-gray to pale orange fossiliferous limestones that belong to the Suwannee Limestone unit of the Floridan Aquifer System. The Ocala and Avon Park aquifers lie beneath the Suwannee Limestone across the study area. Confinement between the Lower Hawthorn and underlying aquifers is thought to be provided primarily by thick sequences of generally low permeability sediments within the Suwannee Limestone.

The top of the Suwannee Limestone occurs at depths ranging from approximately 850 to 950 feet below land surface. The predominant lithology is a yellowish-gray to pale orange fossiliferous limestone. Permeability of the unit is significantly lower than that encountered in the overlying Lower Hawthorn aquifer or underlying units and thus potential well yields are not as great. Water quality with respect to dissolved chloride concentration is similar to that of the Lower Hawthorn aquifer with values of approximately 2000 mg/l to 3000 mg/l in the upper part of the unit. Dissolved chloride concentrations tend to increase with depth in the Suwannee Limestone and water quality can degrade significantly between the upper and lower part of the unit.

The Ocala Group limestones underlie the Suwannee Limestone in the study area. The Ocala Group occurs at depths ranging from approximately 1100 to 1200 feet below land surface. The lithology within the Ocala Group is primarily fossiliferous limestone. The productive capacity of the Ocala Limestone is low to moderate. A marked increase in salinity occurs in the Ocala Group. Although only limited data are available, dissolved chloride concentrations ranging from 6000 to 8000 mg/l have been reported from test wells tapping the aquifer.

The Avon Park aquifer is the lowermost unit considered in this report. Limestone, dolomitic limestone, and dolomite are the primary lithologies present within this zone. Relatively high porosities are encountered and the aquifer possesses a high yield potential. However, water quality within this unit is very poor with dissolved chloride concentrations approaching that of seawater.

Section 3
Current Water Uses

The South Florida Water Management District (SFWMD) maintains a database of permitted well locations and allocations for Collier County (Bengtsson, 2001 personal communication). The database consists of two files, one with allocation per permit number, and a second which gives the locations of the individual wells associated with each permit, the aquifer each well draws from, and the well's pump details. This information comes from the water use permit application information that each user submits to the agency. These two databases were combined to show permitted water use geographically, however, these databases were incomplete. To augment this data, information is taken from the numerical groundwater model developed in 1992 by the SFWMD that contains a well file that also has allocation information.

3.1 Permitted Water Allocations

Figure 3-1 displays the maximum daily allocation in millions of gallons per day for each section within the study area. The water use permits have different periods of allocation depending on the permit type (public supply, agricultural irrigation, etc.). In the data set, most of the permits have an annual allocation and then either a maximum monthly or a maximum daily allocation listed. The annual allocation information is of little value as it includes periods of non-use or low use. Potential impacts of a given water use are typically judged on a maximum month basis. Therefore, the maximum monthly allocation data is most useful for this report. When the maximum monthly data were unavailable, the maximum daily allocation data were multiplied by 30 and then used. When these daily data were also unavailable, the annual allocation data were divided by 12, and then corrected by a factor of 1.7 to conservatively estimate a maximum monthly allocation. Sample permits with both annual allocation data and maximum monthly allocation data were investigated to determine a correction factor. The maximum monthly allocations were found to vary from 1.4 to 1.9 times the annual allocation normalized to a monthly value. The correction factor of 1.7 is approximately the average of the sampled factors. Once all data were in maximum monthly form, the data were then converted to a daily amount for display purposes.

It should be noted that for approximately 7.5% of the well permits, no allocation was given over any time period. This represents a hole in the SFWMD's database. A numerical groundwater model developed in 1992 by the SFWMD, contains a well file that combines all pumpages located within a model grid cell to one value. Since the grid size is one mile by one mile, these pumpage values approximately represent the permitted allocation for each section. In sections where wells are present, but no allocation was given in the permit database as described above, the model data were used to approximate the maximum daily permitted allocation.

