Lower West Coast Water Supply Plan

Appendices

Volume 3

prepared by

South Florida Water Management District

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Water Supply Planning and
Development Department
West Palm Beach, Florida

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Appendix A
SELECTED PASSAGES FROM THE FLORIDA STATUTES AND FLORIDA ADMINISTRATIVE CODE

SELECTED PASSAGES FROM SECTION 187.201, F.S.

187.201 State Comprehensive Plan Adopted

8) Water Resources

(a) Goal. --Florida shall assure the availability of an adequate supply of water for all competing uses deemed reasonable and beneficial and shall maintain the functions of natural systems and the overall present level of surface and ground water quality. Florida shall improve and restore the quality of waters not presently meeting water quality standards.

(b) Policies. --

1. Ensure the safety and quality of drinking water supplies and promote the development of reverse osmosis and desalinization technologies for developing water supplies.
2. Identify and protect the functions of water recharge area and provide incentives for their conservation.
3. Encourage the development of local and regional water supplies within water management districts instead of transporting surface water across district boundaries.
4. Protect and use natural water systems in lieu of structural alternatives and restore modified systems.
5. Ensure that new development is compatible with existing local and regional water supplies.
6. Establish minimum seasonal flows and levels for surface watercourses with primary consideration given to the protection of natural resources, especially marine, estuarine, and aquatic ecosystems.
7. Discourage the channelization, diversion, or damming of natural riverine systems.
8. Encourage the development of a strict floodplain management program by state and local governments designed to preserve hydrologically significant wetlands and other natural floodplain features.
9. Protect aquifers from depletion and contamination through appropriate regulatory programs and through incentives.
10. Protect surface and ground water quality and quantity in the state.
11. Promote water conservation as an integral part of water management programs as well as the use and reuse of water of the lowest acceptable quality for the purposes intended.
12. Eliminate the discharge of inadequately treated wastewater and stormwater runoff into the waters of the state.
13. Identify and develop alternative methods of wastewater treatment, disposal, and reuse of wastewater to reduce degradation of water resources.

14. Reserve from use that water necessary to support essential non-withdrawal demands, including navigation, recreation, and the protection of fish and wildlife.

History. --+ s.2, ch. 85-57; s. 1, ch. 87-354; s. 47, ch. 88-130; s. 4, ch. 89-279; s.85, ch. 90-201; s. 28, ch. 91-5; s. 103, ch. 91-282.

SELECTED PASSAGES FROM SECTIONS 373.016 - 373.62, F.S.

Part I State Water Resource Plan

373.016 Declaration of Policy

(1) The waters in the state are among its basic resources. Such waters have not heretofore been conserved or fully controlled so as to realize their full beneficial use.

(2) The department and the governing board shall take into account cumulative impacts on water resources and manage those resources in a manner to ensure their sustainability.

(3) It is further declared to be the policy of the Legislature:

(a) To provide for the management of water and related land resources;

(b) To promote the conservation, replenishment, recapture, enhancement, development, and proper utilization of surface and ground water;

(c) To develop and regulate dams, impoundments, reservoirs, and other works and to provide water storage for beneficial purposes;

(d) To promote the availability of sufficient water for all existing and future reasonable-beneficial uses and natural systems;

(e) To prevent damage from floods, soil erosion, and excessive drainage;

(f) To minimize degradation of water resources caused by the discharge of stormwater;

(g) To preserve natural resources, fish, and wildlife;

(h) To promote the public policy set forth in s. 403.021;

(i) To promote recreational development, protect public lands, and assist in maintaining the navigability of rivers and harbors; and

(j) Otherwise to promote the health, safety, and general welfare of the people of this state.

In implementing this chapter, the department and the governing board shall construe and apply the policies in this subsection as a whole, and no specific policy is to be construed or applied in isolation from the other policies in this subsection.

(4)(a) Because water constitutes a public resource benefiting the entire state, it is the policy of the Legislature that the waters in the state be managed on a state and regional basis. Consistent with this directive, the Legislature recognizes the need to allocate water throughout the state so as to meet all reasonable-beneficial uses. However, the Legislature acknowledges that such allocations have in the past adversely affected the water resources of certain areas in this state. To protect such water resources and to meet the current and future needs of those areas with abundant water, the Legislature directs the department and the water management districts to encourage the use of water from sources nearest the area of use or application whenever practicable. Such sources shall include all naturally occurring water sources and all alternative water sources, including but not limited to, desalination, conservation, reuse of nonpotable reclaimed water and stormwater, and aquifer storage and recovery. Reuse of potable reclaimed water and stormwater shall not be subject to the evaluation described in s. 373.223(3)(a)-(g). However, this directive to encourage the use of water, whenever practicable, from sources nearest the area of use or application shall not apply to the transport and direct and indirect use of water within the area encompassed by the Central and Southern Florida Flood Control Project, nor shall it apply anywhere in the state to the transport and use of water supplied exclusively for bottled water as defined in s. 500.03(1)(d), nor shall it apply to the transport and use of reclaimed water for electrical power production by an electric utility as defined in section 366.02(2).

(4)(b) In establishing the policy outlined in paragraph (a), the Legislature realizes that under certain circumstances the need to transport water from distant sources may be necessary for environmental, technical, or economic reasons.

(5) The Legislature recognizes that the water resource problems of the state vary from region to region, both in magnitude and complexity. It is therefore the intent of the Legislature to vest in the Department of Environmental Protection or its successor agency the power and responsibility to accomplish the conservation, protection, management, and control of the waters of the state and with sufficient flexibility and discretion to accomplish these ends through delegation of appropriate powers to the various water management districts. The department may exercise any power herein authorized to be exercised by a water management district; however, to the greatest extent practicable, such power should be delegated to the governing board of a water management district.

(6) It is further declared the policy of the Legislature that each water management district, to the extent consistent with effective management practices, shall approximate its fiscal and budget policies and procedures to those of the state.

History.--s. 2, part I, ch. 72-299; s. 36, ch. 79-65; s. 70, ch. 83-310; s. 5, ch. 89-279; s. 20, ch. 93-213; s. 250, ch. 94-356; s. 1, ch. 97-160.

373.019 Definitions.—

When appearing in this chapter or in any rule, regulation, or order adopted pursuant thereto, the following words shall, unless the context clearly indicates otherwise, mean:

(1) “Coastal waters” means waters of the Atlantic Ocean or the Gulf of Mexico within the jurisdiction of the state.

(2) “Department” means the Department of Environmental Protection or its successor agency or agencies.

(3) “District water management plan” means the regional water resource plan developed by a governing board under s. 373.036.

(4) “Domestic use” means the use of water for the individual personal household purposes of drinking, bathing, cooking, or sanitation. All other uses shall not be considered domestic.

(5) “Florida water plan” means the state-level water resource plan developed by the department under s. 373.036.

(6) “Governing board” means the governing board of a water management district.

(7) “Ground water” means water beneath the surface of the ground, whether or not flowing through known and definite channels.

(8) “Impoundment” means any lake, reservoir, pond, or other containment of surface water occupying a bed or depression in the earth's surface and having a discernible shoreline.

(9) “Independent scientific peer review” means the review of scientific data, theories, and methodologies by a panel of independent, recognized experts in the fields of hydrology, hydrogeology, limnology, and other scientific disciplines relevant to the matters being reviewed under s. 373.042.

(10) “Nonregulated use” means any use of water which is exempted from regulation by the provisions of this chapter.

(11) “Other watercourse” means any canal, ditch, or other artificial watercourse in which water usually flows in a defined bed or channel. It is not essential that the flowing be uniform or uninterrupted.

(12) “Person” means any and all persons, natural or artificial, including any individual, firm, association, organization, partnership, business trust, corporation, company, the United States of America, and the state and all political subdivisions, regions, districts, municipalities, and public agencies thereof. The enumeration herein is not intended to be exclusive or exhaustive.

(13) “Reasonable-beneficial use” means the use of water in such quantity as is necessary for economic and efficient utilization for a purpose and in a manner which is both reasonable and consistent with the public interest.

(14) “Regional water supply plan” means a detailed water supply plan developed by a governing board under s. 373.036[1].

(15) "Stream" means any river, creek, slough, or natural watercourse in which water usually flows in a defined bed or channel. It is not essential that the flowing be uniform or uninterrupted. The fact that some part of the bed or channel has been dredged or improved does not prevent the watercourse from being a stream.

(16) "Surface water" means water upon the surface of the earth, whether contained in bounds created naturally or artificially or diffused. Water from natural springs shall be classified as surface water when it exits from the spring onto the earth's surface.

(17) "Water" or "waters in the state" means any and all water on or beneath the surface of the ground or in the atmosphere, including natural or artificial watercourses, lakes, ponds, or diffused surface water and water percolating, standing, or flowing beneath the surface of the ground, as well as all coastal waters within the jurisdiction of the state.

(18) "Water management district" means any flood control, resource management, or water management district operating under the authority of this chapter.

(19) "Water resource development" means the formulation and implementation of regional water resource management strategies, including the collection and evaluation of surface water and ground water data; structural and nonstructural programs to protect and manage water resources; the development of regional water resource implementation programs; the construction, operation, and maintenance of major public works facilities to provide for flood control, surface and underground water storage, and ground water recharge augmentation; and related technical assistance to local governments and to government-owned and privately owned water utilities.

(20) "Water resource implementation rule" means the rule authorized by s. 373.036, which sets forth goals, objectives, and guidance for the development and review of programs, rules, and plans relating to water resources, based on statutory policies and directives. The waters of the state are among its most basic resources. Such waters should be managed to conserve and protect water resources and to realize the full beneficial use of these resources.

(21) "Water supply development" means the planning, design, construction, operation, and maintenance of public or private facilities for water collection, production, treatment, transmission, or distribution for sale, resale, or end use.

(22) For the sole purpose of serving as the basis for the unified statewide methodology adopted pursuant to s. 373.421(1), as amended,"wetlands" means those areas that are inundated or saturated by surface water or ground water at a frequency and a duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soils. Soils present in wetlands generally are classified as hydric or alluvial, or possess characteristics that are associated with reducing soil conditions. The prevalent vegetation in wetlands generally consists of facultative or obligate hydrophytic macrophytes that are typically adapted to areas having soil conditions described above. These species, due to morphological, physiological, or reproductive adaptations, have the ability to grow, reproduce, or persist in

aquatic environments or anaerobic soil conditions. Florida wetlands generally include swamps, marshes, bayheads, bogs, cypress domes and strands, sloughs, wet prairies, riverine swamps and marshes, hydric seepage slopes, tidal marshes, mangrove swamps and other similar areas. Florida wetlands generally do not include longleaf or slash pine flatwoods with an understory dominated by saw palmetto. Upon legislative ratification of the methodology adopted pursuant to s. 373.421(1), as amended, the limitation contained herein regarding the purpose of this definition shall cease to be effective.

(23) “Works of the district” means those projects and works, including, but not limited to, structures, impoundments, wells, streams, and other watercourses, together with the appurtenant facilities and accompanying lands, which have been officially adopted by the governing board of the district as works of the district.

History.--s. 3, part I, ch. 72-299; s. 37, ch. 79-65; s. 1, ch. 80-259; s. 5, ch. 82-101; s. 6, ch. 89-279; s. 21, ch. 93-213; s. 15, ch. 94-122; s. 251, ch. 94-356; s. 1, ch. 96-339; s. 1, ch. 96-370; s. 2, ch. 97-160.

[1]Note.--Former s. 373.194

373.033 Saltwater Barrier Line

(1) The department may, at the request of the board of county commissioners of any county, at the request of the governing board of any water management district, or any municipality or water district responsible for the protection of a public water supply, or, having determined by adoption of an appropriate resolution that saltwater intrusion has become a matter of emergency proportions, by its own initiative, establish generally along the seacoast, inland from the seashore and within the limits of the area within which the petitioning board has jurisdiction, a saltwater barrier line inland of which no canal shall be constructed or enlarged, and no natural stream shall be deepened or enlarged, which shall discharge into tidal waters without a dam, control structure or spillway at or seaward of the saltwater barrier line, which shall prevent the movement of salt water inland of the saltwater barrier line. Provided, however, that the department is authorized, in cases where saltwater intrusion is not a problem, to waive the requirement of a barrier structure by specific permit to construct a canal crossing the saltwater barrier line without a protective device and provided, further that the agency petitioning for the establishment of the saltwater barrier line shall concur in the waiver.

(2) Application by a board of county commissioners or by the governing board of a water management district, a municipality or a water district for the establishment of a saltwater barrier line shall be made by adoption of an appropriate resolution, agreeing to:

(a) Reimburse the department the cost of necessary investigation, including, but not limited to, subsurface exploration by drilling, to determine the proper location of the saltwater barrier line in that county or in all or part of the district over which the applying agency has jurisdiction.

(b) Require compliance with the provisions of this law by county or district forces under their control; by those individuals or corporations filing plats for record and by individuals, corporations or agencies seeking authority to discharge surface or subsurface drainage into tidal waters.

(3) The board of county commissioners of any county or the governing board of any water management district, municipality or water district desiring to establish a saltwater barrier line is authorized to reimburse the department for any expense entailed in making an investigation to determine the proper location of the saltwater barrier line, from any funds available to them for general administrative purposes.

(4) The department, any board of county commissioners, and the governing board of any water management district, municipality, or water district having competent jurisdiction over an area in which a saltwater barrier is established shall be charged with the enforcement of the provisions of this section, and authority for the maintenance of actions set forth in s. 373.129 shall apply to this section.

(5) The provisions of s. 373.191 shall apply specifically to the authority of the board of county commissioners, or to the governing board of a water management district, a municipality, or a water district having jurisdiction over an area in which a saltwater barrier line is established, to expend funds from whatever source may be available to them for the purpose of constructing saltwater barrier dams, dikes, and spillways within existing canals and streams in conformity with the purpose and intent of the board in establishing the saltwater barrier line.

History.--s. 2, ch. 63-210; ss. 25, 35, ch. 69-106; s. 25, ch. 73-190; s. 14, ch. 78-95; s. 40, ch. 79-65; s. 85, ch. 79-164.

373.036 Florida water plan; district water management plans.--

(1) FLORIDA WATER PLAN.--In cooperation with the water management districts, regional water supply authorities, and others, the department shall develop the Florida water plan. The Florida water plan shall include, but not be limited to:

(a) The programs and activities of the department related to water supply, water quality, flood protection and floodplain management, and natural systems.

(b) The water quality standards of the department.

(c) The district water management plans.

(d) Goals, objectives, and guidance for the development and review of programs, rules, and plans relating to water resources, based on statutory policies and directives. The state water policy rule, renamed the water resource implementation rule pursuant to s. 373.019(2), shall serve as this part of the plan. Amendments or additions to this part of the Florida water plan shall be adopted by the department as part of the water resource implementation rule. In accordance with s. 373.114, the department shall review rules of the water management districts for consistency with this rule. Amendments to the water resource implementation rule must be adopted by the secretary of the department and be submitted to the President of the Senate and the Speaker of the House of Representatives within 7 days after publication in the Florida Administrative Weekly. Amendments shall not become effective until the conclusion of the next regular session of the Legislature following their adoption.

(2) DISTRICT WATER MANAGEMENT PLANS.--

(a) Each governing board shall develop a district water management plan for water resources within its region, which plan addresses water supply, water quality, flood protection and floodplain management, and natural systems. The district water management plan shall be based on at least a 20-year planning period, shall be developed and revised in cooperation with other agencies, regional water supply authorities, units of government, and interested parties, and shall be updated at least once every 5 years. The governing board shall hold a public hearing at least 30 days in advance of completing the development or revision of the district water management plan.

(b) The district water management plan shall include, but not be limited to:

1. The scientific methodologies for establishing minimum flows and levels under s. 373.042, and all established minimum flows and levels.
2. Identification of one or more water supply planning regions that singly or together encompass the entire district.
3. Technical data and information prepared under ss. 373.0391 and 373.0395.
4. A districtwide water supply assessment, to be completed no later than July 1, 1998, which determines for each water supply planning region:
   a. Existing legal uses, reasonably anticipated future needs, and existing and reasonably anticipated sources of water and conservation efforts; and
   b. Whether existing and reasonably anticipated sources of water and conservation efforts are adequate to supply water for all existing legal uses and reasonably anticipated future needs and to sustain the water resources and related natural systems.
5. Any completed regional water supply plans.

(c) If necessary for implementation, the governing board shall adopt by rule or order relevant portions of the district water management plan, to the extent of its statutory authority.

(d) In the formulation of the district water management plan, the governing board shall give due consideration to:

1. The attainment of maximum reasonable-beneficial use of water resources.
2. The maximum economic development of the water resources consistent with other uses.

3. The management of water resources for such purposes as environmental protection, drainage, flood control, and water storage.
4. The quantity of water available for application to a reasonable-beneficial use.
5. The prevention of wasteful, uneconomical, impractical, or unreasonable uses of water resources.
6. Presently exercised domestic use and permit rights.
7. The preservation and enhancement of the water quality of the state.
8. The state water resources policy as expressed by this chapter.

(3) The department and governing board shall give careful consideration to the requirements of public recreation and to the protection and procreation of fish and wildlife. The department or governing board may prohibit or restrict other future uses on certain designated bodies of water which may be inconsistent with these objectives.

(4) The governing board may designate certain uses in connection with a particular source of supply which, because of the nature of the activity or the amount of water required, would constitute an undesirable use for which the governing board may deny a permit.

(5) The governing board may designate certain uses in connection with a particular source of supply which, because of the nature of the activity or the amount of water required, would result in an enhancement or improvement of the water resources of the area. Such uses shall be preferred over other uses in the event of competing applications under the permitting systems authorized by this chapter.

(6) The department, in cooperation with the Executive Office of the Governor, or its successor agency, may add to the Florida water plan any other information, directions, or objectives it deems necessary or desirable for the guidance of the governing boards or other agencies in the administration and enforcement of this chapter.

History.--s. 6, part I, ch. 72-299; ss. 2, 3, ch. 73-190; s. 122, ch. 79-190; s. 3, ch. 97-160; s. 7, ch. 98-88.

373.0361 Regional water supply planning.--

(1) By October 1, 1998, the governing board shall initiate water supply planning for each water supply planning region identified in the district water management plan under s. 373.036, where it determines that sources of water are not adequate for the planning period to supply water for all existing and projected reasonable-beneficial uses and to sustain the water resources and related natural systems. The planning must be conducted in an open public process, in coordination and cooperation with local governments, regional water supply authorities, government-owned and privately owned water utilities, self-suppliers, and other affected and interested parties. A determination by the governing board that initiation of a regional water supply plan for a specific planning region is not needed pursuant to this section shall be subject to s. 120.569. The governing

board shall reevaluate such a determination at least once every 5 years and shall initiate a regional water supply plan, if needed, pursuant to this subsection.

(2) Each regional water supply plan shall be based on at least a 20-year planning period and shall include, but not be limited to:

(a) A water supply development component that includes:

1. A quantification of the water supply needs for all existing and reasonably projected future uses within the planning horizon. The level-of-certainty planning goal associated with identifying the water supply needs of existing and future reasonable-beneficial uses shall be based upon meeting those needs for a 1-in-10-year drought event.
2. A list of water source options for water supply development, including traditional and alternative sources, from which local government, government-owned and privately owned utilities, self-suppliers, and others may choose, which will exceed the needs identified in subparagraph 1.
3. For each option listed in subparagraph 2., the estimated amount of water available for use and the estimated costs of and potential sources of funding for water supply development.
4. A list of water supply development projects that meet the criteria in s. 373.0831(4).

(b) A water resource development component that includes:

1. A listing of those water resource development projects that support water supply development.
2. For each water resource development project listed:
   a. An estimate of the amount of water to become available through the project.
   b. The timetable for implementing or constructing the project and the estimated costs for implementing, operating, and maintaining the project.
   c. Sources of funding and funding needs.
   d. Who will implement the project and how it will be implemented.

(c) The recovery and prevention strategy described in s. 373.0421(2).

(d) A funding strategy for water resource development projects, which shall be reasonable and sufficient to pay the cost of constructing or implementing all of the listed projects.

(e) Consideration of how the options addressed in paragraphs (a) and (b) serve the public interest or save costs overall by preventing the loss of natural resources or avoiding greater future expenditures for water resource development or water supply development. However, unless adopted by rule, these considerations do not constitute final agency action.

(f) The technical data and information applicable to the planning region which are contained in the district water management plan and are necessary to support the regional water supply plan.

(g) The minimum flows and levels established for water resources within the planning region.

(3) Regional water supply plans initiated or completed by July 1, 1997, shall be revised, if necessary, to include a water supply development component and a water resource development component as described in paragraphs (2)(a) and (b).

(4) Governing board approval of a regional water supply plan shall not be subject to the rulemaking requirements of chapter 120. However, any portion of an approved regional water supply plan which affects the substantial interests of a party shall be subject to s. 120.569.

(5) By November 15, 1997, and annually thereafter, the department shall submit to the Governor and the Legislature a report on the status of regional water supply planning in each district. The report shall include:

(a) A compilation of the estimated costs of and potential sources of funding for water resource development and water supply development projects, as identified in the water management district regional water supply plans.

(b) A description of each district's progress toward achieving its water resource development objectives, as directed by s. 373.0831(3), including the district's implementation of its 5-year water resource development work program.

(6) Nothing contained in the water supply development component of the district water management plan shall be construed to require local governments, government-owned or privately owned water utilities, self-suppliers, or other water suppliers to select a water supply development option identified in the component merely because it is identified in the plan. However, this subsection shall not be construed to limit the authority of the department or governing board under part II.

History.--s. 4, ch. 97-160.

373.0391 Technical Assistance to Local Governments

(1) The water management districts shall assist local governments in the development and future revision of local government comprehensive plan elements or public facilities report as required by s. 189.415, related to water resource issues.

(2) By July 1, 1991, each water management district shall prepare and provide information and data to assist local governments in the preparation and implementation of their local government comprehensive plans or public facilities report as required by s. 189.415, whichever is applicable. Such information and data shall include, but not be limited to:

(a) All information and data required in a public facilities report pursuant to s. 189.415.

(b) A description of regulations, programs, and schedules implemented by the district.

(c) Identification of regulations, programs, and schedules undertaken or proposed by the district to further the State Comprehensive Plan.

(d) A description of surface water basins, including regulatory jurisdictions, flood-prone areas, existing and projected water quality in water management district operated facilities, as well as surface water runoff characteristics and topography regarding flood plains, wetlands, and recharge areas.

(e) A description of ground water characteristics, including existing and planned wellfield sites, existing and anticipated cones of influence, highly productive ground water areas, aquifer recharge areas, deep well injection zones, contaminated areas, an assessment of regional water resource needs and sources for the next 20 years, and water quality.

(f) The identification of existing and potential water management district land acquisitions.

(g) Information reflecting the minimum flows for surface watercourses to avoid harm to water resources or the ecosystem and information reflecting the minimum water levels for aquifers to avoid harm to water resources or the ecosystem.

History.--s. 55, ch. 89-169; s. 8, ch. 89-279.

373.0395 Ground water basin resource availability inventory.—

Each water management district shall develop a ground water basin resource availability inventory covering those areas deemed appropriate by the governing board. This inventory shall include, but not be limited to, the following:

(1) A hydrogeologic study to define the ground water basin and its associated recharge areas.

(2) Site specific areas in the basin deemed prone to contamination or overdraft resulting from current or projected development.

(3) Prime ground water recharge areas.

(4) Criteria to establish minimum seasonal surface and ground water levels.

(5) Areas suitable for future water resource development within the ground water basin.

(6) Existing sources of wastewater discharge suitable for reuse as well as the feasibility of integrating coastal wellfields.

(7) Potential quantities of water available for consumptive uses.

Upon completion, a copy of the ground water basin availability inventory shall be submitted to each affected municipality, county, and regional planning agency. This inventory shall be reviewed by the affected municipalities, counties, and regional planning agencies for consistency with the local government comprehensive plan and shall be considered in future revisions of such plan. It is the intent of the Legislature that future growth and development planning reflect the limitations of the available ground water or other available water supplies.

History.--s. 6, ch. 82-101.

373.0397 Floridan and Biscayne aquifers; designation of prime ground water recharge areas.—

Upon preparation of an inventory of prime ground water recharge areas for the Floridan or Biscayne aquifers as a part of the requirements of s. 373.0395(3), but prior to adoption by the governing board, the water management district shall publish a legal notice of public hearing on the designated areas for the Floridan and Biscayne aquifers, with a map delineating the boundaries of the areas, in newspapers defined in chapter 50 as having general circulation within the area to be affected. The notice shall be at least one-fourth page andhall read as follows:

NOTICE OF PRIME RECHARGE AREA DESIGNATION

The (name of taxing authority) proposes to designate specific land areas as areas of prime recharge to the (name of aquifer) Aquifer.

All concerned citizens are invited to attend a public hearing on the proposed designation to be held on (date and time) at (meeting place).

A map of the affected areas follows.

The governing board of the water management district shall adopt a designation of prime ground water recharge areas to the Floridan and Biscayne aquifers by rule within 120 days after the public hearing, subject to the provisions of chapter 120.

History.--s. 2, ch. 85-42.

373.042 Minimum Flows and Levels

(1) Within each section, or the water management district as a whole, the department or the governing board shall establish the following:
   - (a) Minimum flow for all surface watercourses in the area. The minimum flow for a given watercourse shall be the limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area.
   - (b) Minimum water level. The minimum water level shall be 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 of the area.

The minimum flow and minimum water level shall be calculated by the department and the governing board using the best information available. When appropriate, minimum flows and levels may be calculated to reflect seasonal variations. The department and the governing board shall also consider, and at their discretion may provide for, the protection of nonconsumptive uses in the establishment of minimum flows and levels.

(4)

(a) Upon written request to the department or governing board by a substantially affected person, or by decision of the department or governing board, prior to the establishment of a minimum flow or level and prior to the filing of any petition for administrative hearing related to the minimum flow or level, all scientific or technical data, methodologies, and models, including all scientific and technical assumptions employed in each model, used to establish a minimum flow or level shall be subject to independent scientific peer review. Independent scientific peer review means review by a panel of independent, recognized experts in the fields of hydrology, hydrogeology, limnology, biology, and other scientific disciplines, to the extent relevant to the establishment of the minimum flow or level.

(b) If independent scientific peer review is requested, it shall be initiated at an appropriate point agreed upon by the department or governing board and the person or persons requesting the peer review. If no agreement is reached, the department or governing board shall determine the appropriate point at which to initiate peer review. The members of the peer review panel shall be selected within 60 days of the point of initiation by agreement of the department or governing board and the person or persons requesting the peer review. If the panel is not selected within the 60-day period, the time limitation may be waived upon the agreement of all parties. If no waiver occurs, the department or governing board may proceed to select the peer review panel. The cost of the peer review shall be borne equally by the district and each party requesting the peer review, to the extent economically feasible. The panel shall submit a final report to the governing board within 120 days after its selection unless the deadline is waived by agreement of all parties. Initiation of peer review pursuant to this paragraph shall toll any applicable deadline under chapter 120 or other law or district rule regarding permitting, rulemaking, or administrative hearings, until 60 days following submittal of the final report. Any such deadlines shall also be tolled for 60 days following withdrawal of the request or following agreement of the parties that peer review will no longer be pursued. The department or the governing board shall give significant weight to the final report of the peer review panel when establishing the minimum flow or level.

(c) If the final data, methodologies, and models, including all scientific and technical assumptions employed in each model upon which a minimum flow or level is based, have undergone peer review pursuant to this subsection, by request or by decision of the department or governing board, no further peer review shall be required with respect to that minimum flow or level.

(d) No minimum flow or level adopted by rule or formally noticed for adoption on or before May 2, 1997, shall be subject to the peer review provided for in this subsection.

(5) If a petition for administrative hearing is filed under chapter 120 challenging the establishment of a minimum flow or level, the report of an independent scientific peer review conducted under subsection (4) is admissible as evidence in the final hearing, and the administrative law judge must render the order within 120 days after the filing of the petition. The time limit for rendering the order shall not be extended except by agreement of all the parties. To the extent that the parties agree to the findings of the peer review, they may stipulate that those findings be incorporated as findings of fact in the final order.

History.--s. 6, part I, ch. 72-299; s. 2, ch. 73-190; s. 2, ch. 96-339; s. 5, ch. 97-160.

373.0421 Establishment and implementation of minimum flows and levels.--

(1) ESTABLISHMENT.--

(a) Considerations.--When establishing minimum flows and levels pursuant to s. 373.042, the department or governing board shall consider changes and structural alterations to watersheds, surface waters, and aquifers and the effects such changes or alterations have had, and the constraints such changes or alterations have placed, on the hydrology of an affected watershed, surface water, or aquifer, provided that nothing in this paragraph shall allow significant harm as provided by s. 373.042(1) caused by withdrawals.

(b) Exclusions.--

1. The Legislature recognizes that certain water bodies no longer serve their historical hydrologic functions. The Legislature also recognizes that recovery of these water bodies to historical hydrologic conditions may not be economically or technically feasible, and that such recovery effort could cause adverse environmental or hydrologic impacts. Accordingly, the department or governing board may determine that setting a minimum flow or level for such a water body based on its historical condition is not appropriate.
2. The department or the governing board is not required to establish minimum flows or levels pursuant to s. 373.042 for surface water bodies less than 25 acres in area, unless the water body or bodies, individually or cumulatively, have significant economic, environmental, or hydrologic value.
3. The department or the governing board shall not set minimum flows or levels pursuant to s. 373.042 for surface water bodies constructed prior to the requirement for a permit, or pursuant to an exemption, a permit, or a reclamation plan which regulates the size, depth, or function of the surface water body under the provisions of this chapter, chapter 378, or chapter 403, unless the constructed surface water body is of significant

hydrologic value or is an essential element of the water resources of the area.

The exclusions of this paragraph shall not apply to the Everglades Protection Area, as defined in s. 373.4592(2)(h).

(2) If the existing flow or level in a water body is below, or is projected to fall within 20 years below, the applicable minimum flow or level established pursuant to s. 373.042, the department or governing board, as part of the regional water supply plan described in s. 373.036[1], shall expeditiously implement a recovery or prevention strategy, which includes the development of additional water supplies and other actions, consistent with the authority granted by this chapter, to:

(a) Achieve recovery to the established minimum flow or level as soon as practicable; or

(b) Prevent the existing flow or level from falling below the established minimum flow or level.

The recovery or prevention strategy shall include phasing or a timetable which will allow for the provision of sufficient water supplies for all existing and projected reasonable-beneficial uses, including development of additional water supplies and implementation of conservation and other efficiency measures concurrent with, to the extent practical, and to offset, reductions in permitted withdrawals, consistent with the provisions of this chapter.

(3) The provisions of this section are supplemental to any other specific requirements or authority provided by law. Minimum flows and levels shall be reevaluated periodically and revised as needed.

History.--s. 6, ch. 97-160.

[1]Note.--Former s. 378.16.

373.0831 Water resource development; water supply development.--

(1) The Legislature finds that:

(a) The proper role of the water management districts in water supply is primarily planning and water resource development, but this does not preclude them from providing assistance with water supply development.

(b) The proper role of local government, regional water supply authorities, and government-owned and privately owned water utilities in water supply is primarily water supply development, but this does not preclude them from providing assistance with water resource development.

(c) Water resource development and water supply development must receive priority attention, where needed, to increase the availability of sufficient water for all existing and future reasonable-beneficial uses and natural systems.

(2) It is the intent of the Legislature that:

(a) Sufficient water be available for all existing and future reasonable-beneficial uses and the natural systems, and that the adverse effects of competition for water supplies be avoided.

(b) Water management districts take the lead in identifying and implementing water resource development projects, and be responsible for securing necessary funding for regionally significant water resource development projects.

(c) Local governments, regional water supply authorities, and government-owned and privately owned water utilities take the lead in securing funds for and implementing water supply development projects. Generally, direct beneficiaries of water supply development projects should pay the costs of the projects from which they benefit, and water supply development projects should continue to be paid for through local funding sources.

(d) Water supply development be conducted in coordination with water management district regional water supply planning and water resource development.

(3) The water management districts shall fund and implement water resource development as defined in s. 373.019. Each governing board shall include in its annual budget the amount needed for the fiscal year to implement water resource development projects, as prioritized in its regional water supply plans.

(4)

(a) Water supply development projects which are consistent with the relevant regional water supply plans and which meet one or more of the following criteria shall receive priority consideration for state or water management district funding assistance:

1. The project supports establishment of a dependable, sustainable supply of water which is not otherwise financially feasible;
2. The project provides substantial environmental benefits by preventing or limiting adverse water resource impacts, but requires funding assistance to be economically competitive with other options; or
3. The project significantly implements reuse, storage, recharge, or conservation of water in a manner that contributes to the sustainability of regional water sources.

(b) Water supply development projects which meet the criteria in paragraph (a) and also bring about replacement of existing sources in order to help implement a minimum flow or level shall be given first consideration for state or water management district funding assistance.

History.--s. 11, ch. 97-160.

373.086 Providing for District Works

(1) In order to carry out the works for the district, and for effectuating the purposes of this chapter, the governing board is authorized to clean out, straighten,

enlarge, or change the course of any waterway, natural or artificial, within or without the district; to provide such canals, levees, dikes, dams, sluiceways, reservoirs, holding basins, floodways, pumping stations, bridges, highways, and other works and facilities which the board may deem necessary; to establish, maintain, and regulate water levels in all canals, lakes, rivers, channels, reservoirs, streams, or other bodies of water owned or maintained by the district; to cross any highway or railway with works of the district and to hold, control, and acquire by donation, lease, or purchase, or to condemn any land, public or private, needed for rights-of-way or other purposes, and may remove any building or other obstruction necessary for the construction, maintenance, and operation of the works; and to hold and have full control over the works and rights-of-way of the district.

(2) The works of the district shall be those adopted by the governing board of the district. The district may require or take over for operation and maintenance such works of other districts as the governing board may deem advisable under agreement with such districts.

(3)

(a) Notwithstanding the provisions of chapter 120, the temporary construction, operation, or maintenance of water supply backpumping facilities to be used for storage of surplus water shall not require a permit under this chapter, chapter 253, or chapter 403 from the Department of Environmental Protection if the governing board issues an order declaring a water emergency which order is approved by the Secretary of Environmental Protection. Such approval may be given by telephone and confirmed by appropriate order at a later date. The temporary construction, operation, or maintenance of the facilities shall cease when the governing board or the secretary issues an order declaring that the emergency no longer exists. If the district intends to operate any such facilities permanently under nonemergency conditions, it shall apply for the appropriate required permits from the Department of Environmental Protection within 30 days of rescinding the emergency order.

(b) Notwithstanding the provisions of chapter 120, emergency orders issued pursuant to this subsection shall be valid for a period of 90 days and may be renewed for a single 90-day period.

History.--s. 16, ch. 25209, 1949; s. 2, ch. 29790, 1955; s. 1, ch. 61-147; s. 3, ch. 61-497; s. 2, ch. 63-224; s. 1, ch. 67-206; s. 1, part VI, ch. 72-299; s. 25, ch. 73-190; s. 1, ch. 82-46; s. 4, ch. 82-101; s. 25, ch. 88-242; ss. 1, 2, ch. 89-279; ss. 11, 12, ch. 90-217; s. 255, ch. 94-356.

373.087 District works using aquifer for storage and supply.—

The governing board may establish works of the district for the purpose of introducing water into, or drawing water from, the underlying aquifer for storage or supply. However, only water of a compatible quality shall be introduced directly into such aquifer.

History.--s. 1, ch. 72-318; s. 1, ch. 82-46; s. 25, ch. 88-242; ss. 1, 2, ch. 89-279; ss. 11, 12, ch. 90-217.

373.106 Permit Required for Construction Involving Underground Formation

1) No construction may be begun on a project involving artificial recharge or the intentional introduction of water into any underground formation except as permitted in chapter 377, without the written permission of the governing board of any water management district within which the construction will take place. Such application shall contain the detailed plans and specifications for the construction of the project.

2) Each water management district has the exclusive authority to process and issue permits under this section and permits and licenses delegated under s. 403.812, except permits required by the department pursuant to 42 U.S.C. s. 300h until delegated by the department to the districts.

(3) A water management district may do any act necessary to replenish the ground water of the district. The district may, among other things, for the purposes of replenishing the ground water supplies within the district:

   (a) Buy water;

   (b) Exchange water;

   (c) Distribute water to persons in exchange for ceasing or reducing ground water extractions;

   (d) Spread, sink, and inject water into the underground;

   (e) Store, transport, recapture, reclaim, purify, treat, or otherwise manage and control water for the beneficial use of persons or property within the district; and

   (f) Build the necessary works to achieve ground water replenishment.

History.--s. 18, part I, ch. 72-299; s. 14, ch. 78-95; s. 71, ch. 83-310; s. 2, ch. 84-338; s. 1, ch. 84-341.

373.171 Rules and Regulations

(1) In order to obtain the most beneficial use of the water resources of the state and to protect the public health, safety, and welfare and the interests of the water users affected, governing boards, by action not inconsistent with the other provisions of this law and without impairing property rights, may:

(a) Establish rules, regulations, or orders affecting the use of water, as conditions warrant, and forbidding the construction of new diversion facilities or wells, the initiation of new water uses, or the modification of any existing uses, diversion facilities, or storage facilities within the affected area.

(b) Regulate the use of water within the affected area by apportioning, limiting, or rotating uses of water or by preventing those uses which the governing board finds have ceased to be reasonable or beneficial.

(c) Make other rules, regulations, and orders necessary for the preservation of the interests of the public and of affected water users.

(2) In promulgating rules and regulations and issuing orders under this law, the governing board shall act with a view to full protection of the existing rights to water in this state insofar as is consistent with the purpose of this law.

(3) No rule, regulation or order shall require any modification of existing use or disposition of water in the district unless it is shown that the use or disposition proposed to be modified is detrimental to other water users or to the water resources of the state.

(4) All rules and regulations adopted by the governing board shall be filed with the Department of State as provided in chapter 120. An information copy will be filed with the Department of Environmental Protection.

History.--s. 11, ch. 57-380; s. 8, ch. 63-336; ss. 10, 25, 35, ch. 69-106; s. 8, ch. 76-243; s. 1, ch. 77-117; s. 14, ch. 78-95; s. 256, ch. 94-356.

373.175 Declaration of Water Shortage; Emergency Orders[1]

(1) The governing board of the district may by order declare that a water shortage exists within all or part of the district when insufficient ground or surface water is available to meet the needs of the users or when conditions are such as to require temporary reduction in total use within the area to protect water resources from serious harm.

(2) The governing board may impose such restrictions on one or more users of the water resource as may be necessary to protect the water resources of the area from serious harm.

(3) When a water shortage is declared, the governing board shall cause notice thereof to be published in a prominent place within a newspaper of general circulation throughout the area. Publication of such notice shall serve as notice to all users in the area of the condition of water shortage.

(4) If an emergency condition exists due to a water shortage within any area of the district and the executive director of the district, with the concurrence of the governing board, finds that the exercise of powers under this section is not sufficient to protect the public health, safety, or welfare, the health of animals, fish, or aquatic life, a public water supply, or recreational, commercial, industrial, agricultural, or other reasonable uses, the executive director may, pursuant to the provisions of chapter 120, issue emergency orders reciting the

existence of such an emergency and requiring that such action, including, but not limited to, apportioning, rotating, limiting, or prohibiting the use of the water resources of the district, be taken as the executive director, with the concurrence of the governing board, deems necessary to meet the emergency.

History.--s. 1, ch. 72-730; s. 25, ch. 73-190; s. 1, ch. 73-295; s. 14, ch. 78-95; s. 35, ch. 83-218; s. 597, ch. 95-148.

[1]Note.--Former s. 378.152.

373.185 Local Xeriscape ordinances.--

1) As used in this section, the term:

(a) "Local government" means any county or municipality of the state.

(b) "Xeriscape" means a landscaping method that maximizes the conservation of water by the use of site-appropriate plants and an efficient watering system. The principles of Xeriscape include planning and design, appropriate choice of plants, soil analysis which may include the use of solid waste compost, efficient irrigation, practical use of turf, appropriate use of mulches, and proper maintenance.

(2) Each water management district shall design and implement an incentive program to encourage all local governments within its district to adopt new ordinances or amend existing ordinances to require Xeriscape landscaping for development permitted after the effective date of the new ordinance or amendment. Each district shall adopt rules governing the implementation of its incentive program and governing the review and approval of local government Xeriscape ordinances or amendments which are intended to qualify a local government for the incentive program. Each district shall assist the local governments within its jurisdiction by providing a model Xeriscape code and other technical assistance. A local government Xeriscape ordinance or amendment, in order to qualify the local government for a district's incentive program, must include, at a minimum:

(a) Landscape design, installation, and maintenance standards that result in water conservation. Such standards shall address the use of plant groupings, soil analysis including the promotion of the use of solid waste compost, efficient irrigation systems, and other water-conserving practices.

(b) Identification of prohibited invasive exotic plant species.

(c) Identification of controlled plant species, accompanied by the conditions under which such plants may be used.

(d) A provision specifying the maximum percentage of turf and the maximum percentage of impervious surfaces allowed in a xeriscaped area and addressing the practical selection and installation of turf.

(e) Specific standards for land clearing and requirements for the preservation of existing native vegetation.

(f) A monitoring program for ordinance implementation and compliance.

The districts also shall work with local governments to promote, through educational programs and publications, the use of Xeriscape practices, including the use of solid waste compost, in existing residential and commercial development. This section may not be construed to limit the authority of the districts to require Xeriscape ordinances or practices as a condition of any consumptive use permit.

History.--s. 3, ch. 91-41; s. 3, ch. 91-68.

373.191 County water conservation projects.—

The several counties of the state may cooperate with the division[1] by engaging in county water development and conservation projects and may use county funds and equipment for this purpose and to do all other things necessary in connection with the development and conservation of the county’s water resources consistent with the provisions of this law and the rules and regulations adopted pursuant thereto.

History.--s. 13, ch. 57-380; ss. 25, 35, ch. 69-106.

[1]Note.--Former s. 373.081(1), which defined the word"division" as the Division of Interior Resources of the Department of Natural Resources, was repealed by s. 1, pt. VI, ch. 72-299.

373.196 Legislative findings.--

(1) It is the finding of the Legislature that cooperative efforts between municipalities, counties, water management districts, and the Department of Environmental Protection are mandatory in order to meet the water needs of rapidly urbanizing areas in a manner which will supply adequate and dependable supplies of water where needed without resulting in adverse effects upon the areas from whence such water is withdrawn. Such efforts should utilize all practical means of obtaining water, including, but not limited to, withdrawals of surface water and ground water, recycling of waste water, and desalinization, and will necessitate not only cooperation but also well-coordinated activities. The purpose of this act is to provide additional statutory authority for such cooperative and coordinated efforts.

(2) Municipalities and counties are encouraged to create regional water supply authorities as authorized herein. It is further the intent that municipalities, counties, and regional water supply authorities are to have the primary responsibility for water supply, and water management districts and their basin boards are to engage only in those functions that are incidental to the exercise of their flood control and water management powers or that are related to water resource development pursuant to s. 373.0831.

(3) Nothing herein shall be construed to preclude the various municipalities and counties from continuing to operate existing water production and transmission facilities or to enter into cooperative agreements with other municipalities and counties for the purpose of meeting their respective needs for dependable and

adequate supplies of water, provided the obtaining of water through such operations shall not be done in a manner which results in adverse effects upon the areas from whence such water is withdrawn.

History.--s. 1, ch. 74-114; s. 43, ch. 79-65; s. 257, ch. 94-356; s. ch. 98-88.

373.1961 Water production.--

(1) In the performance of, and in conjunction with, its other powers and duties, the governing board of a water management district existing pursuant to this chapter:

(a) Shall engage in planning to assist counties, municipalities, private utilities, or regional water supply authorities in meeting water supply needs in such manner as will give priority to encouraging conservation and reducing adverse environmental effects of improper or excessive withdrawals of water from concentrated areas. As used in this section, regional water supply authorities are regional water authorities created under s. 373.1962 or other laws of this state.

(b) Shall assist counties, municipalities, private utilities, or water supply authorities in meeting water supply needs in such manner as will give priority to encouraging conservation and reducing adverse environmental effects of improper or excessive withdrawals of water from concentrated areas.

(c) May establish, design, construct, operate, and maintain water production and transmission facilities for the purpose of supplying water to counties, municipalities, private utilities, or regional water supply authorities. The permit required by part II of this chapter for a water management district engaged in water production and transmission shall be granted, denied, or granted with conditions by the department.

(d) Shall not engage in local distribution.

(e) Shall not deprive, directly or indirectly, any county wherein water is withdrawn of the prior right to the reasonable and beneficial use of water which is required to supply adequately the reasonable and beneficial needs of the county or any of the inhabitants or property owners therein.

(f) May provide water and financial assistance to regional water supply authorities, but may not provide water to counties and municipalities which are located within the area of such authority without the specific approval of the authority or, in the event of the authority's disapproval, the approval of the Governor and Cabinet sitting as the Land and Water Adjudicatory Commission. The district may supply water at rates and upon terms mutually agreed to by the parties or, if they do not agree, as set by the governing board and specifically approved by the Governor and Cabinet sitting as the Land and Water Adjudicatory Commission.

(g) May acquire title to such interest as is necessary in real property, by purchase, gift, devise, lease, eminent domain, or otherwise, for water production and transmission consistent with this section. However, the district shall not use any of the eminent domain powers herein granted to acquire water and water rights already devoted to reasonable and beneficial use or any water production or transmission facilities owned by any county, municipality, or regional water supply authority. The district may exercise eminent domain powers outside of its district boundaries for the acquisition of pumpage facilities, storage areas, transmission facilities, and the normal appurtenances thereto, provided that at least 45 days prior to the exercise of eminent domain, the district notifies the district where the property is located after public notice and the district where the property is located does not object within 45 days after notification of such exercise of eminent domain authority.

(h) In addition to the power to issue revenue bonds pursuant to s. 373.584, may issue revenue bonds for the purposes of paying the costs and expenses incurred in carrying out the purposes of this chapter or refunding obligations of the district issued pursuant to this section. Such revenue bonds shall be secured by, and be payable from, revenues derived from the operation, lease, or use of its water production and transmission facilities and other water-related facilities and from the sale of water or services relating thereto. Such revenue bonds may not be secured by, or be payable from, moneys derived by the district from the Water Management Lands Trust Fund or from ad valorem taxes received by the district. All provisions of s. 373.584 relating to the issuance of revenue bonds which are not inconsistent with this section shall apply to the issuance of revenue bonds pursuant to this section. The district may also issue bond anticipation notes in accordance with the provisions of s. 373.584.

(i) May join with one or more other water management districts, counties, municipalities, private utilities, or regional water supply authorities for the purpose of carrying out any of its powers, and may contract with such other entities to finance acquisitions, construction, operation, and maintenance. The contract may provide for contributions to be made by each party thereto, for the division and apportionment of the expenses of acquisitions, construction, operation, and maintenance, and for the division and apportionment of the benefits, services, and products therefrom. The contracts may contain other covenants and agreements necessary and appropriate to accomplish their purposes.