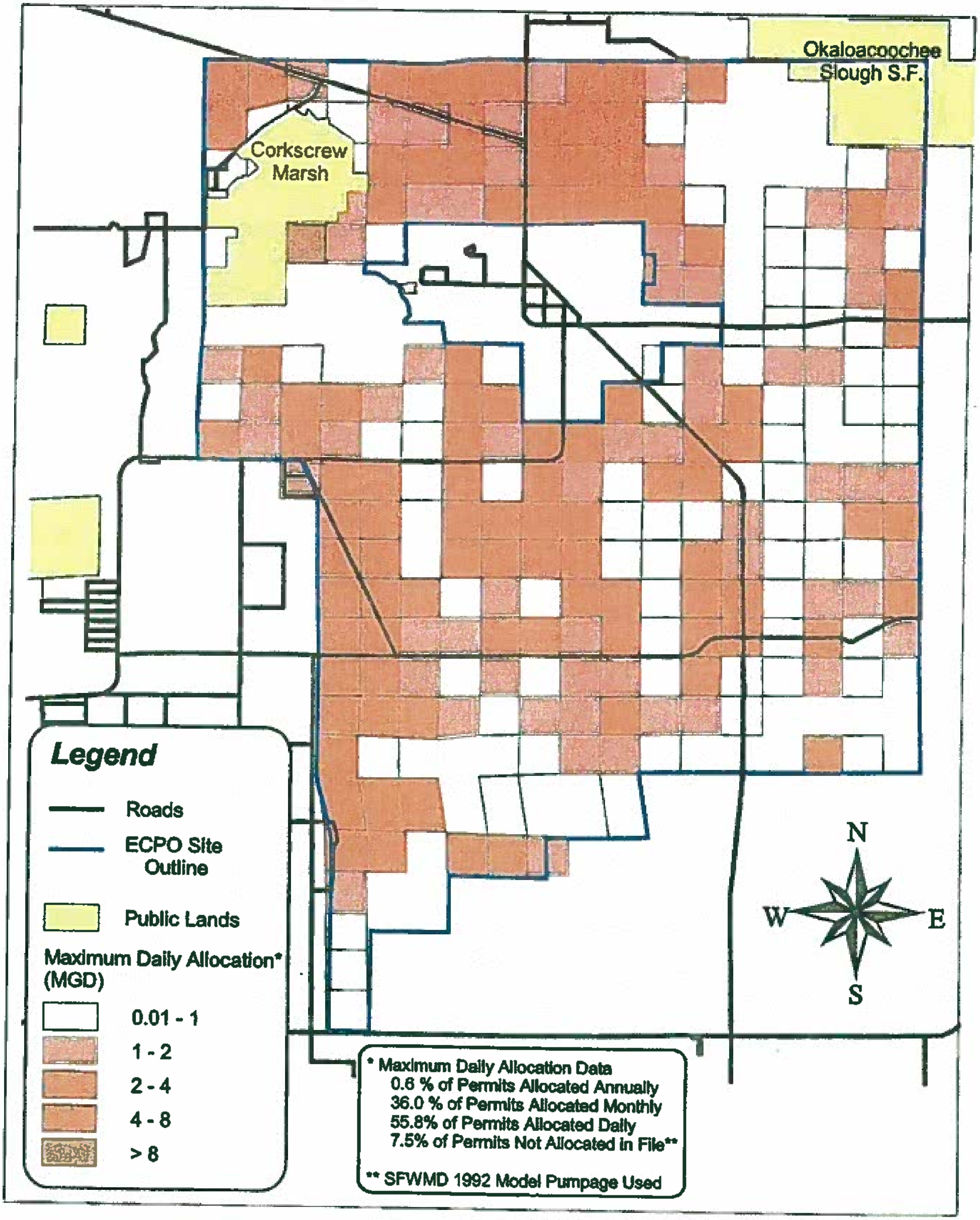

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Figure 3-1
ECPO Site
Groundwater Allocation by Section