(2) The Legislature finds that, due to a combination of factors, vastly increased demands have been placed on natural supplies of fresh water, and that, absent increased development of alternative water supplies, such demands may increase in the future. The Legislature also finds that potential exists in the state for the production of significant quantities of alternative water supplies, including reclaimed water, and that water production includes the development of alternative water supplies, including reclaimed water, for appropriate uses. It is the intent of the Legislature that utilities develop reclaimed water systems, where reclaimed water is the most appropriate alternative water supply option, to deliver reclaimed water to as many users as possible through the most cost-effective means, and to construct reclaimed water system infrastructure to their owned or operated properties and facilities where they have reclamation

capability. It is also the intent of the Legislature that the water management districts which levy ad valorem taxes for water management purposes should share a percentage of those tax revenues with water providers and users, including local governments, water, wastewater, and reuse utilities, municipal, industrial, and agricultural water users, and other public and private water users, to be used to supplement other funding sources in the development of alternative water supplies. The Legislature finds that public moneys or services provided to private entities for such uses constitute public purposes which are in the public interest. In order to further the development and use of alternative water supply systems, including reclaimed water systems, the Legislature provides the following:

(a) The governing boards of the water management districts where water resource caution areas have been designated shall include in their annual budgets an amount for the development of alternative water supply systems, including reclaimed water systems, pursuant to the requirements of this subsection. Beginning in 1996, such amounts shall be made available to water providers and users no later than December 31 of each year, through grants, matching grants, revolving loans, or the use of district lands or facilities pursuant to the requirements of this subsection and guidelines established by the districts.

(b) It is the intent of the Legislature that for each reclaimed water utility, or any other utility, which receives funds pursuant to this subsection, the appropriate rate-setting authorities should develop rate structures for all water, wastewater, and reclaimed water and other alternative water supply utilities in the service area of the funded utility, which accomplish the following:

1. Provide meaningful progress toward the development and implementation of alternative water supply systems, including reclaimed water systems;
2. Promote the conservation of fresh water withdrawn from natural systems;
3. Provide for an appropriate distribution of costs for all water, wastewater, and alternative water supply utilities, including reclaimed water utilities, among all of the users of those utilities; and
4. Prohibit rate discrimination within classes of utility users.

(c) In order to be eligible for funding pursuant to this subsection, a project must be consistent with a local government comprehensive plan and the governing body of the local government must require all appropriate new facilities within the project's service area to connect to and use the project's alternative water supplies. The appropriate local government must provide written notification to the appropriate district that the proposed project is consistent with the local government comprehensive plan.

(d) Any and all revenues disbursed pursuant to this subsection shall be applied only for the payment of capital or infrastructure costs for the construction of alternative water supply systems that provide alternative water supplies for uses within one or more water resource caution areas.

(e) By January 1 of each year, the governing boards shall make available written guidelines for the disbursal of revenues pursuant to this subsection. Such guidelines shall include at minimum:

1. An application process and a deadline for filing applications annually.
2. A process for determining project eligibility pursuant to the requirements of paragraphs (c) and (d).
3. A process and criteria for funding projects pursuant to this subsection that cross district boundaries or that serve more than one district.

(f) The governing board of each water management district shall establish an alternative water supplies grants advisory committee to recommend to the governing board projects for funding pursuant to this subsection. The advisory committee members shall include, but not be limited to, one or more representatives of county, municipal, and investor-owned private utilities, and may include, but not be limited to, representatives of agricultural interests and environmental interests. Each committee member shall represent his or her interest group as a whole and shall not represent any specific entity. The committee shall apply the guidelines and project eligibility criteria established by the governing board in reviewing proposed projects. After one or more hearings to solicit public input on eligible projects, the committee shall rank the eligible projects and shall submit them to the governing board for final funding approval. The advisory committee may submit to the governing board more projects than the available grant money would fund.

(g) All revenues made available annually pursuant to this subsection must be disbursed annually by the governing board if it approves projects sufficient to expend the available revenues.

(h) For purposes of this subsection, alternative water supplies are supplies of water that have been reclaimed after one or more public supply, municipal, industrial, commercial, or agricultural uses, or are supplies of stormwater, or brackish or salt water, that have been treated in accordance with applicable rules and standards sufficient to supply the intended use.

(i) This subsection shall not be subject to the rulemaking requirements of chapter 120.

(j) By January 30 of each year, each water management district shall submit an annual report to the Governor, the President of the Senate, and the Speaker of the House of Representatives which accounts for the disbursal of all budgeted amounts pursuant to this subsection. Such report shall describe all projects funded and shall account separately for moneys provided through grants, matching grants, revolving loans, and the use of district lands or facilities.

History.--s. 2, ch. 74-114; s. 14, ch. 76-243; s. 7, ch. 82-101; s. 2, ch. 87-347; s. 7, ch. 95-323.

373.1962 Regional water supply authorities.--

(1) By agreement between local governmental units created or existing pursuant to the provisions of Art. VIII of the State Constitution, pursuant to the Florida Interlocal Cooperation Act of 1969, s. 163.01, and upon the approval of the Secretary of Environmental Protection to ensure that such agreement will be in the public interest and complies with the intent and purposes of this act, regional water supply authorities may be created for the purpose of developing, recovering, storing, and supplying water for county or municipal purposes in such a manner as will give priority to reducing adverse environmental effects of excessive or improper withdrawals of water from concentrated areas. In approving said agreement the Secretary of Environmental Protection shall consider, but not be limited to, the following:

(a) Whether the geographic territory of the proposed authority is of sufficient size and character to reduce the environmental effects of improper or excessive withdrawals of water from concentrated areas.

(b) The maximization of economic development of the water resources within the territory of the proposed authority.

(c) The availability of a dependable and adequate water supply.

(d) The ability of any proposed authority to design, construct, operate, and maintain water supply facilities in the locations, and at the times necessary, to ensure that an adequate water supply will be available to all citizens within the authority.

(e) The effect or impact of any proposed authority on any municipality, county, or existing authority or authorities.

(f) The existing needs of the water users within the area of the authority.

(2) In addition to other powers and duties agreed upon, and notwithstanding the provisions of s. 163.01, such authority may:

(a) Upon approval of the electors residing in each county or municipality within the territory to be included in any authority, levy ad valorem taxes, not to exceed 0.5 mill, pursuant to s. 9(b), Art. VII of the State Constitution. No tax authorized by this paragraph shall be levied in any county or municipality without an affirmative vote of the electors residing in such county or municipality.

(b) Acquire water and water rights; develop, store, and transport water; provide, sell and deliver water for county or municipal uses and purposes; provide for the furnishing of such water and water service upon terms and conditions and at rates which will apportion to parties and nonparties an equitable share of the capital cost and operating expense of the authority's work to the purchaser.

(c) Collect, treat, and recover wastewater.

(d) Not engage in local distribution.

(e) Exercise the power of eminent domain in the manner provided by law for the condemnation of private property for public use to acquire title to such interest in real property as is necessary to the exercise of the powers herein granted, except water and water rights already devoted to reasonable and beneficial use or any water production or transmission facilities owned by any county or municipality.

(f) Issue revenue bonds in the manner prescribed by the Revenue Bond Act of 1953, as amended, part I, chapter 159, to be payable solely from funds derived from the sale of water by the authority to any county or municipality. Such bonds may be additionally secured by the full faith and credit of any county or municipality, as provided by s. 159.16 or by a pledge of excise taxes, as provided by s. 159.19. For the purpose of issuing revenue bonds, an authority shall be considered a "unit" as defined in s. 159.02(2) and as that term is used in the Revenue Bond Act of 1953, as amended. Such bonds may be issued to finance the cost of acquiring properties and facilities for the production and transmission of water by the authority to any county or municipality, which cost shall include the acquisition of real property and easements therein for such purposes. Such bonds may be in the form of refunding bonds to take up any outstanding bonds of the authority or of any county or municipality where such outstanding bonds are secured by properties and facilities for production and transmission of water, which properties and facilities are being acquired by the authority. Refunding bonds may be issued to take up and refund all outstanding bonds of said authority that are subject to call and termination, and all bonds of said authority that are not subject to call or redemption, when the surrender of said bonds can be procured from the holder thereof at prices satisfactory to the authority. Such refunding bonds may be issued at any time when, in the judgment of the authority, it will be to the best interest of the authority financially or economically by securing a lower rate of interest on said bonds or by extending the time of maturity of said bonds or, for any other reason, in the judgment of the authority, advantageous to said authority.

(g) Sue and be sued in its own name.

(h) Borrow money and incur indebtedness and issue bonds or other evidence of such indebtedness.

(i) Join with one or more other public corporations for the purpose of carrying out any of its powers and for that purpose to contract with such other public corporation or corporations for the purpose of financing such acquisitions, construction, and operations. Such contracts may provide for contributions to be made by each party thereto, for the division and apportionment of the expenses of such acquisitions and operations, and for the division and apportionment of the benefits, services, and products therefrom. Such contract may contain such other and further covenants and agreements as may be necessary and convenient to accomplish the purposes hereof.

(3) A regional water supply authority is authorized to develop, construct, operate, maintain, or contract for alternative sources of potable water, including desalinated water, and pipelines to interconnect authority sources and facilities, either by itself or jointly with a water management district; however, such

alternative potable water sources, facilities, and pipelines may also be privately developed, constructed, owned, operated, and maintained, in which event an authority and a water management district are authorized to pledge and contribute their funds to reduce the wholesale cost of water from such alternative sources of potable water supplied by an authority to its member governments.

(4) When it is found to be in the public interest, for the public convenience and welfare, for a public benefit, and necessary for carrying out the purpose of any regional water supply authority, any state agency, county, water control district existing pursuant to chapter 298, water management district existing pursuant to this chapter, municipality, governmental agency, or public corporation in this state holding title to any interest in land is hereby authorized, in its discretion, to convey the title to or dedicate land, title to which is in such entity, including tax-reverted land, or to grant use-rights therein, to any regional water supply authority created pursuant to this section. Land granted or conveyed to such authority shall be for the public purposes of such authority and may be made subject to the condition that in the event said land is not so used, or if used and subsequently its use for said purpose is abandoned, the interest granted shall cease as to such authority and shall automatically revert to the granting entity.

(5) Each county or municipality which is a party to an agreement pursuant to subsection (1) shall have a preferential right to purchase water from the regional water supply authority for use by such county or municipality.

(6) In carrying out the provisions of this section, any county wherein water is withdrawn by the authority shall not be deprived, directly or indirectly, of the prior right to the reasonable and beneficial use of water which is required adequately to supply the reasonable and beneficial needs of the county or any of the inhabitants or property owners therein.

(7) Upon a resolution adopted by the governing body of any county or municipality, the authority may, subject to a majority vote of its voting members, include such county or municipality in its regional water supply authority upon such terms and conditions as may be prescribed.

(8) The authority shall design, construct, operate, and maintain facilities in the locations and at the times necessary to ensure that an adequate water supply will be available to all citizens within the authority.

(9) Where a water supply authority exists pursuant to s. 373.1962 or s. 373.1963 under a voluntary interlocal agreement that is consistent with requirements in s. 373.1963(1)(b) and receives or maintains consumptive use permits under this voluntary agreement consistent with the water supply plan, if any, adopted by the governing board, such authority shall be exempt from consideration by the governing board or department of the factors specified in s. 373.223(3)(a)-(g) and the submissions required by s. 373.229(3). Such exemptions shall apply only

to water sources within the jurisdictional areas of such voluntary water supply interlocal agreements.

History.--s. 7, ch. 74-114; s. 1, ch. 77-174; s. 35, ch. 79-5; s. 1, ch. 86-22; s. 258, ch. 94-356; s. 29, ch. 97-160; s. 3, ch. 98-88.

Part II Permitting Consumptive Uses Water

373.207 Abandoned Artesian Well--

(1) Each water management district shall develop a work plan which identifies the location of all known abandoned artesian wells within its jurisdictional boundaries and defines the actions which the district must take in order to ensure that each such well is plugged on or before January 1, 1992. The work plan shall include the following:

(a) An initial inventory which accounts for all known abandoned artesian wells in the district.

(b) The location and owner of each known abandoned well.

(c) The methodology proposed by the district to accomplish the plugging of all known abandoned wells within the district on or before January 1, 1992.

(d) Data relating to costs to be incurred for the plugging of all wells, including the per-well cost and personnel costs.

(e) A schedule of priority for the plugging of wells, which schedule is established to mitigate damage to the ground water resource due to water quality degradation.

(2) Each water management district shall submit an annual update of its work plan to the Secretary of Environmental Protection by January 1 of each year, until all wells identified by the plan are plugged.

History.--s. 8, ch. 83-310; s. 263, ch. 94-356.

373.217 Superseded Laws and Regulations

(1) It is the intent of the Legislature to provide a means whereby reasonable programs for the issuance of permits authorizing the consumptive use of particular quantities of water may be authorized by the Department of Environmental Protection, subject to judicial review and also subject to review by the Governor and Cabinet, sitting as the Land and Water Adjudicatory Commission as provided in s. 373.114.

(2) It is the further intent of the Legislature that Part II of the Florida Water Resources Act of 1972, as amended, as set forth in ss. 373.203-373.249, shall provide the exclusive authority for requiring permits for the consumptive use of water and for authorizing transportation thereof pursuant to s. 373.223(2).

(3) If any provision of Part II of the Florida Water Resources Act of 1972, as amended, as set forth in ss. 373.203-373.249, is in conflict with any other

provision, limitation, or restriction which is now in effect under any law or ordinance of this state or any political subdivision or municipality, or any rule or regulation promulgated thereunder, Part II shall govern and control, and such other law or ordinance or rule or regulation promulgated thereunder shall be deemed superseded for the purpose of regulating the consumptive use of water. However, this section shall not be construed to supersede the provisions of the Florida Electrical Power Plant Siting Act.

(4) Other than as provided in subsection (3) of this section, Part II of the Florida Water Resources Act of 1972, as amended, preempts the regulation of the consumptive use of water as defined in this act.

History.--s. 9, ch. 76-243; s. 1, ch. 77-174; s. 265, ch. 94-356.

373.219 Permits required.--

(1) The governing board or the department may require such permits for consumptive use of water and may impose such reasonable conditions as are necessary to assure that such use is consistent with the overall objectives of the district or department and is not harmful to the water resources of the area. However, no permit shall be required for domestic consumption of water by individual users.

(2) In the event that any person shall file a complaint with the governing board or the department that any other person is making a diversion, withdrawal, impoundment, or consumptive use of water not expressly exempted under the provisions of this chapter and without a permit to do so, the governing board or the department shall cause an investigation to be made, and if the facts stated in the complaint are verified the governing board or the department shall order the discontinuance of the use.

History.--s. 2, part II, ch. 72-299; s. 9, ch. 73-190.

373.223 Conditions for a permit.--

(1) To obtain a permit pursuant to the provisions of this chapter, the applicant must establish that the proposed use of water:

(a) Is a reasonable-beneficial use as defined in s. 373.019[1];

(b) Will not interfere with any presently existing legal use of water; and

(c) Is consistent with the public interest.

(2) The governing board or the department may authorize the holder of a use permit to transport and use ground or surface water beyond overlying land, across county boundaries, or outside the watershed from which it is taken if the governing board or department determines that such transport and use is consistent with the public interest, and no local government shall adopt or enforce any law, ordinance, rule, regulation, or order to the contrary.

(3) Except for the transport and use of water supplied by the Central and Southern Florida Flood Control Project, and anywhere in the state when the transport and use of water is supplied exclusively for bottled water as defined in s. 500.03(1)(d), any water use permit applications pending as of April 1, 1998, with the Northwest Florida Water Management District and self-suppliers of water for which the proposed water source and area of use or application are located on contiguous private properties, when evaluating whether a potential transport and use of ground or surface water across county boundaries is consistent with the public interest, pursuant to subsection (1)(c), the governing board or department shall consider:

(a) The proximity of the proposed water source to the area of use or application.

(b) All impoundments, streams, groundwater sources, or watercources that are geographically closer to the area of use or application than the proposed source, and that are technically and economically feasible for the proposed transport and use.

(c) All economically and technically feasible alternatives to the proposed source, including, but not limited to, desalination, conservation, reuse of nonpotable reclaimed water and stormwater, and aquifer storage and recovery.

(d) The potential environmental impacts that may result from the transport and use of water from the proposed source, and the potential environmental impacts that may result from the use of other water sources identified in paragraphs (b) and (c).

(e) Whether existing and reasonably anticipated sources of water and conservation efforts are adequate to supply water for existing legal uses and reasonably anticipated future needs of the water supply planning region in which the proposed water source is located.

(f) Consultations with local governments affected by the proposed transport and use.

(g) The value of the existing capital investment in water-related infrastructure made by the applicant.

Where districtwide water supply assessments and regional water supply plans have been prepared pursuant to ss. 373.036 and 373.0361, the governing board or the department shall use the applicable plans and assessments as the basis for its consideration of the applicable factors in s. 373.223(3).

(4) The governing board or the department, by regulation, may reserve from use by permit applicants, water in such locations and quantities, and for such seasons of the year, as in its judgment may be required for the protection of fish and wildlife or the public health and safety. Such reservations shall be subject to periodic review and revision in the light of changed conditions. However, all presently

existing legal uses of water shall be protected so long as such use is not contrary to the public interest.

History.--s. 3, part II, ch. 72-299; s. 10, ch. 73-190; s. 10, ch. 76-243; s. 35, ch. 85-81; s. 4, ch. 98-88.

373.224 Existing Permits

Any permits or permit agreements for consumptive use of water executed or issued by an existing flood control, water management, or water regulatory district pursuant to this chapter or chapter 378 prior to December 31, 1976, shall remain in full force and effect in accordance with their terms until otherwise modified or revoked as authorized herein.

History.--s. 11, ch. 73-190; s. 3, ch. 75-125.

373.226 Existing uses.--

(1) All existing uses of water, unless otherwise exempted from regulation by the provisions of this chapter, may be continued after adoption of this permit system only with a permit issued as provided herein.

(2) The governing board or the department shall issue an initial permit for the continuation of all uses in existence before the effective date of implementation of this part if the existing use is a reasonable-beneficial use as defined in s. 373.019 and is allowable under the common law of this state.

(3) Application for permit under the provisions of subsection (2) must be made within a period of 2 years from the effective date of implementation of these regulations in an area. Failure to apply within this period shall create a conclusive presumption of abandonment of the use, and the user, if he or she desires to revive the use, must apply for a permit under the provisions of s. 373.229.

History.--s. 4, part II, ch. 72-299; s. 12, ch. 73-190; s. 598, ch. 95-148; s. 9, ch. 98-88.

[1]Note.--Substituted by the editors for a reference to s. 373.019(5) to conform to the redesignation of subunits by s. 37, ch. 79-65, and the further redesignation of subunits by s. 2, ch. 97-160.

373.2295 Interdistrict Transfers of Ground water

(1) As used in this section, “interdistrict transfer and use” means a consumptive water use which involves the withdrawal of ground water from a point within one water management district for use outside the boundaries of that district.

(2) To obtain a permit for an interdistrict transfer and use of ground water, an applicant must file an application in accordance with s. 373.229 with the water management district having jurisdiction over the area from which the applicant proposes to withdraw ground water and submit a copy of the application to the

water management district having jurisdiction over the area where the water is to be used.

(3) The governing board of the water management district where the ground water is proposed to be withdrawn shall review the application in accordance with this part, the rules of the district which relate to consumptive water use permitting, and other applicable provisions of this chapter.

(4) In determining if an application is consistent with the public interest as required by s. 373.223, the projected populations, as contained in the future land use elements of the comprehensive plans adopted pursuant to chapter 163 by the local governments within which the withdrawal areas and the proposed use areas are located, will be considered together with other evidence presented on future needs of those areas. If the proposed interdistrict transfer of ground water meets the requirements of this chapter, and if the needs of the area where the use will occur and the specific area from which the ground water will be withdrawn can be satisfied, the permit for the interdistrict transfer and use shall be issued.

(5) In addition to other requirements contained in this part, the water management district where the ground water is proposed to be withdrawn shall:

(a) Furnish copies of any application, information, correspondence, or other related material to the water management district having jurisdiction over the area where the water is to be used; and

(b) Request comments on the application and the future water needs of the proposed use area from the water management district having jurisdiction over the area where the water is to be used. If comments are received, they must be attached to the preliminary notice of intended agency action and may not create a point of entry for review whether issued by the governing board or district staff.

(6) Upon completion of review of the application, the water management district where the ground water is proposed to be withdrawn shall prepare a notice of preliminary intended agency action which shall include an evaluation of the application and a recommendation of approval, denial, or approval with conditions. The notice shall be furnished to the district where the water is to be used, the applicant, the Department of Environmental Protection, the local governments having jurisdiction over the area from which the ground water is to be withdrawn and where the water is to be used, and any person requesting a copy of the notice.

(a) Any interested person may, within the time specified in the notice, notify in writing the district from where the ground water is to be withdrawn of such person's position and comments or objections, if any, to the preliminary intended action.

(b) The filing of the notice of intended agency action shall toll the time periods contained in s. 120.60 for the granting or denial of a permit for an interdistrict transfer and use of ground water.

(c) The preliminary intended agency action and any comments or objections of interested persons made pursuant to paragraph (a) shall be considered by the governing board of the water management district where the ground water is proposed to be withdrawn. Following such consideration, the governing board shall issue a notice of intended agency action.

(d) Any substantially affected person who submitted a notification pursuant to paragraph (a) may request review by the department within 14 days after the filing of the notice of intended agency action. If no request for review is filed, the notice of intended agency action shall become the final order of the governing board.

(7) Notwithstanding the provisions of chapter 120, the department shall, within 30 days after its receipt of a request for review of the water management district's action, approve, deny, or modify the water management district's action on the proposed interdistrict transfer and use of ground water. The department shall issue a notice of its intended action. Any substantially affected person who requested review pursuant to paragraph (6)(a) may request an administrative hearing pursuant to chapter 120 within 14 days after notice of the department's intended action. The parties to such proceeding shall include, at a minimum, the affected water management districts and the applicant. The proceedings initiated by a petition under ss. 120.569 and 120.57, following the department's issuance of a notice of intended agency action, is the exclusive proceeding authorized for the review of agency action on the interdistrict transfer and use of ground water. This procedure is to give effect to the legislative intent that this section provide a single, efficient, simplified, coordinated permitting process for the interdistrict transfer and use of ground water.

(8) The department shall issue a final order which is subject to review pursuant to s. 120.68 or s. 373.114.

(9) In administering this part, the department or the water management districts may enter into interagency agreements. However, such agreements are not subject to the provisions of s. 373.046 and chapter 120.

(10) The state hereby preempts any regulation of the interdistrict transfer and use of ground water. If any provision of this section is in conflict with any other provision or restriction under any law, administrative rule, or ordinance, this section shall govern and such law, rule, or ordinance shall be deemed superseded for the purposes of this section. A water management district or the department may not adopt special rules which prohibit or restrict interdistrict transfer and use of ground water in a manner inconsistent with this section.

(11) Any applicant who has submitted an application for interdistrict transfer and use of ground water which is pending on July 11, 1987, may have the application considered pursuant to this section. New permits are not required for interdistrict transfers existing on July 11, 1987, for the duration of the permits issued for such uses.

(12) If, after the final order of the department or final agency action under this section, the proposed use of the site designated in the application for ground water production, treatment, or transmission facilities does not conform with the existing zoning ordinances, a rezoning application may be submitted. If local

authorities deny the application for rezoning, the applicant may appeal this decision to the Land and Water Adjudicatory Commission, which shall authorize a variance or nonconforming use to the existing comprehensive plan and zoning ordinances, unless the commission determines after notice and hearing that such variance or nonconforming use is contrary to the public interest.

(13) The permit required under this section and other sections of this chapter and chapter 403 are the sole permits required for interdistrict transfer and use of ground water, and such permits are in lieu of any license, permit, or similar document required by any state agency or political subdivision pursuant to chapter 163, chapter 380, or chapter 381, and the Florida Transportation Code.

(14) When a consumptive use permit under this section is granted for water use beyond the boundaries of a local government from which or through which the ground water is withdrawn or transferred and a local government denies a permit required under chapter 125 or chapter 153 for a facility or any infrastructure which produces, treats, transmits, or distributes such ground water, the person or unit of government applying for the permit under chapter 125 or chapter 153 may appeal the denial to the Land and Water Adjudicatory Commission. The commission shall review the local government action for consistency with this chapter and the interdistrict ground water transfer permit and may reverse, modify, or approve the local government's action.

History.--s. 1, ch. 87-347; s. 266, ch. 94-356; s. 99, ch. 96-410.

373.233 Competing applications.--

(1) If two or more applications which otherwise comply with the provisions of this part are pending for a quantity of water that is inadequate for both or all, or which for any other reason are in conflict, the governing board or the department shall have the right to approve or modify the application which best serves the public interest.

(2) In the event that two or more competing applications qualify equally under the provisions of subsection (1), the governing board or the department shall give preference to a renewal application over an initial application.

History.--s. 6, part II, ch. 72-299.

373.236 Duration of permits; compliance reports.--

(1) Permits shall be granted for a period of 20 years, if requested for that period of time, if there is sufficient data to provide reasonable assurance that the conditions for permit issuance will be met for the duration of the permit; otherwise, permits may be issued for shorter durations which reflect the period for which such reasonable assurances can be provided. The governing board or the department may base the duration of permits on a reasonable system of classification according to source of supply or type of use, or both.

(2) The governing board or the department may authorize a permit of duration of up to 50 years in the case of a municipality or other governmental body or of a public works or public service corporation where such a period is required to provide for the retirement of bonds for the construction of waterworks and waste disposal facilities.

(3) Where necessary to maintain reasonable assurance that the conditions for issuance of a 20-year permit can continue to be met, the governing board or department, in addition to any conditions required pursuant to s. 373.219, may require a compliance report by the permittee every 5 years during the term of a permit. This report shall contain sufficient data to maintain reasonable assurance that the initial conditions for permit issuance are met. Following review of this report, the governing board or the department may modify the permit to ensure that the use meets the conditions for issuance. Permit modifications pursuant to this subsection shall not be subject to competing applications, provided there is no increase in the permitted allocation or permit duration, and no change in source, except for changes in source requested by the district. This subsection shall not be construed to limit the existing authority of the department or the governing board to modify or revoke a consumptive use permit.

History.--s. 7, part II, ch. 72-299; s. 13, ch. 97-160.

373.239 Modification and renewal of permit terms.--

(1) A permittee may seek modification of any terms of an unexpired permit.

(2) If the proposed modification involves water use of 100,000 gallons or more per day, the application shall be treated under the provisions of s. 373.229 in the same manner as the initial permit application. Otherwise, the governing board or the department may at its discretion approve the proposed modification without a hearing, provided the permittee establishes that:

(a) A change in conditions has resulted in the water allowed under the permit becoming inadequate for the permittee’s need, or

(b) The proposed modification would result in a more efficient utilization of water than is possible under the existing permit.

(3) All permit renewal applications shall be treated under this part in the same manner as the initial permit application.

History.--s. 8, part II, ch. 72-299; s. 14, ch. 73-190.

373.243 Revocation of permits.—

The governing board or the department may revoke a permit as follows:

(1) For any material false statement in an application to continue, initiate, or modify a use, or for any material false statement in any report or statement of fact required of the user pursuant to the provisions of this chapter, the governing

board or the department may revoke the user's permit, in whole or in part, permanently.

(2) For willful violation of the conditions of the permit, the governing board or the department may permanently or temporarily revoke the permit, in whole or in part.

(3) For violation of any provision of this chapter, the governing board or the department may revoke the permit, in whole or in part, for a period not to exceed 1 year.

(4) For nonuse of the water supply allowed by the permit for a period of 2 years or more, the governing board or the department may revoke the permit permanently and in whole unless the user can prove that his or her nonuse was due to extreme hardship caused by factors beyond the user's control.

(5) The governing board or the department may revoke a permit, permanently and in whole, with the written consent of the permittee.

History.--s. 9, part II, ch. 72-299; s. 14, ch. 78-95; s. 600, ch. 95-148.

373.246 Declaration of Water Shortage or Emergency

(1) The governing board or the department by regulation shall formulate a plan for implementation during periods of water shortage. Copies of the water shortage plan shall be submitted to the Speaker of the House of Representatives and the President of the Senate no later than October 31, 1983. As a part of this plan the governing board or the department shall adopt a reasonable system of water-use classification according to source of water supply; method of extraction, withdrawal, or diversion; or use of water or a combination thereof. The plan may include provisions for variances and alternative measures to prevent undue hardship and ensure equitable distribution of water resources.

(2) The governing board or the department by order may declare that a water shortage exists for a source or sources within all or part of the district when insufficient water is or will be available to meet the present and anticipated requirements of the users or when conditions are such as to require temporary reduction in total use within the area to protect water resources from serious harm. Such orders will be final agency action.

(3) In accordance with the plan adopted under subsection (1), the governing board or the department may impose such restrictions on one or more classes of water uses as may be necessary to protect the water resources of the area from serious harm and to restore them to their previous condition.

(4) A declaration of water shortage and any measures adopted pursuant thereto may be rescinded by the governing board or the department.

(5) When a water shortage is declared, the governing board or the department shall cause notice thereof to be published in a prominent place within a newspaper of general circulation throughout the area. Publication of such notice will serve as notice to all users in the area of the condition of water shortage.

(6) The governing board or the department shall notify each permittee in the district by regular mail of any change in the condition of his or her permit or any suspension of his or her permit or of any other restriction on the permittee's use of water for the duration of the water shortage.

(7) If an emergency condition exists due to a water shortage within any area of the district, and if the department, or the executive director of the district with the concurrence of the governing board, finds that the exercise of powers under subsection (1) is not sufficient to protect the public health, safety, or welfare; the health of animals, fish, or aquatic life; a public water supply; or recreational, commercial, industrial, agricultural, or other reasonable uses, it or he or she may, pursuant to the provisions of s. 373.119, issue emergency orders reciting the existence of such an emergency and requiring that such action, including, but not limited to, apportioning, rotating, limiting, or prohibiting the use of the water resources of the district, be taken as the department or the executive director deems necessary to meet the emergency.

(8) An affected party to whom an emergency order is directed under subsection (7) shall comply immediately, but may challenge such an order in the manner set forth in s. 373.119.

History.--s. 10, part II, ch. 72-299; s. 14, ch. 78-95; s. 11, ch. 82-101; s. 10, ch. 84-341; s. 601, ch. 95-148.

373.250 Reuse of reclaimed water.--

(1) The encouragement and promotion of water conservation and reuse of reclaimed water, as defined by the department, are state objectives and considered to be in the public interest. The Legislature finds that the use of reclaimed water provided by domestic wastewater treatment plants permitted and operated under a reuse program approved by the department is environmentally acceptable and not a threat to public health and safety.

(2)

(a) For purposes of this section, "uncommitted" means the average amount of reclaimed water produced during the three lowest-flow months minus the amount of reclaimed water that a reclaimed water provider is contractually obligated to provide to a customer or user.

(b) Reclaimed water may be presumed available to a consumptive use permit applicant when a utility exists which provides reclaimed water, which has uncommitted reclaimed water capacity, and which has distribution facilities, which are initially provided by the utility at its cost, to the site of the affected applicant's proposed use.

(3) The water management district shall, in consultation with the department, adopt rules to implement this section. Such rules shall include, but not be limited to:

(a) Provisions to permit use of water from other sources in emergency situations or if reclaimed water becomes unavailable, for the duration of the emergency or the unavailability of reclaimed water. These provisions shall also specify the method for establishing the quantity of water to be set aside for use in emergencies or when reclaimed water becomes unavailable. The amount set aside is subject to periodic review and revision. The methodology shall take into account the risk that reclaimed water may not be available in the future, the risk that other sources may be fully allocated to other uses in the future, the nature of the uses served with reclaimed water, the extent to which the applicant intends to rely upon reclaimed water and the extent of economic harm which may result if other sources are not available to replace the reclaimed water. It is the intent of this paragraph to ensure that users of reclaimed water have the same access to ground or surface water and will otherwise be treated in the same manner as other users of the same class not relying on reclaimed water.

(b) A water management district shall not adopt any rule which gives preference to users within any class of use established under s. 373.246 who do not use reclaimed water over users within the same class who use reclaimed water.

(4) Nothing in this section shall impair a water management district's authority to plan for and regulate consumptive uses of water under this chapter.

(5) This section applies to new consumptive use permits and renewals of existing consumptive use permits.

(6) Each water management district shall submit to the Legislature, by June 1 of each year, an annual report which describes the district's progress in promoting the reuse of reclaimed water. The report shall include, but not be limited to:

(a) The number of permits issued during the year which required reuse of reclaimed water and, by categories, the percentages of reuse required.

(b) The number of permits issued during the year which did not require the reuse of reclaimed water and, of those permits, the number which reasonably could have required reuse.

(c) In the second and subsequent annual reports, a statistical comparison of reuse required through consumptive use permitting between the current and preceding years.

(d) A comparison of the volume of reclaimed water available in the district to the volume of reclaimed water required to be reused through consumptive use permits.

(e) A comparison of the volume of reuse of reclaimed water required in water resource caution areas through consumptive use permitting to the volume required in other areas in the district through consumptive use permitting.

(f) An explanation of the factors the district considered when determining how much, if any, reuse of reclaimed water to require through consumptive use permitting.

(g) A description of the district's efforts to work in cooperation with local government and private domestic wastewater treatment facilities to increase the reuse of reclaimed water. The districts, in consultation with the department, shall devise a uniform format for the report required by this subsection and for presenting the information provided in the report.

History.--s. 2, ch. 94-243; s. 35, ch. 97-160; s. 18, ch. 97-164.

Part V Finance and Taxation

373.536 District budget and hearing thereon.--

(1) The fiscal year of districts created under the provisions of this chapter shall extend from October 1 of one year through September 30 of the following year. The budget officer of the district shall, on or before July 15 of each year, submit for consideration by the governing board of the district a tentative budget for the district covering its proposed operation and requirements for the ensuing fiscal year. Unless alternative notice requirements are otherwise provided by law, notice of all budget hearings conducted by the governing board or district staff must be published in a newspaper of general circulation in each county in which the district lies not less than 5 days nor more than 15 days before the hearing. Budget workshops conducted for the public and not governed by s. 200.065 must be advertised in a newspaper of general circulation in the community or area in which the workshop will occur not less than 5 days nor more than 15 days before the workshop. The tentative budget shall be adopted in accordance with the provisions of s. 200.065; however, if the mailing of the notice of proposed property taxes is delayed beyond September 3 in any county in which the district lies, the district shall advertise its intention to adopt a tentative budget and millage rate, pursuant to s. 200.065(3)(g), in a newspaper of general paid circulation in that county. The budget shall set forth, classified by object and purpose, and by fund if so designated, the proposed expenditures of the district for bonds or other debt, for construction, for acquisition of land, for operation and maintenance of the district works, for the conduct of the affairs of the district generally, and for other purposes, to which may be added an amount to be held as a reserve. District administrative and operating expenses must be identified in the budget and allocated among district programs.

(2) The budget shall also show the estimated amount which will appear at the beginning of the fiscal year as obligated upon commitments made but uncompleted. There shall be shown the estimated unobligated or net balance which will be on hand at the beginning of the fiscal year, and the estimated amount to be raised by district taxes and from other sources for meeting the requirements of the district.

(3) As provided in s. 200.065(2)(d), the board shall publish one or more notices of its intention to finally adopt a budget for the district for the ensuing fiscal year. The notice shall appear adjacent to an advertisement which shall set forth the tentative budget in full. The notice and advertisement shall be published in one or more newspapers having a combined general circulation in the counties having land in the district. Districts may include explanatory phrases and

examples in budget advertisements published under s. 200.065 to clarify or illustrate the effect that the district budget may have on ad valorem taxes.

(4) The hearing to finally adopt a budget and millage rate shall be by and before the governing board of the district as provided in s. 200.065 and may be continued from day to day until terminated by the board. The final budget for the district will thereupon be the operating and fiscal guide for the district for the ensuing year; however, transfers of funds may be made within the budget by action of the governing board at a public meeting of the governing board. Should the district receive unanticipated funds after the adoption of the final budget, the final budget may be amended by including such funds, so long as notice of intention to amend is published one time in one or more newspapers qualified to accept legal advertisements having a combined general circulation in the counties in the district. The notice shall set forth the proposed amendment and shall be published at least 10 days prior to the public meeting of the board at which the proposed amendment is to be considered. However, in the event of a disaster or of an emergency arising to prevent or avert the same, the governing board shall not be limited by the budget but shall have authority to apply such funds as may be available therefor or as may be procured for such purpose.

(5)

(a) The Executive Office of the Governor is authorized to approve or disapprove, in whole or in part, the budget of each water management district and shall analyze each budget as to the adequacy of fiscal resources available to the district and the adequacy of district expenditures related to water supply, including water resource development projects identified in the district's regional water supply plans; water quality; flood protection and floodplain management; and natural systems. This analysis shall be based on the particular needs within each water management district in those four areas of responsibility.

(b) The Executive Office of the Governor and the water management districts shall develop a process to facilitate review and communication regarding water management district budgets, as necessary. Written disapproval of any provision in the tentative budget must be received by the district at least 5 business days prior to the final district budget adoption hearing conducted under s. 200.065(2)(d). If written disapproval of any portion of the budget is not received at least 5 business days prior to the final budget adoption hearing, the governing board may proceed with final adoption. Any provision rejected by the Governor shall not be included in a district's final budget.

(c)[1] Each water management district shall, by August 1 of each year, submit for review a tentative budget to the Governor, the President of the Senate, the Speaker of the House of Representatives, the chairs of all legislative committees and subcommittees with substantive or fiscal jurisdiction over water management districts, the secretary of the department, and the governing body of each county in which the district has jurisdiction or derives any funds for the operations of the district. The tentative budget must[2] include, but is not limited to, the following information for the preceding fiscal year and the current fiscal year, and the proposed amounts for the upcoming fiscal year, in a standard format prescribed by the Executive Office of the Governor which is generally consistent with the format prescribed by legislative budget instructions for state agencies and the format requirements of s. 216.031:

1. The millage rates and the percentage increase above the rolled-back rate, together with a summary of the reasons the increase is required, and the percentage increase in taxable value resulting from new construction;
2. The salary and benefits, expenses, operating capital outlay, number of authorized positions, and other personal services for the following program areas, including a separate section for lobbying, intergovernmental relations, and advertising:
   a. District management and administration;
   b. Implementation through outreach activities;
   c. Implementation through regulation;
   d. Implementation through acquisition, restoration, and public works;
   e. Implementation through operations and maintenance of lands and works;
   f. Water resources planning and monitoring; and
   g. A full description and accounting of expenditures for lobbying activities relating to local, regional, state, and federal governmental affairs, whether incurred by district staff or through contractual services and all expenditures for public relations, including all expenditures for public service announcements and advertising in any media.

In addition to the program areas reported by all water management districts, the South Florida Water Management District shall include in its budget document a separate section on all costs associated with the Everglades Construction Project.

3. The total amount in the district budget for each area of responsibility listed in paragraph (a) and for water resource development projects identified in the district's regional water supply plans.
4. A 5-year capital improvements plan.
5. A description of each new, expanded, reduced, or eliminated program.
6. A proposed 5-year water resource development work program, that describes the district's implementation strategy for the water resource development component of each approved regional water supply plan developed or revised pursuant to s. 373.0361. The work program shall address all the elements of the water resource development component in the district's approved regional water supply plans. The office of the Governor, with the assistance of the department, shall review the proposed work program. The review shall include a written evaluation of its consistency with and furtherance of the district's approved regional water supply plans, and adequacy of proposed expenditures. As part of

the review, the Executive Office of the Governor and the department shall afford to all interested parties the opportunity to provide written comments on each district's proposed work program. At least 7 days prior to the adoption of its final budget, the governing board shall state in writing to the Executive Office of the Governor which changes recommended in the evaluation it will incorporate into its work program, or specify the reasons for not incorporating the changes. The office of the Governor shall include the district's responses in the written evaluation and shall submit a copy of the evaluation to the Legislature; and

7. The funding sources, including, but not limited to, ad valorem taxes, Surface Water Improvement and Management Program funds, other state funds, federal funds, and user fees and permit fees for each program area.

(d) By September 5 of the year in which the budget is submitted, the House and Senate appropriations chairs may transmit to each district comments and objections to the proposed budgets. Each district governing board shall include a response to such comments and objections in the record of the governing board meeting where final adoption of the budget takes place, and the record of this meeting shall be transmitted to the Executive Office of the Governor, the department, and the chairs of the House and Senate appropriations committees.

(e) The Executive Office of the Governor shall annually, on or before December 15, file with the Legislature a report that summarizes the expenditures of the water management districts by program area and identifies the districts that are not in compliance with the reporting requirements of this section. State funds shall be withheld from a water management district that fails to comply with these reporting requirements.

History.--s. 28, ch. 25209, 1949; s. 3, ch. 29790, 1955; s. 4, ch. 61-497; s. 1, ch. 65-432; s. 1, ch. 67-74; s. 25, ch. 73-190; s. 18, ch. 74-234; s. 46, ch. 80-274; s. 230, ch. 81-259; s. 3, ch. 84-164; s. 2, ch. 86-190; s. 9, ch. 91-288; s. 24, ch. 93-213; s. 276, ch. 94-356; s. 1012, ch. 95-148; s. 5, ch. 96-339; s. 16, ch. 97-160.

[1]Note.--Section 16, ch. 97-160, purported to amend paragraph (c) of subsection (5), but did not set out in full the amended paragraph to include subparagraph 4. Absent affirmative evidence that the Legislature intended to repeal the omitted material, it is set out here pending clarification by the Legislature.

[2]Note.--The word "which" preceding the word "must" was deleted by the editors to improve clarity.

Note.--Former s. 378.28.

373.59 Water Management Lands Trust Fund.--

(1) There is established within the Department of Environmental Protection the Water Management Lands Trust Fund to be used as a nonlapsing fund for the

purposes of this section. The moneys in this fund are hereby continually appropriated for the purposes of land acquisition, management, maintenance, capital improvements, payments in lieu of taxes, and administration of the fund in accordance with the provisions of this section.

(2)

(a) By January 15 of each year, each district shall file with the Legislature and the Secretary of Environmental Protection a report of acquisition activity together with modifications or additions to its 5-year plan of acquisition. Included in the report shall be an identification of those lands which require a full fee simple interest to achieve water management goals and those lands which can be acquired using alternatives to fee simple acquisition techniques and still achieve such goals. In their evaluation of which lands would be appropriate for acquisition through alternatives to fee simple, district staff shall consider criteria including, but not limited to, acquisition costs, the net present value of future land management costs, the net present value of ad valorem revenue loss to the local government, and the potential for revenue generated from activities compatible with acquisition objectives. The report shall also include a description of land management activity. Expenditure of moneys from the Water Management Lands Trust Fund shall be limited to the costs for acquisition, management, maintenance, and capital improvements of lands included within the 5-year plan as filed by each district and to the department's costs of administration of the fund. The department’s costs of administration shall be charged proportionally against each district’s allocation using the formula provided in subsection (7)[1]. However, no acquisition of lands shall occur without a public hearing similar to those held pursuant to the provisions set forth in s. 120.54. In the annual update of its 5-year plan for acquisition, each district shall identify lands needed to protect or recharge ground water and shall establish a plan for their acquisition as necessary to protect potable water supplies. Lands which serve to protect or recharge ground water identified pursuant to this paragraph shall also serve to protect other valuable natural resources or provide space for natural resource based recreation.

(b) Moneys from the fund shall be used for continued acquisition, management, maintenance, and capital improvements of the following lands and lands set forth in the 5-year land acquisition plan of the district:

1. By South Florida Water Management District--lands in the water conservation areas and areas adversely affected by raising water levels of Lake Okeechobee in accordance with present regulation schedules, and the Savannahs Wetland area in Martin County and St. Lucie County.
2. Each district shall remove the property of an unwilling seller from its plan of acquisition at the next scheduled update of the plan, if in receipt of a request to do so by the property owner.

(4)

(a). Moneys from the Water Management Lands Trust Fund shall be used for acquiring the fee or other interest in lands necessary for water management, water supply, and the conservation and protection of water resources, except that such moneys shall not be used for the acquisition of rights-of-way for canals or pipelines. Such moneys shall also be used for management, maintenance, and capital improvements. Interests in real property acquired by the districts under this section may be used for permittable water resource development and water supply development purposes under the following conditions: the minimum flows and levels of priority water bodies on such lands have been established; the project complies with all conditions for issuance of a permit under part II of this chapter; and the project is compatible with the purposes for which the land was acquired. Lands acquired with moneys from the fund shall be managed and maintained in an environmentally acceptable manner and, to the extent practicable, in such a way as to restore and protect their natural state and condition.

(b). The Secretary of Environmental Protection shall release moneys from the Water Management Lands Trust Fund to a district for preacquisition costs within 30 days after receipt of a resolution adopted by the district's governing board which identifies and justifies any such preacquisition costs necessary for the purchase of any lands listed in the district's 5-year plan. The district shall return to the department any funds not used for the purposes stated in the resolution, and the department shall deposit the unused funds into the Water Management Lands Trust Fund.

(c). The Secretary of Environmental Protection shall release acquisition moneys from the Water Management Lands Trust Fund to a district following receipt of a resolution adopted by the governing board identifying the lands being acquired and certifying that such acquisition is consistent with the plan of acquisition and other provisions of this act. The governing board shall also provide to the Secretary of Environmental Protection a copy of all certified appraisals used to determine the value of the land to be purchased. Each parcel to be acquired must have at least one appraisal. Two appraisals are required when the estimated value of the parcel exceeds $500,000. However, when both appraisals exceed $500,000 and differ significantly, a third appraisal may be obtained. If the purchase price is greater than the appraisal price, the governing board shall submit written justification for the increased price. The Secretary of Environmental Protection may withhold moneys for any purchase that is not consistent with the 5-year plan or the intent of this act or that is in excess of appraised value. The governing board may appeal any denial to the Land and Water Adjudicatory Commission pursuant to s. 373.114.

(d). The Secretary of Environmental Protection shall release to the districts moneys for management, maintenance, and capital improvements following receipt of a resolution and request adopted by the governing board which specifies the designated managing agency, specific management activities, public use, estimated annual operating costs, and other acceptable documentation to justify release of moneys.

(5) Water management land acquisition costs shall include payments to owners and costs and fees associated with such acquisition.

(6) If a district issues revenue bonds or notes under s. 373.584, the district may pledge its share of the moneys in the Water Management Lands Trust Fund as security for such bonds or notes. The Department of Environmental Protection shall pay moneys from the trust fund to a district or its designee sufficient to pay the debt service, as it becomes due, on the outstanding bonds and notes of the district; however, such payments shall not exceed the district's cumulative portion of the trust fund. However, any moneys remaining after payment of the amount due on the debt service shall be released to the district pursuant to subsection (3)[2].

(7) Any unused portion of a district's share of the fund shall accumulate in the trust fund to the credit of that district. Interest earned on such portion shall also accumulate to the credit of that district to be used for land acquisition, management, maintenance, and capital improvements as provided in this section. The total moneys over the life of the fund available to any district under this section shall not be reduced except by resolution of the district governing board stating that the need for the moneys no longer exists.

(8) Moneys from the Water Management Lands Trust Fund shall be allocated to the five water management districts in the following percentages:

(a) Thirty percent to the South Florida Water Management District.

(b) Twenty-five percent to the Southwest Florida Water Management District.

(c) Twenty-five percent to the St. Johns River Water Management District.

(d) Ten percent to the Suwannee River Water Management District.

(e) Ten percent to the Northwest Florida Water Management District.

(9) Each district may use its allocation under subsection (8) for management, maintenance, and capital improvements. Capital improvements shall include, but need not be limited to, perimeter fencing, signs, firelanes, control of invasive exotic species, controlled burning, habitat inventory and restoration, law enforcement, access roads and trails, and minimal public accommodations, such as primitive campsites, garbage receptacles, and toilets.

(10) Moneys in the fund not needed to meet current obligations incurred under this section shall be transferred to the State Board of Administration, to the credit of the fund, to be invested in the manner provided by law. Interest received on such investments shall be credited to the fund.