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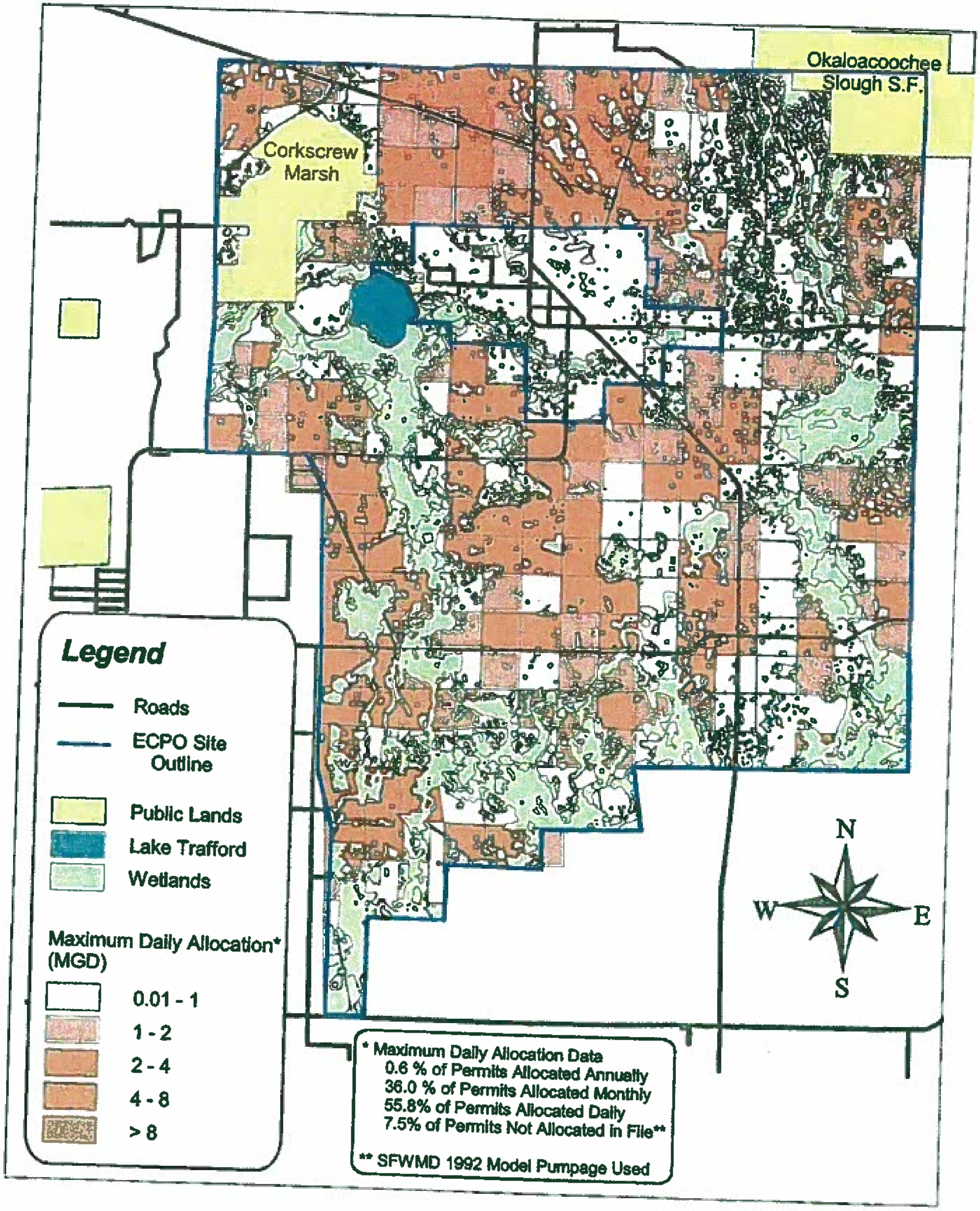
The land use designation of wetlands as described in the Stage I Report and provided by WilsonMiller was superimposed on this map and shown in **Figure 3-2**. This figure indicates the there are extensive areas in the ECPO study area that have little or no aquifer withdrawals and are not designated as wetlands.