(11) Lands acquired for the purposes enumerated in this section shall also be used for general public recreational purposes. General public recreational purposes shall include, but not be limited to, fishing, hunting, horseback riding, swimming, camping, hiking, canoeing, boating, diving, birding, sailing, jogging, and other related outdoor activities to the maximum extent possible considering the environmental sensitivity and suitability of those lands. These public lands shall be evaluated for their resource value for the purpose of establishing which parcels, in whole or in part, annually or seasonally, would be conducive to general public recreational purposes. Such findings shall be included in management plans which are developed for such public lands. These lands shall

be made available to the public for these purposes, unless the district governing board can demonstrate that such activities would be incompatible with the purposes for which these lands were acquired. For any fee simple acquisition of a parcel which is or will be leased back for agricultural purposes, or for any acquisition of a less-than-fee interest in land that is or will be used for agricultural purposes, the district governing board shall first consider having a soil and water conservation district created pursuant to chapter 582 manage and monitor such interest.

(12) A district may dispose of land acquired under this section, pursuant to s. 373.056 or s. 373.089. However, revenue derived from such disposal may not be used for any purpose except the purchase of other lands meeting the criteria specified in this section or payment of debt service on revenue bonds or notes issued under s. 373.584, as provided in this section.

(13) No moneys generated pursuant to this act may be applied or expended subsequent to July 1, 1985, to reimburse any district for prior expenditures for land acquisition from ad valorem taxes or other funds other than its share of the funds provided herein or to refund or refinance outstanding debt payable solely from ad valorem taxes or other funds other than its share of the funds provided herein.

(14)

(a) Beginning in fiscal year 1992-1993, not more than one-fourth of the land management funds provided for in subsections (1) and (9) in any year shall be reserved annually by a governing board, during the development of its annual operating budget, for payment in lieu of taxes to qualifying counties for actual ad valorem tax losses incurred as a result of lands purchased with funds allocated pursuant to s. 259.101(3)(b). In addition, the Northwest Florida Water Management District, the South Florida Water Management District, the Southwest Florida Water Management District, the St. Johns River Water Management District, and the Suwannee River Water Management District shall pay to qualifying counties payments in lieu of taxes for district lands acquired with funds allocated pursuant to subsection (8). Reserved funds that are not used for payment in lieu of taxes in any year shall revert to the fund to be used for management purposes or land acquisition in accordance with this section.

(b) Payment in lieu of taxes shall be available to counties for each year in which the levy of ad valorem tax is at least 8.25 mills or the amount of the tax loss from all completed Preservation 2000 acquisitions in the county exceeds 0.01 percent of the county’s total taxable value, and the population is 75,000 or less and to counties with a population of less than 100,000 which contain all or a portion of an area of critical state concern designated pursuant to chapter 380.

(c) If insufficient funds are available in any year to make full payments to all qualifying counties, such counties shall receive a pro rata share of the moneys available.

(d) The payment amount shall be based on the average amount of actual taxes paid on the property for the 3 years immediately preceding acquisition. For lands purchased prior to July 1, 1992, applications for payment in lieu of taxes shall be made to the districts by January 1, 1993. For lands purchased after July 1, 1992, applications for payment in lieu of taxes shall be made no later than January 31 of the year following acquisition. No payment in lieu of taxes shall be made for properties which were exempt from ad valorem taxation for the year immediately preceding acquisition. Payment in lieu of taxes shall be limited to a period of 10 consecutive years of annual payments.

(e) Payment in lieu of taxes shall be made within 30 days after: certification by the Department of Revenue that the amounts applied for are appropriate, certification by the Department of Environmental Protection that funds are available, and completion of any fund transfers to the district. The governing board may reduce the amount of a payment in lieu of taxes to any county by the amount of other payments, grants, or in-kind services provided to that county by the district during the year. The amount of any reduction in payments shall remain in the Water Management Lands Trust Fund for purposes provided by law.

(f) If a district governing board conveys to a local government title to any land owned by the board, any payments in lieu of taxes on the land made to the local government shall be discontinued as of the date of the conveyance.

(15) Each district is encouraged to use volunteers to provide land management and other services. Volunteers shall be covered by liability protection and workers' compensation in the same manner as district employees, unless waived in writing by such volunteers or unless such volunteers otherwise provide equivalent insurance.

(16) Each water management district is authorized and encouraged to enter into cooperative land management agreements with state agencies or local governments to provide for the coordinated and cost-effective management of lands to which the water management districts, the Board of Trustees of the Internal Improvement Trust Fund, or local governments hold title. Any such cooperative land management agreement must be consistent with any applicable laws governing land use, management duties, and responsibilities and procedures of each cooperating entity. Each cooperating entity is authorized to expend such funds as are made available to it for land management on any such lands included in a cooperative land management agreement.

History.—ss. 3, 5, ch. 81-33; s. 36, ch. 83-218; s. 5, ch. 85-347; s. 4, ch. 86-22; s. 8, ch. 86-294; s. 13, ch. 90-217; s. 11, ch. 91-288; s. 13, ch. 92-288; s. 277, ch. 94-356; s. 1, ch. 95-311; s. 6, ch. 95-349; s. 21, ch. 95-430; s. 17, ch. 96-389; s. 25, ch. 97-94; s. 17, ch. 97-160; s. 14, ch. 97-164.

[1]Note.—Redesignated as subsection (8) by s. 17, ch. 96-389.

[2]Note.—Redesignated as subsection (4) by s. 17, ch. 96-389.

Part VI Miscellaneous Provisions

373.619 Recognition of Water and Sewer-Saving Devices

The Legislature urges all public-owned or investor-owned water and sewerage systems to reduce connection fees and regular service charges for customers who utilize water or sewer-saving devices, including, but not limited to, individual graywater disposal systems.

History.--s. 2, ch. 82-10..--

373.62 Water conservation; automatic sprinkler systems.--

Any person who purchases and installs an automatic lawn sprinkler system after May 1, 1991, shall install a rain sensor device or switch which will override the irrigation cycle of the sprinkler system when adequate rainfall has occurred.

History.--s. 7, ch. 91-41; s. 7, ch. 91-68.

SELECTED PASSAGES FROM CHAPTER 62-40, F.A.C.

Part I General Water Policy Part I General Water

62-40.110 Declaration and Intent

(1) The waters of the state are among its basic resources. Such waters should be managed to conserve and protect natural resources and scenic beauty and to realize the full beneficial use of the resource. Recognizing the importance of water to the state, the Legislature passed the Water Resources Act, Chapter 373, Florida Statutes, and the Air and Water Pollution Control Act, Chapter 403, Florida Statutes. Additionally, numerous goals and policies within the State Comprehensive Plan, Chapter 187, Florida Statutes, address water resources and natural systems protection.

(2) This Chapter is intended to provide water policy goals, objectives, and guidance for the development and review of programs, rules, and plans relating to water resources, as expressed in Chapters 187, 373, and 403, Florida Statutes.

(3) These policies shall be construed as a whole and no individual policy shall be construed or applied in isolation from other policies. All constructions of this Chapter shall give meaning to all parts of the rule when possible.

(4) Notwithstanding the incorporation of other Department rules in Rule 62-40.120, F.A.C., this Chapter shall not constitute standards or criteria for decisions on individual permits.

(5) A goal of this Chapter is to coordinate the management of water and related land resources. Local governments shall consider state water policy in the development of their comprehensive plans as required by Chapter 163, Florida Statutes, and as required by Section 403.0891(3)(a), F.S. Special districts which manage water shall consider state water policy in the development of their plans and programs. The Legislature has also expressed its intent, in Section 373.0395, F.S., that future growth and development planning reflect the limitations of available ground water and other water supplies.

(6) It is an objective of the State to protect the functions of entire ecological systems, as developed and defined in the programs, rules, and plans of the Department and water management districts.

(7) Government services should be provided efficiently. Inefficiency resulting from duplication of permitting shall be eliminated where appropriate, including water quality and water quantity permitting functions.

(8) Public education, awareness, and participation shall be encouraged. The Department and Districts should assist educational institutions in the development of educational curricula and research programs which meet Florida’s present and future water management needs.

(9) This Chapter does not repeal, amend or otherwise alter any rule now existing or later adopted by the Department or Districts. However, procedures are included

in this Chapter which provide for the review of Department and District plans, programs, and rules to assure consistency with the provisions of this Chapter. The procedure for modification of District rules as requested by the Department shall be as prescribed in Section 373.114, F.S. and applicable provisions of this Chapter.

(10) It is the intent of the Department, in cooperation with the Water Management Districts, to seek adequate sources of funding to supplement District ad valorem taxes to implement the provisions of this Chapter.

62-40.120 Department Rules

State water policy shall also include the following Department rules:

(1) Water Quality Standards, Chapter 62-3, F.A.C.

(2) Surface Water Quality Standards, Chapter 62-302, F.A.C.

(3) Surface Water Improvement and Management, Chapter 62-43, F.A.C.

(4) Ground Water Classes, Standards, and Exemptions, Chapter 62-520, F.A.C.

(5) Drinking Water Standards, Monitoring, and Reporting, Chapter 62-550, F.A.C.

Part II Definitions

62-40.210 Definitions

When used in this Chapter and in the review of rules of the Districts pursuant to Section 373.114(2), F.S., unless the context or content of such District rule requires a narrower, more specific meaning, the following words shall mean:

(1) “Aquifer” shall mean a geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield useful quantities of ground water to wells, springs or surface water.

(2) “Consumptive use” means any use of water which reduces the supply from which it is withdrawn or diverted.

(3) “Department” means the Department of Environmental Protection.

(4) “Detention” means the delay of stormwater runoff prior to its discharge.

(5) “District” means a Water Management District created pursuant to Chapter 373, Florida Statutes.

(6) “District Water Management Plan” means the long-range comprehensive water resource management plan prepared by a District.

(7) “Drainage basin” means a subdivision of a watershed.

(8) "Effluent", unless specifically stated otherwise, means water that is not reused after flowing out of any wastewater treatment facility or other works used for the purpose of treating, stabilizing, or holding wastes.

(9) "Floodplain" means land area subject to inundation by flood waters from a river, watercourse, lake, or coastal waters. Floodplains are delineated according to their estimated frequency of flooding.

(10) "Florida Water Plan" means the State Water Use Plan, together with the water quality standards and water classifications adopted by the Department.

(11) "Governing Board" means the governing board of a water management district.

(12) "Ground water" means water beneath the surface of the ground, whether or not flowing through known and definite channels.

(13) "Ground water availability" means the potential quantity of ground water which can be withdrawn without resulting in significant harm to the water resources or associated natural systems.

(14) "Ground water basin" means a ground water flow system that has defined boundaries and may include permeable materials that are capable of storing or furnishing a significant water supply. The basin includes both the surface area and the permeable materials beneath it.

(15) "High recharge areas" means areas contributing significant volumes of water which add to the storage and flow of an aquifer through vertical movement from the land surface. The term significant will vary geographically depending on the hydrologic characteristics of that aquifer.

(16) "Natural systems" for the purpose of this rule means an ecological system supporting aquatic and wetland-dependent natural resources, including fish and aquatic and wetland-dependent wildlife habitat.

(17) "Nutrient limitations" means those numeric values which establish a maximum or minimum allowable nutrient loading or concentration, as appropriate, for a specific nutrient. Nutrient limitations are established through an individual permit or other action within the regulatory authority of the Department or a District. These limitations serve to implement state water quality standards.

(18) "Pollutant load reduction goal" means estimated numeric reductions in pollutant loadings needed to preserve or restore designated uses of receiving bodies of water and maintain water quality consistent with applicable state water quality standards.

(19) "Prime recharge areas" means areas that are generally within high recharge areas and are significant to present and future ground water uses including protection and maintenance of natural systems and water supply.

(20) "Reasonable-beneficial use" means the use of water in such quantity as is necessary for economic and efficient utilization for a purpose and in a manner which is both reasonable and consistent with the public interest.

(21) "Reclaimed water" means water that has received at least secondary treatment and is reused after flowing out of a domestic wastewater treatment facility.

(22) "Retention" means the prevention of stormwater runoff from direct discharge.

(23) "Reuse" means the deliberate application of reclaimed water, in compliance with Department and District rules, for a beneficial purpose.

(a) For example, said uses may encompass:

1. Landscape irrigation (such as irrigation of golf courses, cemeteries, highway medians, parks, playgrounds, school yards, retail nurseries, and residential properties);
2. Agricultural irrigation (such as irrigation of food, fiber, fodder and seed crops, wholesale nurseries, sod farms, and pastures);
3. Aesthetic uses (such as decorative ponds and fountains);
4. Ground water recharge (such as slow rate, rapid-rate, and absorption field land application systems) but not including disposal methods described in Rule 62-40.210(23)(b), F.A.C.;
5. Industrial uses (such as cooling water, process water, and wash waters);
6. Environmental enhancement of surface waters resulting from discharge of reclaimed water having received at least advanced wastewater treatment or from discharge of reclaimed water for wetlands restoration;
7. Fire protection; or
8. Other useful purpose.

(b) Overland flow land application systems, rapid-rate land application systems providing continuous loading to a single percolation cell, other land application systems involving less than secondary treatment prior to application, septic tanks, and ground water disposal systems using Class I wells injecting effluent or wastes into Class G-IV waters shall be excluded from the definition of reuse.

(24) "Secretary" means the Secretary of the Department of Environmental Protection.

(25) "State water quality standards" means water quality standards adopted by the Environmental Regulations Commission pursuant to Chapter 403, Florida Statutes, including standards composed of designated most beneficial uses (classification of waters), the numerical and narrative criteria applied to the specific water use or classification, the Florida anti-degradation policy, and the moderating provisions contained in Rules 62-3, 62-4, 62-302, 62-520, and 62-550, F.A.C.

(26) "State Water Use Plan" means the plan formulated pursuant to Section 373.036, Florida Statutes, for the use and development of waters of the State.

(27) "Stormwater" means the water which results from a rainfall event.

(28) "Stormwater management program" means the institutional strategy for stormwater management, including urban, agricultural, and other stormwater.

(29) "Stormwater management system" means a system which is designed and constructed or implemented to control stormwater, incorporating methods to collect, convey, store, absorb, inhibit, treat, use, or reuse stormwater to prevent

or reduce flooding, over-drainage, environmental degradation and water pollution or otherwise affect the quantity and quality of discharges from the system.

(30) "Stormwater utility" means the entity through which funding for a stormwater management program is obtained by assessing the cost of the program to the beneficiaries based on their relative contribution to its need. It is operated as a typical utility which bills services regularly, similar to water and wastewater services.

(31) "Surface water" means water upon the surface of the earth, whether contained in bounds created naturally or artificially or diffused. Water from natural springs shall be classified as surface water when it exits from the spring onto the earth's surface.

(32) "Surface water availability" means the potential quantity of surface water that can be removed or retained without significant harm to the water resources or associated natural systems.

(33) "Water resource caution area" means a geographic area identified by a water management district as having existing water resource problems or an area in which water resource problems are projected to develop during the next twenty years. A critical water supply problem area, as described in Section 403.064, F.S., is an example of a water resource caution area.

(34) "Water" or "waters in the state" means any and all water on or beneath the surface of the ground or in the atmosphere, including natural or artificial watercourses, lakes, ponds, or diffused surface water and water percolating, standing, or flowing beneath the surface of the ground, as well as all coastal waters within the jurisdiction of the state.

(35) "Watershed" means the land area which contributes to the flow of water into a receiving body of water.

(36) "Watershed management goal" means an overall goal for the management of water resources within a watershed.

(37) "Wetlands" means those areas that are inundated or saturated by surface or ground water with a frequency sufficient to support, and under normal circumstances do or would support, a prevalence of vegetative or aquatic life that requires saturated or seasonably saturated soil conditions for growth and reproduction, such as swamps, marshes, bayheads, cypress ponds, sloughs, wet prairies, wet meadows, river overflows, mud flats and natural ponds. This definition does not alter the Department's jurisdiction over dredging and filling activities in wetlands as defined in Section 403.911(7), F.S.

Part III General Provisions

62-40.310 General Policies

The following statement of general water policy shall guide Department review of water management programs, rules, and plans. Water management programs, rules and plans, where economically and environmentally feasible, not contrary to the public interest, and consistent with Florida law, shall seek to:

(1) Water Supply

(a) Assure availability of an adequate and affordable supply of water for all reasonable-beneficial uses. Uses of water authorized by a permit shall be limited to reasonable-beneficial uses.

(b) Reserve from use that water necessary to support essential non-withdrawal demands, including navigation, recreation, and the protection of fish and wildlife.

(c) Champion and develop sound water conservation practices and public information programs.

(d) Advocate and direct the reuse of reclaimed water as an integral part of water and wastewater management programs, rules, and plans consistent with protection of the public health and surface and ground water quality.

(e) Encourage the use of water of the lowest acceptable quality for the purpose intended.

(f) Encourage the development of local and regional surface and ground water supplies within districts rather than transfer water across District boundaries.

(g) Encourage demand management and the development of alternative water supplies, including water conservation, reuse of reclaimed water, desalination, stormwater and industrial wastewater reuse, recharge, and aquifer storage and recovery.

(h) Protect aquifers from depletion through water conservation and preservation of the functions of high recharge areas.

(2) Water Quality Protection and Management

(a) Restore and protect the quality of ground and surface water by solving current problems and ensuring high quality treatment for stormwater and wastewater.

(b) Identify existing and future public water supply areas and protect them from contamination.

(3) Flood Protection and Floodplain Protection

(a) Encourage nonstructural solutions to water resource problems and give adequate consideration to nonstructural alternatives whenever structural works are proposed.

(b) Manage the construction and operation of facilities which dam, divert, or otherwise alter the flow of surface waters to minimize damage from flooding, soil erosion or excessive drainage.

(c) Encourage the management of floodplains and other flood hazard areas to prevent or reduce flood damage, consistent with establishment and maintenance of desirable hydrologic characteristics and associated natural systems.

(d) Encourage the development and implementation of a strict floodplain management program by state, regional, and local governments designed to preserve floodplain functions and associated natural systems.

(e) Avoid the expenditure of public funds that encourage or subsidize incompatible new development or significant expansion of existing development in high-hazard flood areas.

(f) Minimize flood-related emergencies, human disasters, loss of property, and other associated impacts.

(4) Natural Systems Protection and Management

(a) Establish minimum flows and levels to protect water resources and the environmental values associated with marine, estuarine, freshwater, and wetlands ecology.

(b) Mitigate adverse impacts resulting from prior alteration of natural hydrologic patterns and fluctuations in surface and ground water levels.

(c) Utilize, preserve, restore, and enhance natural water management systems and discourage the channelization or other alteration of natural rivers, streams and lakes.

(5) Management Policies

(a) Protect the water storage and water quality enhancement functions of wetlands, floodplains, and aquifer recharge areas through acquisition, enforcement of laws, and the application of land and water management practices which provide for compatible uses.

(b) Emphasize the prevention of pollution and other water resource problems.

(c) Develop interstate agreements and undertake cooperative programs with Alabama and Georgia to provide for coordinated management of surface and ground waters.

Part IV Resource Protection and Management

62-40.410 Water Supply Protection and Management

The following shall apply to those areas where the use of water is regulated pursuant to Part II of Chapter 373, Florida Statutes:

(1) No permit shall be granted to authorize the use of water unless the applicant establishes that the proposed use is a reasonable-beneficial use, will not interfere

with presently existing legal uses of water and is consistent with the public interest.

(2) In determining whether a water use is a reasonable-beneficial use, the following factors will be considered:

(a) The quantity of water requested for the use;

(b) The demonstrated need for the use;

(c) The suitability of the use to the source of water;

(d) The purpose and value of the use;

(e) The extent and amount of harm caused;

(f) The practicality of mitigating any harm by adjusting the quantity or method of use;

(g) Whether the impact of the withdrawal extends to land not owned or legally controlled by the user;

(h) The method and efficiency of use;

(i) Water conservation measures taken or available to be taken;

(j) The feasibility of alternative sources such as reclaimed water, stormwater, brackish water and salt water;

(k) The present and projected demand for the source of water;

(l) The long term yield available from the source of water;

(m) The extent of water quality degradation caused;

(n) Whether the proposed use would cause or contribute to flood damage;

(o) Whether the proposed use would significantly induce saltwater intrusion;

(p) The amount of water which can be withdrawn without causing harm to the resource;

(q) Whether the proposed use would adversely affect public health; and

(r) Whether the proposed use would significantly affect natural systems.

(3) Water may be reserved from permit use in such locations and quantities, and for such seasons of the year, as is required for the protection of fish and wildlife or the public health or safety. Such reservations shall be subject to periodic review and revision in light of changed conditions. However, all presently existing legal users of water shall be protected so long as such use is not contrary to the public interest.

(4) Water use shall not be allowed to exceed ground water availability or surface water availability. If either is exceeded, the Districts shall expeditiously implement a remedial program. The remedial program shall consider options such as designation of a water resource caution area, declaration of a water shortage, development of water resource projects, regulation of consumptive water users, or other options consistent with this chapter and Chapter 373, F.S.

(5) In implementing consumptive use permitting programs, the Department and the Districts shall recognize the rights of property owners, as limited by law, to make consumptive uses of water from their land, and the rights of other users, as

limited by law, to make consumptive uses of water, for reasonable-beneficial uses in a manner consistent with the public interest that will not interfere with any presently existing legal use of water.

(6) Permits authorizing consumptive uses of water which cause unanticipated significant adverse impacts on off-site land uses existing at the time of permit application, or on legal uses of water existing at the time of permit application, should be considered for modification, to curtail or abate the adverse impacts, unless the impacts can be mitigated by the permittee.

(7) The Districts shall determine whether Section 373.233, F.S., entitled "Competing Applications", and implementing rules, are applicable to pending applications.

(8) Any reallocation of an existing permitted quantity of water shall be reviewed by the District and shall be subject to full compliance with the applicable permitting criteria of the District.

62-40.412 Water Conservation

The overall water conservation goal of the state shall be to prevent and reduce wasteful, uneconomical, impractical, or unreasonable use of water resources. Conservation of water shall be required unless not economically or environmentally feasible. The Districts shall accomplish this goal by:

(1) Assisting local and regional governments and other parties in formulating plans and programs to conserve water to meet their long-term needs, including incentives such as longer term or more flexible permits, economic incentives, and greater certainty of supply during water shortages;

(2) Establishing efficiency standards for urban, industrial, and agricultural demand management which may include the following:

(a) Restrictions against inefficient irrigation practices;

(b) If a District imposes year-round restrictions, which may include variances or exemptions, on particular irrigation activities or irrigation sources, using a uniform time period of 10:00 a.m. to 4:00 p.m.;

(c) Minimizing unaccounted for water losses;

(d) Promoting water conserving rate structures;

(e) Water conserving plumbing fixtures, xeriscape, and rain sensors.

(3) Maintaining public information and education programs for long- and short-term water conservation goals;

(4) Executing provisions to implement the above criteria and to consistently apply water shortage restrictions between those Districts whose boundaries contain political jurisdictions located in more than one District.

62-40.416 Water Reuse

(1) As required by Section 373.0391(2)(e), F.S., the Districts shall designate areas that have water supply problems which have become critical or are anticipated to

become critical within the next 20 years. The Districts shall identify such water resource caution areas during preparation of a District Plan pursuant to Rule 62-40.520, F.A.C., and shall adopt and amend these designations by rule.

(2) In implementing consumptive use permitting programs, a reasonable amount of reuse of reclaimed water shall be required within designated water resource caution areas, unless objective evidence demonstrates that such reuse is not economically, environmentally, or technically feasible.

(3) The Districts shall periodically update their designations of water resource caution areas by rule. Such updates shall occur within one year after updates of the District Plan prepared pursuant to Rule 62-40.520, F.A.C. After completion of the District Plan or updates pursuant to Rule 62-40.520, F.A.C., the Districts may limit areas where reuse shall be required to areas where reuse is specified as a remedial or preventive action pursuant to Rule 62-40.520, F.A.C. Any such limitation of areas where reuse shall be required shall be designated by rule.

(4) In implementing consumptive use permitting programs, a reasonable amount of reuse of reclaimed water from domestic wastewater treatment facilities may be required outside of areas designated pursuant to Rule 62-40.416(1), F.A.C., as subject to water supply problems, provided:

(a) Reclaimed water is readily available;

(b) Objective evidence demonstrates that such reuse is economically, environmentally, and technically feasible; and

(c) The District has adopted rules for reuse in these areas.

(5) The Department encourages local governments to implement programs for reuse of reclaimed water. The Districts are encouraged to establish incentives for local governments and other interested parties to implement programs for reuse of reclaimed water. These rules shall not be deemed to pre-empt any such local reuse programs.

62-40.422 Interdistrict Transfer

The following shall apply to the transfers of surface and ground water where such transfers are regulated pursuant to Part II of Chapter 373, Florida Statutes:

(1) The transfer or use of surface water across District boundaries shall require approval of each involved District. The transfer or use of ground water across District boundaries shall require approval of the District where the withdrawal of ground water occurs.

(2) In deciding whether the transfer and use of surface water across District boundaries is consistent with the public interest pursuant to Section 373.223, Florida Statutes, the Districts should consider the extent to which:

(a) Comprehensive water conservation and reuse programs are implemented and enforced in the area of need;

(b) The major costs, benefits, and environmental impacts have been adequately determined including the impact on both the supplying and receiving areas;

(c) The transfer is an environmentally and economically acceptable method to supply water for the given purpose;

(d) The present and projected water needs of the supplying area are reasonably determined and can be satisfied even if the transfer takes place;

(e) The transfer plan incorporates a regional approach to water supply and distribution including, where appropriate, plans for eventual interconnection of water supply sources; and

(f) The transfer is otherwise consistent with the public interest based upon evidence presented.

(3) The interdistrict transfer and use of ground water must meet the requirements of Section 373.2295, Florida Statutes.

62-40.430 Water Quality

(1) Water quality standards shall be enforced pursuant to Chapter 403, Florida Statutes, to protect waters of the State from point and non-point sources of pollution.

(2) State water quality standards adopted by Department rule shall be a part of the Florida Water Plan.

62-40.432 Surface Water Protection and Management

(1) Surface Water Protection and Management Goals.

The following goals are established to provide guidance for Department, District and local government storm water management programs:

(a) It shall be a goal of surface water management programs to protect, preserve and restore the quality, quantity and environmental values of water resources. A goal of surface water management programs includes effective storm water management for existing and new systems which shall seek to protect, maintain and restore the functions of natural systems and the beneficial uses of waters.

(b) The primary goals of the state's storm water management program are to maintain, to the maximum extent practicable, during and after construction and development, the pre-development storm water characteristics of a site; to reduce stream channel erosion, pollution, siltation, sedimentation and flooding; to reduce storm water pollutant loadings discharged to waters to preserve or restore beneficial uses; to reduce the loss of fresh water resources by encouraging the reuse of storm water; to enhance ground water recharge by promoting infiltration of storm water in areas with appropriate soils and geology; to maintain the appropriate salinity regimes in estuaries needed to support the natural flora and fauna; and to address storm water management on a watershed basis to provide cost effective water quality and water quantity solutions to specific watershed problems.

(c) Inadequate management of storm water throughout a watershed increases storm water flows and velocities, contributes to erosion and sedimentation, overtaxes the carrying capacity of streams and other conveyances, disrupts the functions of natural systems, undermines floodplain management and flood control efforts in downstream communities, reduces ground water recharge, threatens public health and safety, and is the primary source of pollutant loading entering Florida's rivers, lakes and estuaries, thus causing degradation of water quality and a loss of beneficial uses. Accordingly, it is a goal to eliminate the discharge of inadequately managed storm water into waters and to minimize other adverse impacts on natural systems, property and public health, safety and welfare caused by improperly managed storm water.

(d) It shall be a goal of storm water management programs to reduce unacceptable pollutant loadings from older storm water management systems, constructed before the adoption of Chapter 62-25, F.A.C., (February 1, 1982), by developing watershed management and storm water master plans or District-wide or basin specific rules.

(e) The concept of developing comprehensive watershed management plans in designated watersheds is intended not only to prevent existing environmental, water quantity, and water quality problems from becoming worse but also to reduce existing flooding problems, to improve existing water quality, and to preserve or restore the values of natural systems.

(2) Watershed management goals shall be developed by the District for all watersheds within the boundaries of each District and shall be consistent with the Surface Water Improvement and Management (SWIM) program and the EPA National Pollution Discharge Elimination System (NPDES) program. Watershed management goals shall be included in the District Water Management Plans.

(3) Storm Water Management Program Implementation.

As required by Section 403.0891, F.S., the Department, Districts and local governments shall cooperatively implement on a watershed basis a comprehensive storm water management program designed to minimize the adverse effects of storm water on land and water resources. All such programs shall be mutually compatible with the State Comprehensive Plan (Chapter 187, Florida Statutes), the Local Government Comprehensive Planning and Land Development Regulation Act (Chapter 163, Florida Statutes), the Surface Water Improvement and Management Act (Sections 373.451-.4595, F.S.), Chapters 373 and 403, F.S., and this chapter. Programs shall be implemented in a manner that will improve and restore the quality of waters that do not meet state water quality standards and maintain the water quality of those waters which meet or exceed state water quality standards.

(a) The Department shall be the lead agency responsible for coordinating the statewide storm water management program by establishing goals, objectives and guidance for the development and implementation of storm water management programs by the Districts and local governments. The Department shall implement the state storm water management program in Districts which do not have the economic and technical resources to implement a comprehensive storm water and surface water management program.

(b) The Districts which have implemented a comprehensive storm water and surface water management program shall be the chief administrators of the state storm water management program. The Department or the Districts, where appropriate, shall set regional storm water management goals and policies on a watershed basis, including watershed storm water pollutant load reductions necessary to preserve or restore beneficial uses of receiving waters. For water bodies which fully attain their designated use and meet the applicable state water quality standards, the pollutant load reduction goal shall be zero. Such goals and policies shall be implemented through District SWIM plans, through preparation of watershed management plans in other designated priority watersheds and through appropriate regulations.

(c) Local governments shall establish storm water management programs which are in accordance with the state and District storm water quality and quantity goals. Local governments may establish a storm water utility or other dedicated source of funding to implement a local storm water management program which shall include the development and implementation of a storm water master plan and provisions, such as an operating permit system, to ensure that storm water systems are properly operated and maintained.

(d) Any water control district created pursuant to Chapter 298, F.S., or special act, and other special districts as defined in Section 189.403(1), F.S., which have water management powers shall:

1. Be consistent with the applicable local comprehensive plan adopted under Part II, Chapter 163, F.S., and state and district storm water quality and quantity goals, for the construction and expansion of water control and related facilities.
2. Operate existing water control and related facilities consistent with applicable state and district storm water quality and quantity goals. Any modification or alteration of existing water control and related facilities shall be consistent with the applicable local government comprehensive plan and state and district storm water quality and quantity goals.

(4) Surface Water Management.

The following shall apply to the regulation of surface water pursuant to Part IV, Chapter 373, Florida Statutes.

(a) The construction and operation of facilities which manage or store surface waters, or other facilities which drain, divert, impound, discharge into, or otherwise impact waters in the state, and the improvements served by such facilities, shall not be harmful to water resources or inconsistent with the objectives of the Department or District.

(b) In determining the harm to water resources and consistency with the objectives of the Department or District, consideration should be given to:

1. The impact of the facilities on:
   a. water quality;
   b. fish and wildlife;
   c. wetlands, floodplains, estuaries, and other environmentally sensitive lands;
   d. reasonable-beneficial uses of water;
   e. recreation;
   f. navigation;
   g. saltwater or pollution intrusion, including any barrier line established pursuant to Section 373.033, F.S.;
   h. minimum flows and levels established pursuant to Section 373.042, F.S.; and
   i. other factors relating to the public health, safety, and welfare;
2. Whether the facilities meet applicable design or performance standards;
3. Whether adequate provisions exist for the continued satisfactory operation and maintenance of the facilities; and
4. The ability of the facilities and related improvements to avoid increased damage to off-site property, water resources, natural systems or the public caused by:
   a. floodplain development, encroachment or other alteration;
   b. retardance, acceleration or diversion of flowing water;
   c. reduction of natural water storage areas;
   d. facility failure; or
   e. other actions adversely affecting off-site water flows or levels.

(5) Minimum Storm Water Treatment Performance Standards.

(a) When a storm water management system complies with rules establishing the design and performance criteria for storm water management systems, there shall be a rebuttable presumption that such systems will comply with state water quality standards. The Department and the Districts, pursuant to Section 373.418, F.S., shall adopt rules that specify design and performance criteria for new storm water management systems which:

1. Shall be designed to achieve at least 80 percent reduction of the average annual load of pollutants that would cause or contribute to violations of state water quality standards.
2. Shall be designed to achieve at least 95 percent reduction of the average annual load of pollutants that would cause or contribute to violations of state water quality standards in Outstanding Florida Waters.
3. The minimum treatment levels specified in subparagraphs 1 and 2 above may be replaced by basin specific design and performance criteria

adopted by a District in order to achieve the pollutant load reduction goals established in paragraph (c).

(b) Erosion and sediment control plans detailing appropriate methods to retain sediment on-site shall be required for land disturbing activities.

(c) The pollutant loading from older storm water management systems shall be reduced as necessary to restore or maintain the beneficial uses of waters. The Districts shall establish pollutant load reduction goals and adopt them as part of a SWIM plan, other watershed management plan, or District-wide or basin specific rules.

(d) Watershed specific storm water pollutant load reduction goals shall be developed for older storm water management systems on a priority basis as follows:

1. The Districts shall include in adopted SWIM Plans numeric estimates of the level of pollutant load reduction goals anticipated to result from planned corrective actions included in the plan.
   a. For SWIM water bodies with plans originally adopted before January 1, 1992, these estimates shall be established before December 31, 1994.
   b. For SWIM water bodies with plans originally adopted after January 1, 1992, these estimates shall be established within three years of the plan's original adoption date.
2. Each District shall develop water body specific pollutant load reduction goals for non-SWIM water bodies on a priority basis according to a schedule provided in the District Water Management Plan. The list of water bodies and the schedule shall be developed by each District, giving priority consideration to water bodies that receive discharges from storm water management systems that are required to obtain a NPDES municipal storm water discharge permit.
3. The Districts shall consider economic, environmental, and technical factors in implementing programs to achieve pollutant load reduction goals. These goals shall be considered in local comprehensive plans submitted or updated in accordance with Section 403.0891(3)(a), F.S.

62-40.450 Flood Protection

Flood protection shall be implemented within the context of other interrelated water management responsibilities. Florida will continue to be dependent on some structural water control facilities constructed in the past, and new structural facilities may sometimes be unavoidable in addressing existing and future flooding or other water-related problems. The Department and the Districts shall promote nonstructural flood protection strategies.

(1) Flood Protection Responsibilities

(a) Local governments have the primary responsibility for regulating land use, enforcing construction criteria for flood prone areas, establishing local storm water management levels of service, constructing and maintaining local flood control facilities, and otherwise preventing flood damages to new and existing development.

(b) District flood protection responsibilities relate primarily to serving regional water conveyance and storage needs. Districts have the authority to plan, construct, and operate water control facilities, as well as regulate discharges into works of the District or facilities controlled by the District.

(c) Rules adopted under Part IV of Chapter 373, F.S., shall require that appropriate precautions be taken to protect public health and safety in the event of failure of any water control structures, such as pumps and levees.

(d) Department and District programs shall discourage siting of incompatible public facilities in floodplains and flood prone areas wherever possible. Where no feasible alternative exists to siting an incompatible public facility in a floodplain or flood prone Area, the facility shall be designed to minimize flood damage risks and adverse impacts on natural flood detention and conveyance capabilities.

(e) Each District shall clearly define in its District Water Management Plan, in basin specific plans, or rules, the District's responsibilities related to flood emergencies, including its mechanisms for coordinating with emergency response agencies.

(2) District Facilities

(a) District water control facilities shall be operated and maintained in accordance with established plans or schedules.

(b) Districts shall assess the design characteristics and operational practices of existing District water control facilities to ascertain opportunities for minimizing adverse impacts on water resources and associated natural systems. Where feasible, facility design modifications or operational changes shall be implemented to enhance natural systems or fulfill other water management responsibilities.

62-40.458 Floodplain Protection

(1) The Department and the Districts shall provide leadership to protect and enhance the beneficial values of floodplains. This shall include active coordination with local governments, special districts, and related programs of federal agencies, the Department of Community Affairs, and the Department of Health and Rehabilitative Services. Nothing in this section is intended to diminish the Department's and District's responsibilities regarding flood protection.

(a) The Department and the Districts shall pursue development of adequate floodplain protection information, including:

1. District determination of flood levels for priority floodplains. At a minimum, this shall include the 100-year flood level, with other flood levels to be determined where needed for watershed-specific management purposes. Districts are encouraged to determine the 10-year flood level for the purpose of assisting the Department of Health and

Rehabilitative Services to regulate septic tanks in floodplains pursuant to Section 10D-6.0471, F.A.C.

2. Identification of floodplains with valuable natural systems for potential acquisition.
3. Identification of floodplain areas having potential for restoration of natural flow regimes.

(b) The Department and the Districts shall develop jointly a comprehensive system of coordinated planning, management, and acquisition to protect and, where feasible, enhance floodplain functions and associated natural systems in floodplains. This system shall include implementation of policies and programs to:

1. Acquire and maintain valuable natural systems in floodplains.
2. Protect the natural water storage and water conveyance capabilities of floodplains.
3. Where feasible, enhance or restore natural flow regimes of rivers and watercourses that have been altered for water control purposes.

(c) District regulatory programs shall minimize incompatible activities in floodplains. For regulated floodplains, each District, at a minimum, shall ensure that such activities:

1. Will not result in significant adverse effects on surface and ground water levels and surface water flows.
2. Will not result in significant adverse impacts to existing surface water storage and conveyance capabilities of the floodplain.
3. Will not result in significant adverse impacts to the operation of District facilities.
4. Will assure that any surface water management facilities associated with the proposed activity will be capable of being effectively operated and maintained.
5. Will not cause violations of water quality standards in receiving waters.
6. Will not otherwise be harmful to water resources.

(2) Each District shall provide to local governments and water control districts available information regarding floodplain delineation and floodplain functions and associated natural systems, and assist in developing effective measures to manage floodplains consistently with this Chapter.

62-40.470 Natural Systems Protection and Management

Programs, plans, and rules to accomplish natural systems protection and management shall include rules to address adverse cumulative impacts, the establishment of minimum flows and levels (Rule 62-40.473, F.A.C.) and may include protection measures for surface water resources (Rule 62-40.475, F.A.C.).

62-40.473 Minimum Flows and Levels

(1) In establishing minimum flows and levels pursuant to Section 373.042, consideration shall be given to the protection of water resources, natural seasonal

fluctuations in water flows or levels, and environmental values associated with coastal, estuarine, aquatic, and wetlands ecology, including:

(a) Recreation in and on the water;

(b) Fish and wildlife habitats and the passage of fish;

(c) Estuarine resources;

(d) Transfer of detrital material;

(e) Maintenance of freshwater storage and supply;

(f) Aesthetic and scenic attributes;

(g) Filtration and absorption of nutrients and other pollutants;

(h) Sediment loads;

(i) Water quality; and

(j) Navigation.

(2) Established minimum flows and levels shall be protected where relevant to:

(a) The construction and operation of water resource projects;

(b) The issuance of permits pursuant to Part II, Part IV, and Section 373.086, Florida Statutes; and

(c) The declaration of a water shortage pursuant to Section 373.175 or Section 373.246, Florida Statutes.

(3) Each water management district shall advise the Secretary by January 1, 1995 of the date by which each District shall establish minimum flows and levels for surface waterbodies within the District. Priority shall be given to establishment of minimum flows and levels on waters which are located within:

(a) an Outstanding Florida Water;

(b) an Aquatic Preserve;

(c) an Area of Critical State Concern; or

(d) an area subject to Chapter 380 Resource Management Plans adopted by rule by the Administration Commission, when the plans for an area include waters that are particularly identified as needing additional protection, which provisions are not inconsistent with applicable rules adopted for the management of such areas by the Department and the Governor and Cabinet.

62-40.475 Protection Measures for Surface Water Resources

(1) As part of SWIM Plans or basin-specific management plans, programs, or rules, the Districts are encouraged to implement protection measures as appropriate to enhance or preserve surface water resources. Protection measures shall be based on scientific evaluations of particular surface waters and the need for enhancement or preservation of these surface water resources.

(2) In determining if basin-specific rules should be adopted to establish protection areas, due consideration shall be given to surface waters with the following special designations:

(a) an Outstanding Florida Water,

(b) an Aquatic Preserve,

(c) an Area of Critical State Concern, or

(d) an area subject to Chapter 380 Resource Management Plans adopted by rule by the Administration Commission, when the plans for an area include waters that are particularly identified as needing additional protection, which provisions are not inconsistent with applicable rules adopted for the management of such areas by the Department and the Governor and Cabinet.

62-40.510 Florida Water Plan

(1) The Department shall formulate an integrated, coordinated Florida Water Plan for the management of Florida's water resources. The scope of the plan shall include the State Water Use Plan and all other water-related activities of the Department and the Districts. It shall give due consideration to the factors in Section 373.036(2), F.S.

(2) The Florida Water Plan shall be developed in coordination with District Water Management Plans and include, at a minimum:

(a) Department overview, including a discussion of the interrelationships of Department and District programs;

(b) Water management goals and responsibilities, including the following areas of responsibilities:

1. water supply protection and management,
2. flood protection and management,
3. water quality protection and management, and
4. natural systems protection and management;

(c) Statewide water management implementation strategies for each area of responsibility;

(d) Intergovernmental coordination, including the Department's processes for general supervision of the water management districts;

(e) Procedures for plan development, including public participation;

(f) Methods for assessing program effectiveness and the Department's progress toward implementation of the Plan;

(g) Linkages to Department rulemaking, budgeting, program development, and legislative proposals;

(h) Strategies to identify the amount and sources of supplemental funding to implement the programs identified in Chapter 373, District Water Management Plans, this Chapter, and any delegated programs;

(i) Chapter 62-40, F.A.C., State Water Policy;

(j) Appropriate sections of the District Water Management Plans;

(k) State water quality standards.

(3) The Florida Water Plan shall be developed expeditiously and may be phased. It shall be completed by November 1, 1995.

(4) At a minimum, the Florida Water Plan shall be updated every five years after the initial plan development. Annual status reports on the Plan shall also be prepared by the Department.

Part V Water Program Development

62-40.520 District Water Management Plans

(1) As required by Section 373.036(4), F.S., a long range comprehensive water management plan shall be prepared by each District which is consistent with the provisions of this Chapter and Section 373.036, Florida Statutes. District Water Management Plans are comprehensive guides to the Districts in carrying out all their water resource management responsibilities, including water supply, flood protection, water quality management, and protection of natural systems. The plans shall provide general directions and strategies for District activities, programs, and rules. They will be implemented by a schedule of specific actions of the District, which may include program development, water resource projects, land acquisition, funding, technical assistance, facility operations, and rule development.

(2) The District Plan shall include an assessment of water needs and sources for the next 20 years. The District Plan shall identify specific geographical areas that have water resource problems which have become critical or are anticipated to become critical within the next 20 years to be called water resource caution areas. Identification of water resource caution areas needed for imposition of reuse requirements pursuant to Rule 62-40.416, F.A.C., may be accomplished before publication of the complete District Plan.

(3) Based on economic, environmental, and technical analyses, a course of remedial or preventive action shall be specified for each current and anticipated future problem.

(4) Remedial or preventive measures may include, but are not limited to, water resource projects; water resources restoration projects pursuant to Section 403.0615, Florida Statutes; purchase of lands; conservation of water; reuse of reclaimed water; enforcement of Department or District rules; and actions taken by local government pursuant to a local government comprehensive plan, local ordinance, or zoning regulation.

(5) District Plans shall also provide for identifying areas where collection of data, water resource investigations, water resource projects, or the implementation of regulatory programs are necessary to prevent water resource problems from becoming critical.

(6) District plans shall address, at a minimum, the following subjects:

(a) District overview;

(b) Water management goals;

(c) Water management responsibilities, including:

1. Water supply protection and management, to include needs and sources, source protection, and a schedule for recharge mapping and recharge area designation.
2. Flood protection and floodplain management. This shall include the District's strategies and priorities for managing facilities and floodplains, and a schedule for District mapping of floodplains.
3. Water quality protection and management for both surface water and ground water. This shall include the District's strategies, priorities, and schedules to develop pollutant load reduction goals; and
4. Natural systems protection and management. This shall include a schedule for establishing minimum flows and levels for a priority selection of surface waters and ground waters in the District, considering ground water availability and surface water availability, and a schedule for establishing protection areas for surface waters in the District, where appropriate.

(d) For each water management responsibility, the following shall be included:

1. Resource assessments, including identification of regionally significant water resource issues and problems, and determinations of the need for ground water basin resource availability inventories in various portions of the District;
2. Evaluation of options;
3. Water management policies for identified issues and problems;
4. Implementation strategies for each issue and problem, including tasks, schedules, responsible entities, and measurable benchmarks.

(e) Integrated plan, describing how the water problems of each county in the District are identified and addressed;

(f) Intergovernmental coordination, including measures to implement the plan through coordination with the plans and programs of local, regional, state and federal agencies and governments; and

(g) Procedures for plan development, including definitions and public participation.

(7) District Plans shall be developed expeditiously and may be phased. All District Plans shall be accepted by the Governing Board no later than November 1, 1994. A District Water Management Plan is intended to be a planning document and is not self-executing.

(8) At a minimum, District Plans shall be updated and progress assessed every five years after the initial plan development. Each District shall include in the Plan a procedure for evaluation of the District's progress towards implementing the Plan. Such procedure shall occur at least annually and a copy of the evaluation shall be provided to the Department each year by November 15 for review and comment.

(9) Plan development shall include adequate opportunity for participation by the public and governments. The Districts shall initiate public workshops at least

four months before Plan acceptance by the Governing Board. At the workshops, a preliminary list of schedules to be included in the Plan shall be presented.

62-40.530 Department Review of District Water Management Plans

(1) After acceptance by the District Governing Board, District Water Management Plans shall be submitted to the Department.

(2) Within sixty days after receipt of a Plan for review, the Department shall review each Plan for consistency with this Chapter and recommend any changes to the Governing Board.

(3) After consideration of the comments and recommendations of the Department, the Governing Board shall, within sixty days, either incorporate the recommended changes into the Plan or state in the Plan, with specificity, the reasons for not incorporating the changes.

(4) Plan amendments shall follow the same process as for initial Plan acceptance.

62-40.540 Water Data-40.540 Water Data

(1) All local governments, water management districts, and state agencies are directed by Section 373.026(2), F.S., to cooperate with the Department in making available to the Department such scientific or factual data as they may possess. The Department shall prescribe the format and ensure the quality control for all water quality data collected or submitted.

(2) The Department is the state's lead water quality monitoring agency and central repository for surface water and ground water information. The Department shall coordinate Department, District, state agency, and local government water quality monitoring activities to improve data and reduce costs.

(3) The U.S. Environmental Protection Agency water quality data base (STORET) shall be the central repository of the state's water quality data. All appropriate water quality data collected by the Department, Districts, local governments, and state agencies shall be placed in the STORET system within one year of collection.

(4) The Department's biennial state water quality assessment (the "305(b) Report") shall be the state's general guide to water quality assessment and should be used as the basis for assessments unless more recent, more accurate, or more detailed information is available.

(5) Appropriate monitoring of water quality and water withdrawal shall be required of permittees.

(6) The Districts shall implement a strategy for measuring, estimating, and reporting withdrawal and use of water by permitted and exempted users. Thresholds for measurement requirements and reporting applicable to permittees shall be established and adopted by rule.