The SFWMD's Lower West Coast Water Supply Plan (April 2000) states that there is sufficient water to meet the needs of the region which includes the ECPO study area during a 1 in 10 drought condition through the year 2020 provided appropriate water management and diversification of water supply sources. The District concluded that "projected agricultural water demands could be met from existing sources through modifications to wellfield configurations and pumping regimes with respect to locations of wetlands." They also discuss the possibility of blending water from the Floridan Aquifer System with freshwater supplies to augment the supply. Any land use change from agriculture to residential is likely to decrease the projected water demand. Given the conclusions of the Lower West Coast Water Supply Plan, and the fact that alternative sources of water such as the deeper intermediate and upper Floridan aquifers have not been utilized in ECPO, adequate water supply exists in the area for projected agriculture growth or conversion to other land use.



CDM Missimer

Figure 3-2
ECPO Site
Groundwater Allocation and Wetlands

Section 4
Changes in Land Uses

The Stage I report on the ECPO study area describes land use in the study area in detail. A large percentage of the land in the study area is used for agricultural purposes. In general, uplands are natural recharge areas for aquifers, and wetlands, where water levels frequently exceed land surface, are natural discharge areas. Most agricultural lands can be considered natural recharge areas for the water-table aquifer, however ditching and diking common to agriculture fields alter the natural groundwater flow patterns. Residential developments tend to have larger areas with impermeable surfaces such as roads, houses, and parking areas. Directly connected impervious surface areas can lead to increased runoff that does not enter the groundwater system. However, the regulatory agencies that permit new development, such as the South Florida Water Management District, require that surface water and stormwater management systems be engineered to retain as much runoff as possible in lakes and other water storage systems and that off-site runoff not exceed historic levels. Provision of appropriately designed water management systems allows area recharge characteristics to be maintained even with an increase in impervious surfaces.

There is sufficient freshwater supply in the water-table, Lower Tamiami, and Sandstone aquifers, in most if not all of the ECPO study area, to provide water resources for potential residential/commercial development due to the net reduction in water demand when land use changes from agriculture to residential. However, if the freshwater aquifers are found inadequate on a site-specific basis, other options exist to provide adequate supply. For irrigation purposes such as for a golf course or landscaping, blending of the freshwater and brackish water from the Hawthorn Zone 1 or Lower Hawthorn aquifers may be used. Blending such as this is conducted successfully in many developments in Southern Lee and Western Collier Counties. Another option would be Aquifer Storage and Recovery (ASR) where excess freshwater is injected into a deep aquifer during the rainy season to be withdrawn in the dry season. After a few cycles through the seasons, the water withdrawn from the deeper aquifers is significantly fresher and may be used without blending. Potable water supply from brackish aquifers would need Reverse Osmosis (RO) treatment. A development could choose between a centralized plant or small individual units for each residence. These options would only be needed in the unlikely event that the freshwater supply is inadequate for the potential use.

Section 5
Summary

Conclusions of the SFWMD Lower West Coast Water Supply Plan including evaluations of water resource availability and impacts associated with water use, indicate that within the ECPO area, water resources are sufficient to meet current and projected agricultural demands through a 20-year planning horizon. Conversion of land from agricultural to other uses such as residential, golf, or light commercial has historically resulted in a net reduction in water use. Any existing or proposed land use must have appropriate water management design elements to assure that water levels and groundwater recharge rates are maintained or improved. Properly managed ground and surface water resources within the ECPO area are sufficient to support projected land uses as well as the health and integrity of natural systems.