(7) The Department and the Districts shall coordinate in the development and implementation of a standardized computerized statewide data base and

methodology to track activities authorized by environmental resource permits in wetlands and waters of the state. The data base will be designed to provide for the rapid exchange of information between the Department and the Districts. The Department will serve as the central repository for environmental resource permit data and shall specify the data base organization and electronic format in which the data are to be provided by the Districts.

Part VI Water Program Administration and Evaluation

62-40.610 Review and Application

(1) This Chapter shall be reviewed periodically, but in no case less frequently than once every four years. Revisions, if any, shall be adopted by rule.

(2) Within 12 months after adoption or revision of this Chapter, the Districts shall have revised their rules and reviewed their programs to be consistent with the provisions contained herein.

(3) District rules adopted after this Chapter takes effect shall be reviewed by the Department for consistency with this Chapter.

(4) At the request of the Department, each District shall initiate rulemaking pursuant to Chapter 120, Florida Statutes, to consider changes the Department determines to be necessary to assure consistency with this Chapter. The Department shall be made a party to the proceeding.

(5) District water policies may be adopted which are consistent with this Chapter, but which take into account differing regional water resource characteristics and needs.

(6) A District shall initiate rulemaking or program review to consider implementation of programs pursuant to Sections 373.033, 373.042, 373.106, Part III, or Part IV of Chapter 373, Florida Statutes, where the Department or District determines that present or projected conditions of water shortages, saltwater intrusion, flooding, drainage, or other water resource problems, prevent or threaten to prevent the achievement of reasonable-beneficial uses, the protection of fish and wildlife, or the attainment of other water policy directives.

(7) The Department and Districts shall assist other governmental entities in the development of plans, ordinances, or other programs to promote consistency with this Chapter and District water management plans.

FLORIDA FOREVER PROGRAM LEGISLATION

The Florida Forever Program is a comprehensive legislative effort that includes statutory amendments that provide guidelines for funding the purchase of environmentally significant lands and water resource development projects. The full legislation is approximately 150 pages long and is found throughout Florida Statutes, including chapters 201, 373, 259, and 215. Due to the comprehensive nature of the Florida Forever Program, the reader is advised to refer to the specific statute of interest cited in the text below.

SUMMARY

- Florida Forever Fund (10 year funding program) replaces the P2000 Fund. Florida Forever funds can be used for land acquisition and capital projects to implement the District's Florida Forever Work plan. Funding commences in FY2001, most likely spring after legislative session. Such funds can be specifically used for ecosystem management, water resource development, SWIM implementation, and open space and recreation. Funding for water resource development does not include construction of treatment, transmission, or distribution facilities. Land uses authorized also include water supply development, stormwater management, linear facilities, and sustainable agriculture and forestry.
- Separate authority provided for water resource development and water supply projects funded other than with Florida Forever funds. This authority somewhat broader.
- Water Management Land Trust Fund receives limited doc. stamps tax revenues for District land management and pre-acquisition expenses. WMLTF can't be used for land acquisition costs other than pre-acquisition costs. Capital improvements to be funded by WMLTF is defined.
- Land Acquisition Trust Fund receives doc stamps to pay Florida Forever bond debt service.
- Florida Forever Fund receives bond sale proceeds. At least 50% of the funds must be used for land acquisition. Capital improvements are to be identified prior to acquisition of the parcel or the approval of a project.
- New 5 Year Work Plan to be developed that is very comprehensive in nature and integrates all major water management district projects, including SWIM Plans, SOR land acquisition, stormwater management projects, water resource projects, water body restoration projects, and other acquisitions and activities to meet Florida Forever Act goals. Deadline for

development of the plan not clear but not earlier than FY 2001. Hopefully glitch bill will specify that plan is due June/July 2001.

- Multiple Use Management- all lands acquired under the Florida Forever Act are to be managed for multiple uses where compatible with resource values and management objectives. Multiple use includes general recreational use, water resource development projects, and sustainable forestry development.

1. SOR PROGRAM

SOR program continues until funds allocated to water management districts have been expended or committed. SOR Plan update will be filed with Legislature and DEP by Jan 15 of each year until that time. (See 373.59(2))

Water Management Lands Trust Fund (WMLTF) (See s. 201.15, F.S.) - WMLTF continues in existence. 4.2% of doc stamps distributed to water management districts. **WMLTF can't be used for land acquisition other than pre-acquisition costs**. Acquisition and Restoration Council to decide by 2005 whether to repeal this restriction on land acquisition costs.

Section 373.59 also amended to broaden the purposes for use of the WMLTF to include debt service on bonds issued prior to July 1, 1999 (District may pledge WMLTF as security for revenue bonds or notes issued under 373.584 prior to July 1, 1999), pre-acquisition costs associated with land purchases. It also defines "**capital improvements**" which had already been an authorized purpose, as including but not limited to: perimeter fencing, signs, fire lanes, control of exotic species, controlled burning, habitat inventory and restoration, law enforcement, access roads and trails, and minimal public accommodations, such as primitive campsites, garbage receptacles, and toilets. A district with fund balances in the WMLTF as of March 1, 1999 may use those funds for land acquisitions under 373.139 or for purposes specified in 373.59 (7).

Payment in Lieu of Taxes (373.59(10) – Beginning July 1, 1999, not more than one-fourth of WMLTF in any year may be reserved annually by a governing board during the development of its operating budget for payments in lieu of taxes for all actual tax losses resulting from FF program. Payment in-lieu of tax is available 1) to all counties with a population of 150,000 or less in which amount of tax loss from all completed P-2000 and FF acquisitions in the county exceeds .01 percent of county's total taxable value, 2) all local governments located in eligible counties and whose lands are bought and taken off the tax rolls. Local govt defined in 373.59(10)(b)(2). If insufficient funds are available in any year to make full payments, counties and local govt's receive pro rata share. Payment amount on the average amount of actual taxes paid on the property for the 3 years preceding the acquisition. Once eligibility is established, that governmental entity shall receive 10 consecutive annual payments for each tax loss. Applications by governmental entity payment in lieu shall be made no later than Jan 31 of the year following acquisition. Payments made after Department of Revenue certifies that amounts are reasonably appropriate.

2. FLORIDA FOREVER ACT ("FFA") FUNDING (See s. 259.105, F.S.)

A. Findings and Declaration. Legislature made ten findings. Crux of which is that the P2000 program was successful, but rapidly growing population is impacting water resources, wildlife habitat, outdoor recreation area space, wetlands, forests, beaches. Potential development of remaining natural areas needs response. Groundwater, surface water and springs are being impacted and to ensure sufficient quantities of water are available to meet needs of natural systems and population, water resource development projects on public lands, where compatible with the resource values of and management objectives for the lands is appropriate. Many unique ecosystems, such as Florida Everglades, facing ecological collapse due to population. Land must be acquired to facilitate ecosystem restoration. Florida Forever program will be developed and implemented with measurable state goals and objectives. Performance measures, standards, outcomes , and goals need to be established at the outset. The legislative intent is to change the focus and direction of state's major land acquisition programs, including use of land protection agreements and similar tools with private landowners where appropriate, better coordination among public agencies and other entities in their land acquisition programs, long term financial commitment to managing acquired lands, competitive selection process, and bond proceeds will be used to implement the goals and objectives recommended by Florida Forever Advisory Council(FFAC)

B. District Share. SFWMD gets 35% of water management districts allocation ($36.75 million minus bond admin costs and fees) for **lands and capital projects** to implement the priority lists developed under its FFA 5year workplan in 373.199. **At least 50% of the funds must be used for land acquisition** over the life of the program. See 259.105(3)(a))

Capital improvement project defined in s. 259.03(3) as activities relating to acquisition, restoration, public access, and recreational uses of such lands, waters, necessary to accomplish objectives of this chapter. Activities include but not limited to: initial invasive plant removal, enlargement or extension of facility signs, firelanes, access roads, and trails, or any other activities that serve to restore, conserve, protect, or provide public access, recreational opportunities or necessary services for land or water areas. **Such activities shall be identified prior to acquisition of the parcel or the approval of a project.** Continued expenditures necessary for a capital improvement project approved under this subsection not eligible for funding.

C. DEP Share. DEP gets 35% of the yearly allocation (approx. $105million) for state agencies and other entities for lands and projects under the FFA with priority for acquisitions which achieve combination of conservation goals, including protecting Fl resources and natural groundwater recharge. **Capital projects not to exceed 10% of such funds.** See 259.105(3)(b) Acquisition and Restoration Council to accept applications from state agencies, local governments, nonprofit and for profit organizations, private land trust, and individuals for this funding. The Acquisition and Restoration Council (ARC) evaluates the proposals. (See259.105(3)(b), (7)(a))

D. **WATER RESOURCE DEVELOPMENT PROJECTS** (s. 259.105(6), F.S.) Water Resource or Water Supply Development project is allowed if following conditions met:

1. minimum flows and levels established for those waters, if any, which may reasonably be expected to experience significant harm to water resources as a result of the project
2. project complies with all applicable permits
3. project is consistent with the regional water supply plan, if any, of the water management district and with relevant recovery or prevention strategies if required pursuant to 373.0421(2)(this pertains to water bodies expected within 20 years to fall below the minimum flow or level established under 373.042.)

Water Resource Development defined in 259.03(6) as a project eligible for funding under 259.105 that increases the amount of water available to meet needs of natural system and enhance or restore aquifer recharge, facilitate capture and storage of excess flows in surface waters, or promotes reuse. These projects include land acquisition, land and water body restoration, ASR facilities, surface water reservoirs, and other capital improvements**. TERM DOES NOT INCLUDE** construction of treatment, transmission, or distribution facilities. **(Note see section 8 below for separate authority for such projects where no FFA funds used.)**

3. FLORIDA FOREVER WATER MANAGEMENT DISTRICT WORKPLAN (s. 373.199, F.S.)

Overall quality of Florida water resources continue to degrade, surface water natural systems continue to be altered or not restored to fully functioning level, sufficient quantities of water for current and future reasonable beneficial use and for natural systems remain in doubt.

5 Year Workplan is required to identify projects that meet criteria in subsections (3), (4), and (5) below.

3 (a) integrate plans and projects - including SWIM Plans, SOR land acquisition lists, stormwater management projects, proposed water resource projects,

proposed water body restoration projects, and other properties and activities that assist in meeting goals of FFA.

(b) cooperate - with ecosystem mgt teams, citizen advisory groups, DEP, and other entities

(4) Workplan list – shall include following information, where applicable.

- (a) water body description, historical and current uses, hydrology, conditions requiring restoration or protection; restoration efforts to date
- (b) other governments with jurisdiction over water body and drainage basin within approved SWIM Plan area, including local, regional, state, and federal units
- (c) land uses within the project area drainage basin, tributaries, point and non-point sources pollution, and permitted discharge activities
- (d) strategies and potential strategies for restoring or protecting water body to Class III or better surface water quality, including improved stormwater management
- (e) studies of water body, stormwater project, or water resource development project
- (f) measures to manage and maintain i) the water body once restored and to prevent future degradation, ii) the stormwater management system , or iii) water resource development
- (g) schedule for i) restoration and protection water body, ii) implementation of stormwater management project, iii) or development of the water resource development project.
- (h) Funding estimate for the restoration, protection, or improvement project or development of new water resources, where applicable, and source of the funding
- (i) Numeric performance measures for each project. Including baseline, performance standard project will achieve, performance measurement itself which reflects incremental improvements toward achieving the performance standard. Measures need to reflect the **goals** in s. 259.105(4). These **goals** pertain to 1) Water Management District projects in their Workplan list (35% of FF funds) and 2) state and other entities projects approved by the Acquisition and Restoration Council (see 259.105(4)

259.105(4) Goals (each goal has method of measurement, see legislation):

- (a) increase protection or increase populations for listed plant species
- (b) increase protection or increase populations for listed animal species
- (c) restoration of land areas by reducing non-native species or

regeneration of natural communities
- (d) increase public landholdings
- (e) completion of project begun under previous land acquisition programs
- (f) increase in amount of forest land for sustainable resources
- (g) increase public recreational opportunities
- (h) reduction amount of pollutants flowing into surface waters
- (i) improvement of water recharge rates on public lands
- (j) restoration of water areas
- (k) protection of natural flood plain functions, prevention or reduction in flood damage
- (l) restoration of degraded water bodies
- (m) restoration of wetlands
- (n) preservation of strategic wetlands
- (o) preservation or reduction of contaminants in aquifers and springs

(j) Permitting and regulatory issues related to the project

(k) Identification of the proposed public access for projects with land acquisition components

(l) Identification of lands requiring full fee simple interest to achieve water management goals, lands that can be acquired with alternatives to fee considering acquisition cots, net present value of future land management costs, net present value of local govt. loss of ad valorem revenue, potential for revenue generated by activities compatible with acquisition objectives

(m) Lands needed to protect or recharge groundwater and plan for their acquisition as necessary to protect potable water supplies.

(5) List to indicate relative significance of each project. The schedule of activities, and sums of money earmarked should reflect those rankings as much as possible over the 5 year planning horizon

Pollution Responsibility (259.105(12) – Funds are not to be used to abrogate financial responsibility of point and nonpoint sources that have contributed to the degradation of water or land areas. **Increased priority** is to be given by water management districts to those projects that have secured a cost-sharing agreement allocating responsibility for cleanup of point and nonpoint sources.

Florida Forever Advisory Council to establish specific goals for those identified in s. 259.105(4) above.

No timeframe given for submittal of the original workplan. Since FFA funding is not available until FY 2001, presumably the Workplan would not be due earlier than then. Note that FFAC is to prepare a report by November 2000 to among other things establish specific goals identified in 259.105(4). It would make sense for the report to be completed for guidance to the acquiring agencies in preparing their workplans.

4. WORKPLAN UPDATES (s. 373.199(7) –

By January of each year District must file with DEP and Legislature a report of acquisitions completed during the year together with modifications or additions to its 5Year Workplan. The report must include a description of the land management activity for each property or project area owned by the District. A list of any lands surplused and the amount of compensation received.

105(3) (this includes water management district allocations), and other aspects of the FFA.

5. PUBLIC HEARING (s. 373.139(3)(a) –

No acquisition of lands shall occur without a public hearing similar to those held pursuant to 120.54.

6. DEP RELEASE OF FUNDS –

Pre- Acquisition Costs – DEP must release funds within 30 days after receipt of GB resolution which identifies and justifies the pre-acquisition costs for 5 year plan lands. (See s. 373.139 (3)(c)

Land Acquisition Costs – DEP must release funds after receipt of GB resolution certifying the acquisition is consistent with 5 year work plan. Each parcel must have at least one appraisal. Acquisitions over 500k require 2 appraisals. Third appraisal may be obtained when first two differ significantly. Purchase price in excess of appraised value requires justification. (s. 373.139 (3)(d)

7. MULTIPLE USE MANAGEMENT (259.105(5) –

All lands acquired under FFA are to be managed for **multiple-use purposes**, where compatible with the resource values and management objectives for the land. **"Multiple-use"** is defined to include i) **outdoor recreational activities** including those under 253.034 (couldn't find any reference to recreation activities) and 259.032(9)(b) , which include fishing, hunting, camping bicycling, hiking, nature study, swimming, boating, canoeing, horseback riding, diving, model hobbyist activities, birding, sailing, jogging, and other related outdoor activities compatible with the purposes for which the land was acquired, ii) **water resource development projects**, and iii**) sustainable forestry management**.

Lands may be designated for single use as defined in s. 253.034(2)(b) by the decision of the acquiring entity. Single use is defined in .034(2)(b) as management for one particular purpose to exclusion of all other purposes except compatible secondary purposes which will not interfere or detract with primary management purposes. Single use includes agricultural use, institutional use, use for parks, preserves, wildlife management, archaeological or historic sites, or wilderness areas where maintenance of essentially natural conditions is important. All submerged lands shall be considered single use lands and managed primarily for maintenance of essentially natural conditions, the propagation of fish and wildlife, and public recreation including hunting and fishing where deemed appropriate.

Reporting on Land Management (s. 259.032(10)(g) – By July 1 of each year, each Water Management District reports to DEP on land management matters.

8. DISTRICT LAND MANAGEMENT (s373.1391) –

Lands to be managed to ensure balance between public access, general public recreational purposes, and restoration and protection of their natural state. Lands owned, managed and controlled by a district may be used for multiple purposes, including but not limited to agriculture, silvaculture, and water supply, as well as boating and other recreational uses.

Whenever practicable, such lands shall be open to the general public for recreational uses. General public recreation purposes shall include but not be limited to fishing, hunting, horseback riding, swimming, camping, hiking, canoeing, boating, diving, birding, sailing, jogging, and other related outdoor activities to maximum extent possible considering the environmental sensitivity and suitability of those lands. Management plans developed for such lands shall evaluate the lands resource value to establish which parcels, in whole or in part, annually or seasonally, are conducive to general public recreational purposes. The lands shall be made available to the public for these purposes unless the Governing Board can demonstrate that such activities would be incompatible with the purposes for which the lands were acquired. Disputes re land management plans not resolvable by water management districts shall be forwarded to DEP who shall submit it to the FFAC.

Any acquisition of fee or lesser interest that will be leased back/used for agricultural purposes, Governing Board will first consider having a soil and water conservation district created under Ch. 582 manage and monitor the interest.

Water Resource Development/Water Supply Projects (s. 373.1391((2). Lands acquired with funds other than those appropriated under the Florida Forever Act may be used for permittable water resource development and water supply development purposes provided that 1) minimum flows and levels of priority water bodies on such land established, 2) project complies with all applicable permits under Part II of this Chapter, and 3) project is compatible with the purposes for which the land was acquired. (Note this authority seems somewhat broader than authority for such projects using FFA funding. (See section 2.C above)

Additional land uses authorized (s, 373.1391(5) - The following land uses of lands acquired under the FFA program and other state-funded land purchase programs are authorized upon a finding by the governing board: **water resource development, water supply development, stormwater management , linear facilities, and sustainable agriculture and forestry**, provided they meet all the following criteria: 1) not inconsistent with the management plan for such lands, 2) compatible with the natural ecosystem and resource value of such lands, 3) use is appropriately located on the lands and due consideration to use of other available lands, 4) using entity reasonably compensates the titleholder for such use based on an appropriate measure of value, and 5) the use is consistent with the public interest. Decision of Governing Board presumed correct. Moneys received from the use of state lands shall be returned to the lead managing agency in accordance with s. 373. 59

9. UNWILLING SELLERS (s. 373.199(6) –

District must remove the property of an unwilling seller at the next scheduled update of the plan when requested by the property owner.

10. ALTERNATIVES TO FEE ACQUISITION (s. 259.04(11) –

Beginning in FY99, districts shall implement initiatives to use alternatives to fee simple acquisition. Less than fee simple acquisition that provide public access may be given preference. Legislature recognizes that public access is not always appropriate for less than fee acquisitions an no proposed less than fee simple acquisition shall be rejected simply because public access would be limited. `

11. CONVEYANCE OF LAND INTERESTS (s. 259.105(17)(a) –

Water Management Districts may authorize granting lease, easement, or license for use of lands acquired for uses determined to be compatible with the resource values and management objectives for such lands. Presumed any existing lease, easement, or license for incidental public or private use is compatible. However, no such grant of land interest is permissible if it adversely affects the exclusion of interest from gross income of any revenue bond issued to fund the acquisition under IRS regulations.

12. SURPLUSING LANDS (s. 373.089(5) –

Lands acquired for conservation purposes – 2/3 vote to dispose of based on a determination no longer needed for conservation purposes. All other lands may be disposed of by majority vote.

After July 1, 1999, Governing Board needs to determine if land acquired for conservation purposes. All lands acquired prior to July 1 are designated as acquired for conservation purposes.

13. DISTRICT RULEMAKING (S.373.1391(6) –

Districts authorized to adopt rules that specify

1) allowable activities on District owned lands, 2) amount of fees, licenses, or other charges for land users, 3) application and reimbursement process for payments in lieu of taxes, 4) use of volunteers for management activities, 5) process for entering into or severing cooperative land management agreements. Rules only become effective after submitted to Senate President and House Speaker not later than 30 days prior to next regular session for Legislature review and approval.

14. FLORIDA FOREVER BONDS (s. 215.618) –

Authorizes issuance of up to $3 billion dollars in Florida Forever bonds for **acquisition and improvement** of land, water areas and related property interests for **purposes of restoration, conservation, recreation, water resource development, or historical preservation**, and for **capital improvements** to lands and water areas that accomplish environmental restoration, enhance public access and recreational enjoyment, promote long-term management goals, and facilitate water resource development subject to provisions of Florida Forever Act and s. 11(e), Art. VII of State Constitution. Fl. Forever bonds equally and ratably secured by Land Acquisition Trust Fund pursuant to s.201.15(1)(a) and payable from taxes distributable to the Land Acquisition Trust fund. Proceeds from the sale of bonds deposited into Florida Forever Trust Fund for distribution by DEP under 259.105. Land Acquisition Trust Fund is continued and recreated pursuant to s. 11(e) , Art. VII, State Constitution. LATF continues for so long as Preservation 2000 bonds or Florida Forever bonds are outstanding and secured.

15. DISTRIBUTION OF DOCUMENTARY STAMP TAXES COLLECTED (s. 201.15) –

Amount to be transferred into Land Acquisition Trust Fund can't exceed $300 million in FY 2000 to pay debt service, fund debt service reserve funds, etc. for P-2000 bonds, and $300 million in FY 2001 for Florida Forever bonds.

16. FLORIDA FOREVER ADVISORY COUNCIL (s.259.0345) –

Seven member council appointed by the Governor. FACC tasked with preparing a report to be submitted to DEP, TIITF and Legislature **by November 1, 2000**. Report is to establish specific goals identified in 259.105(4) (which applies to Water Management Districts pursuant to 373.199(4)(i), provide recommendations for development and identification of performance measures on progress made toward the goals, provide recommendations on the process by which projects are submitted and approved by Acquisition and Restoration Council. FFAC also to provide a report prior to the regular legislative sessions in years 2002, 04, 06, and 08. Report shall provide recommendations for adjusting the goals in 259.105(4), adjusting percentage distributions in 259.

17. ACQUISITION AND RESTORATION COUNCIL (s. 259.035) –

Created effective March 1, 2000. Nine voting members, four appointed by Governor, remaining five comprised of Secretary of DEP, Director, Division of Forestry, ACS Department, Executive Director, Fish and Wildlife Conservation Commission, Director, Historical Resources, Dept. of Start, and Secretary, DCA, or designees. Council provides assistance to TIITF in reviewing recommendations and plans for state-owned lands required under s. 253.034, consider optimization of multiple use and conservation strategies to accomplish the provisions funded in 259.101.(3)(a)(Florida P-2000 Act)

Appendix B
RAINFALL ANALYSIS

A primary goal of the Lower West Coast (LWC) Water Supply Plan is to identify areas of expected water supply shortage and the frequency with which those shortages may occur. Rainfall is responsible for nearly all surface water inflows and outflows in the Lower West Coast (LWC) Planning Area and is the single most important source of recharge to the Surficial Aquifer. Rainfall is also the single most important variable controlling the occurrence of water shortages in the LWC Planning Area.

RAINFALL DISTRIBUTION

Since rainfall varies from county to county within the LWC Planning Area, nine rainfall stations distributed throughout the LWC Planning Area were used to determine mean rainfall data (**Figure B-1**) These stations were chosen because they have relatively long and reliable records. A summary of the data is presented in **Table B-1**. The table also lists the period of record for each station, as well as the dbkeys used to retrieve the data from the District's DBHYDRO database.

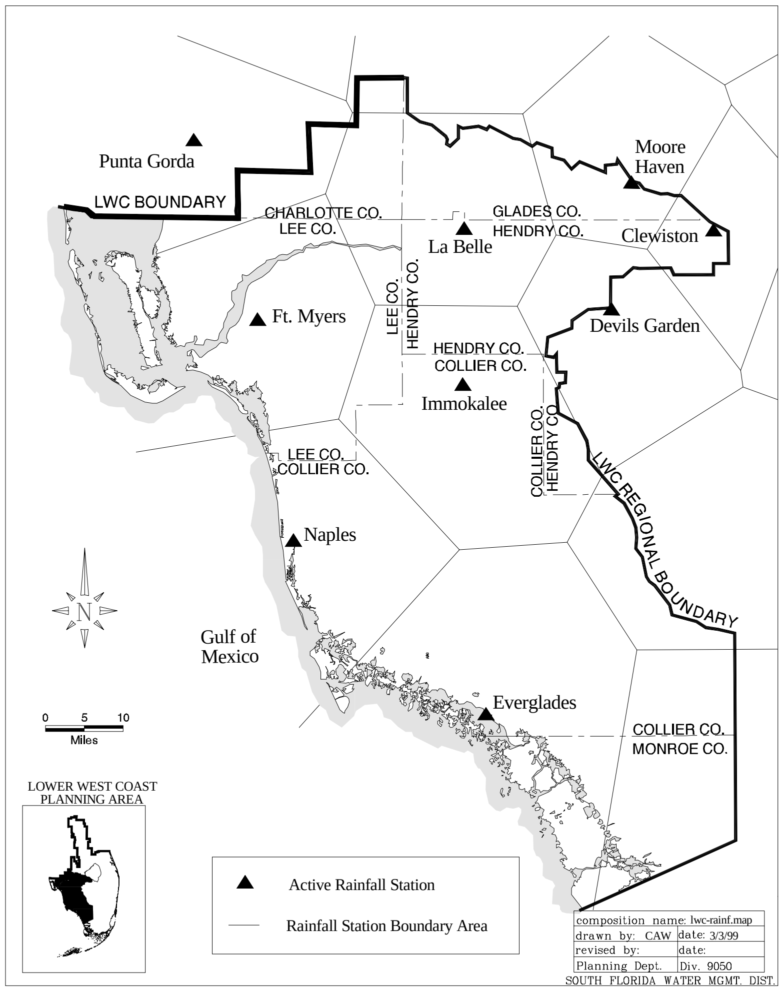


Figure B-1. Rainfall Stations in the Lower West Coast Planning Area.

The mean annual rainfall for the LWC Planning Area is approximately 52 inches (**Table B-1**). The mean monthly distribution of rainfall at the nine stations is presented in **Figure B-2**. The wet period begins on June 1 and ends on October 31, with the heaviest rainfall usually occurring in June or September. The dry period begins on November 1 and ends on May 31. December is usually the month with the lowest rainfall.

Monthly and annual rainfall recorded at each station for the entire period of record are presented in **Tables B-2** through **B-10**. The annual and monthly means for each station are also presented in these tables.

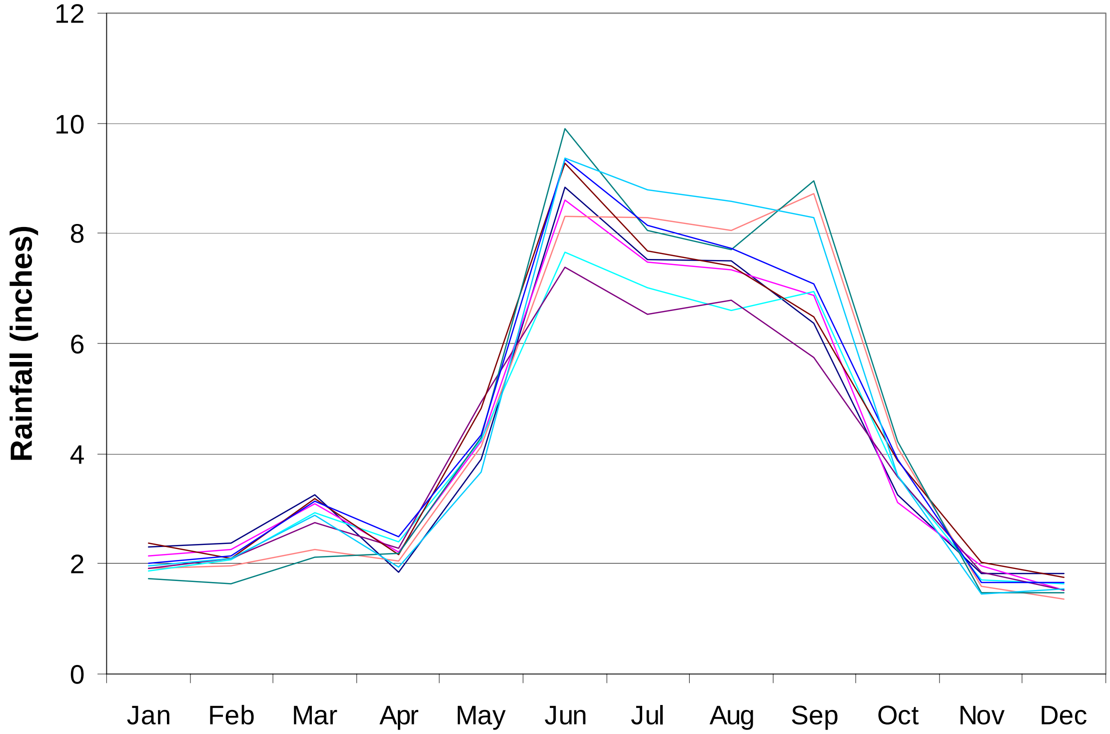


Figure B-2. Mean Monthly Distribution of Rainfall at Nine Stations in the Lower West Coast Planning Area.

Table B-1. Mean Rainfall Data for Rainfall Stations in the Lower West Coast Planning Area.

County	Rainfall Station	Average Annual Rainfall (inches)	Period of Record		Maximum Monthly Rainfall		Minimum Monthly Rainfall		% Rain Falling in Wet Season	Primary DBKEY[a]
			Number of Years	Years	inches	month	inches	month		
Charlotte	Punta Gorda	50.92	30	1968-1997	8.85	Jun	1.83	Nov	65.9	06139
Collier	Everglades	53.74	58	1940-1997	9.89	Jun	1.47	Dec	72.3	06161
	Immokalee	50.84	38	1960-1997	8.61	Jun	1.51	Dec	65.8	06195
	Naples	52.70	56	1942-1997	8.71	Sep	1.35	Dec	71.1	06160
Glades	Moore Haven	48.61	58	1940-1997	7.65	Jun	1.63	Dec	65.3	06124
Hendry	Clewiston	47.36	45	1949-1993	7.39	Jun	1.53	Dec	63.4	06155
	Devils Garden	53.16	42	1956-1997	9.27	Jun	1.74	Dec	65.3	05953
	LaBelle	53.64	58	1940-1997	9.35	Jun	1.65	Dec	67.5	06158
Lee	Fort Myers	54.20	58	1940-1997	9.36	Jun	1.46	Dec	71.3	06193
Overall Average		51.78			8.79		1.58		67.5	

a. Missing data were replaced with countywide mean data.

Table B-2. Monthly Mean Rainfall (inches) at the Punta Gorda Rainfall Station.[a]

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1968	0.11	1.88	0.50	0.58	8.24	14.66	9.68	8.90	5.33	2.95	4.54	0.46	57.83
1969	0.85	2.43	6.34	0.75	6.33	9.06	8.62	7.20	6.08	4.42	1.13	4.31	57.52
1970	4.86	1.41	9.26	0.09	6.52	7.78	3.86	7.96	5.24	0.79	0.30	0.69	48.76
1971	0.59	1.68	0.71	0.66	0.73	6.22	5.86	8.96	7.33	3.49	1.43	0.45	38.11
1972	0.66	2.16	3.70	0.80	7.77	8.33	5.51	10.59	3.71	2.68	4.40	2.55	52.86
1973	6.29	2.05	2.26	2.81	0.69	7.70	9.77	9.98	5.68	0.16	0.11	1.80	49.30
1974	0.10	0.18	0.43	0.63	2.49	23.99	7.89	9.92	4.63	0.56	0.68	2.34	53.84
1976	0.30	1.33	0.53	0.63	5.79	8.38	5.14	3.36	5.94	2.26	1.83	1.38	36.87
1977	2.44	1.15	0.39	0.52	6.03	3.48	8.36	8.39	10.01	2.48	2.08	4.92	50.25
1978	3.06	3.78	2.76	0.30	5.46	8.92	8.19	3.82	1.23	1.97	3.42	3.45	46.36
1979	7.07	0.99	1.17	2.13	7.34	2.00	3.52	9.60	14.03	0.63	0.80	3.45	52.73
1980	2.66	1.11	2.99	2.07	2.88	6.41	9.13	9.33	6.96	2.63	2.96	0.84	49.97
1982	1.45	5.61	4.72	1.67	1.59	7.45	13.15	7.60	10.07	3.33	1.89	0.36	58.89
1983	3.75	11.05	6.14	2.95	0.87	7.04	6.18	6.74	9.69	4.15	3.27	2.60	64.43
1984	0.58	3.31	5.35	3.22	3.74	6.89	10.79	3.50	6.99	2.18	1.04	2.15	49.74
1986	1.44	0.73	5.42	0.47	2.96	11.26	6.00	9.02	3.74	5.77	0.90	4.00	51.71
1987	2.31	2.44	8.18	0.11	3.78	7.89	5.87	6.68	3.44	6.25	5.07	0.59	52.61
1988	2.48	2.02	4.21	2.11	1.27	8.28	8.48	8.41	7.92	1.80	3.25	1.80	52.03
1989	2.25	0.80	1.95	2.05	1.05	5.89	7.26	8.26	5.69	2.13	0.23	2.83	40.39
1990	0.08	2.52	1.96	1.35	3.93	5.21	3.52	7.02	3.33	3.50	0.05	0.38	32.85
1991	5.84	1.87	3.03	1.66	9.45	8.30	7.47	4.19	3.36	1.11	1.75	0.28	48.31
1992	0.96	3.59	3.05	1.18	0.07	19.75	7.89	6.26	5.74	1.97	2.17	1.20	53.83
1993	4.34	2.96	4.04	3.46	0.78	6.37	6.30	4.55	5.10	6.23	0.09	0.64	44.86
1994	1.50	0.84	2.20	5.80	0.75	6.02	7.46	9.18	10.18	1.23	1.34	2.20	48.70
1995	2.79	2.72	1.11	3.49	1.80	17.63	14.22	15.60	7.33	10.88	2.61	0.88	81.06
1996	2.23	0.49	3.24	3.10	6.54	8.60	4.91	4.15	6.76	8.86	0.27	1.07	50.22
1997	1.43	3.14	2.21	5.15	6.32	5.36	8.28	3.41					
Mean	2.31	2.38	3.25	1.84	3.90	8.85	7.53	7.50	6.37	3.25	1.83	1.83	50.92

a. More recent data for these data series can be obtained from the hydrologic data base DBHYDRO. For more information contact Angela Chong (SFWMD) at (561) 682-6514.

Table B-3. Monthly Mean Rainfall (inches) at the Immokalee Rainfall Station.[a]

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1960	0.35	1.57	1.85	2.25	5.37	4.96	15.34	8.37	15.08	3.65	3.40	0.74	62.93
1961	3.36	2.00	2.60	1.58	5.69	3.09	4.76	4.43	2.38	0.55	0.80	0.30	31.54
1962	0.70	0.35	2.45	1.45	1.65	12.38	2.08	10.22	10.52	2.05	2.30	0.25	46.40
1963	0.65	3.23	1.42	0.75	7.02	7.19	3.85	6.38	5.88	0.40	2.12	3.15	42.04
1964	2.43	1.95	1.72	2.72	2.10	11.41	4.59	5.93	4.42	3.77	0.60	1.28	42.92
1965	0.70	3.09	1.93	0.34	1.45	8.25	11.17	9.42	3.96	4.40	0.51	0.70	45.92
1966	3.37	3.13	0.23	5.31	5.25	13.81	8.62	6.37	5.53	4.10	0.32	1.51	57.55
1967	1.72	2.79	0.12	0.00	0.60	8.83	14.23	3.95	7.35	3.80	0.50	3.10	46.99
1968	0.05	3.00	0.80	0.50	6.10	16.30	9.70	4.55	7.90	5.75	2.75	0.50	57.90
1969	1.50	2.30	4.00	3.30	2.20	11.10	4.60	8.05	6.90	7.40	2.60	1.65	55.60
1970	2.50	1.25	18.80	0.00	8.95	12.75	2.75	5.85	3.94	2.31	0.21	0.13	59.44
1971	1.23	1.05	0.31	0.39	3.45	11.14	5.89	5.95	7.32	3.04	0.53	0.93	41.23
1972	1.00	2.18	6.48	1.35	4.77	11.30	4.23	10.22	2.35	0.52	5.99	1.13	51.52
1973	3.07	2.85	4.72	1.40	1.28	7.96	9.21	15.99	5.19	1.28	0.36	1.41	54.72
1974	0.24	1.68	1.23	1.31	6.98	16.78	8.41	8.47	7.41	0.46	2.28	0.35	55.60
1975	0.15	0.61	1.04	4.35	4.74	13.96	6.00	5.66	10.44	2.83	0.62	0.36	50.76
1976	0.43	1.16	1.81	2.74	6.30	6.75	5.97	5.77	8.57	2.02	1.73	1.84	45.09
1977	4.33	1.15	0.06	0.20	2.81	6.00	6.88	6.06	6.95	1.36	4.87	2.47	43.14
1978	2.73	1.81	3.69	2.65	3.05	8.75	8.36	6.93	4.70	2.10	0.21	3.62	48.60
1979	4.87	0.52	2.86	4.26	8.69	1.87	5.77	5.04	14.27	1.34	2.80	5.02	57.31
1980	4.35	1.36	3.22	4.05	3.61	1.70	7.80	5.61	5.60	0.65	3.10	0.79	41.84
1981	0.54	1.95	1.34	0.32	0.76	7.51	6.20	10.65	5.15	1.80	1.86	0.25	38.33
1982	0.70	1.75	3.06	3.05	12.44	11.86	11.38	7.05	6.14	4.86	0.58	3.27	66.14
1983	3.81	11.37	5.20	1.57	0.48	8.22	8.28	7.68	7.24	3.17	1.89	5.67	64.58
1984	0.23	3.78	5.14	0.90	9.28	4.04	7.25	9.05	11.24	0.91	6.90	0.04	58.76
1985	0.47	0.37	1.79	4.44	0.35	4.24	6.81	5.28	7.12	3.20	1.44	0.84	36.35
1986	1.77	3.86	4.44	0.34	0.65	10.59	4.55	9.30	5.90	3.00	0.14	2.88	47.42
1987	3.25	3.39	8.04	0.07	8.30	3.53	6.10	4.51	5.87	4.97	9.12	0.14	57.29
1988	1.44	1.89	2.83	0.34	4.70	1.76	7.77	11.02	2.54	0.07	1.60	0.68	36.64
1989	1.28	0.40	4.20	6.47	1.06	10.84	10.70	5.31	3.49	2.00	0.42	1.94	48.11
1990	0.89	2.60	1.21	1.93	4.08	4.73	9.93	5.93	4.57	3.04	1.02	0.03	39.96
1991	8.12	1.81	3.01	2.01	8.87	8.86	9.82	9.15	5.73	5.30	0.91	0.55	64.14
1992	1.98	4.75	3.50	5.40	0.50	17.01	3.52	5.63	2.52	0.95	2.20	0.22	48.18
1993	8.18	3.09	4.01	3.50	2.52	5.69	6.03	5.20	11.56	2.81	0.70	1.28	54.57
1994	3.84	3.49	2.01	2.07	3.21	8.05	6.01	7.85	10.70	3.14	3.91	6.04	60.32
1995	3.21	1.25	1.02	3.70	1.03	14.00	14.80	15.27	13.45	17.12	0.90	0.70	86.45
1996	0.28	0.58	2.46	1.47	5.14	6.15	2.20	5.57	4.96	4.87	0.14	0.28	34.10
1997	1.48	0.34	2.86	6.13	5.44	3.71	12.75	5.47					38.18
Mean	2.14	2.26	3.09	2.23	4.23	8.61	7.48	7.35	6.89	3.11	1.95	1.51	50.84

a. More recent data for these data series can be obtained from the hydrologic data base DBHYDRO. For more information contact Angela Chong (SFWMD) at (561) 682-6514.

Table B-4. Monthly Mean Rainfall (inches) at the Naples Rainfall Station.[a]

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1942	2.27	2.93	2.93	3.80	2.62	14.16	5.76	7.12	9.81	0.00	0.50	1.21	53.11
1943	0.10	0.66	0.74	2.17	2.30	12.43	6.74	6.12	7.38	3.23	1.24	0.15	43.26
1944	0.85	0.07	1.06	3.13	2.44	2.45	1.30	7.42	7.23	4.21	0.05	0.39	30.60
1945	2.42	0.34	0.00	2.45	0.13	6.41	8.88	12.29	8.88	3.89	1.03	1.60	48.32
1946	0.75	2.18	0.23	0.00	11.49	6.91	5.55	4.56	9.23	2.03	9.69	2.09	54.71
1947	1.29	2.20	6.31	3.94	2.52	17.97	9.57	9.07	9.68	3.13	3.06	3.03	71.77
1948	3.67	0.00	1.12	2.72	1.95	11.50	12.12	3.35	12.27	3.09	0.35	0.49	52.63
1949	0.00	0.00	0.17	1.45	3.82	9.08	14.10	9.31	13.73	6.93	1.19	0.50	60.28
1950	0.15	1.12	0.58	1.45	2.95	4.21	9.48	7.24	9.48	3.98	1.17	2.24	44.05
1951	0.49	1.12	0.51	3.98	2.10	4.47	4.61	9.54	10.30	17.52	0.01	0.24	54.89
1952	0.63	6.00	1.94	0.98	0.90	5.02	5.90	1.46	8.37	8.22	0.80	0.31	40.53
1953	2.10	1.45	4.79	4.77	0.96	3.82	12.97	10.89	9.72	6.00	0.88	1.67	60.02
1954	0.82	2.37	2.87	4.48	5.70	9.43	8.23	10.37	8.51	1.84	1.27	0.92	56.81
1955	1.52	0.31	1.23	2.02	4.85	7.96	16.42	7.98	11.02	1.49	1.14	1.73	57.67
1956	2.00	0.63	0.05	2.95	7.37	1.56	3.19	3.60	5.69	3.86	0.95	1.17	33.02
1957	0.56	4.56	6.23	2.52	2.91	6.63	6.54	10.23	15.30	3.35	0.55	2.23	61.61
1958	7.28	1.67	5.54	1.59	6.87	9.41	13.40	9.49	7.60	3.41	0.28	3.84	70.38
1959	1.57	1.38	3.36	1.38	9.04	13.06	9.69	12.59	7.26	10.70	1.79	0.68	72.50
1960	0.24	1.08	2.53	1.86	5.32	6.04	13.20	6.10	14.41	5.59	2.85	1.38	60.60
1961	4.96	1.06	0.90	0.36	4.71	8.23	8.95	4.28	3.76	1.53	0.45	0.53	39.72
1962	0.88	0.62	2.76	1.02	5.48	12.72	4.73	14.60	19.54	1.63	2.43	0.21	66.62
1963	0.71	3.42	0.13	0.60	5.49	6.41	3.13	5.16	10.61	1.26	2.25	2.87	42.04
1964	2.28	1.94	2.25	0.66	3.50	6.50	6.54	5.63	4.71	2.05	0.64	0.56	37.26
1965	0.87	2.84	0.76	1.96	2.70	8.28	8.82	9.81	4.79	4.48	0.85	0.93	47.09
1966	3.42	2.30	0.53	4.21	2.12	11.69	7.07	10.94	4.30	3.72	0.18	0.70	51.18
1967	4.17	4.40	1.66	0.00	0.84	3.66	6.88	14.29	11.12	4.40	0.65	3.51	55.58
1968	0.19	2.64	0.54	0.05	4.16	15.28	12.84	8.26	8.98	5.04	1.87	0.63	60.48
1969	2.48	1.18	2.84	1.03	5.59	8.53	12.29	8.59	7.18	7.20	2.17	2.10	61.18
1970	1.95	1.97	13.56	0.00	5.32	6.48	5.26	4.68	13.32	2.87	0.43	0.02	55.86
1971	1.18	1.10	0.11	0.14	1.05	3.38	6.50	9.95	16.62	5.94	1.03	0.21	47.21
1972	0.54	4.55	2.19	2.11	6.63	13.67	3.69	11.21	4.85	1.63	3.59	1.12	55.78
1973	1.86	1.21	1.21	0.86	0.88	6.30	7.18	11.95	9.51	0.70	0.80	1.58	44.04
1974	0.12	0.41	0.00	0.03	5.19	12.83	6.73	5.56	7.59	0.06	2.72	1.14	42.38
1975	0.11	0.40	0.55	0.63	10.67	4.44	10.05	2.26	8.82	3.75	0.58	0.00	42.26
1976	0.70	1.62	0.22	1.27	10.55	14.50	7.40	6.52	5.53	3.21	1.06	1.58	54.16
1977	2.74	1.24	0.05	0.20	4.67	14.51	5.51	8.63	7.44	0.05	2.44	3.02	50.50
1978	2.48	3.51	5.28	2.54	5.31	6.42	6.67	12.10	5.75	1.57	0.18	3.93	55.74
1979	4.87	1.57	1.27	4.00	5.91	2.86	6.83	7.00	10.35	5.45	1.08	3.59	54.78
1980	3.67	1.44	1.85	2.47	3.04	0.91	10.93	11.81	10.79	1.38	2.98	0.75	52.02
1981	0.68	5.65	1.54	0.94	0.99	9.95	7.47	12.83	3.81	0.51	1.18	0.35	45.90
1982	0.59	2.18	1.96	6.68	4.16	14.09	7.84	7.53	8.32	3.16	1.96	2.77	61.24

Table B-4. Monthly Mean Rainfall (inches) at the Naples Rainfall Station.[a]

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1983	3.31	7.99	6.05	2.23	0.64	10.03	6.83	7.25	9.39	3.95	6.06	3.05	66.78
1984	0.49	2.32	4.47	0.54	4.69	7.66	6.52	4.73	10.07	0.56	0.91	0.50	43.46
1985	0.83	0.90	1.55	2.41	0.71	6.77	21.49	5.30	9.78	5.28	2.66	0.89	58.57
1986	1.75	1.94	2.44	0.80	4.98	9.46	3.79	7.77	7.61	5.24	2.11	3.14	51.03
1987	2.13	2.19	8.12	0.14	8.34	7.50	6.54	5.77	3.63	7.06	6.60	0.19	58.21
1988	1.08	0.99	2.58	0.16	1.30	2.31	8.66	9.55	6.25	0.84	1.70	0.35	35.77
1989	0.84	0.09	1.40	4.55	0.91	10.86	11.48	9.37	10.07	4.59	0.32	2.37	56.85
1990	0.09	2.21	0.84	2.77	4.62	10.17	5.69	2.17	7.39	5.13	1.06	0.07	42.21
1991	9.40	2.11	1.86	2.92	10.70	5.64	14.15	8.52	5.73	4.51	1.29	0.55	67.38
1992	0.49	3.69	2.65	2.55	0.91	10.94	7.90	9.22	8.27	0.69	0.57	0.06	47.94
1993	7.66	3.93	2.13	2.25	2.97	6.71	9.19	11.72	3.57	6.87	0.52	0.59	58.11
1994	1.56	1.67	1.11	1.21	0.93	10.86	11.30	7.49	9.46	3.79	2.54	3.58	55.50
1995	4.35	1.74	0.75	3.48	3.98	10.38	10.25	10.10	10.90	15.98	0.59	0.74	73.24
1996	2.10	0.01	1.72	1.71	6.20	2.74	2.60	5.56	3.58	7.40	0.26	0.30	34.18
1997	1.04	0.36	4.04	7.73	4.52	8.42	6.36	4.23					36.70
Mean	1.92	1.95	2.25	2.05	4.14	8.30	8.28	8.05	8.71	4.11	1.59	1.35	52.70

a. More recent data for these data series can be obtained from the hydrologic data base DBHYDRO. For more information contact Angela Chong (SFWMD) at (561) 682-6514.

Table B-5. Monthly Mean Rainfall (inches) at the Moore Haven Rainfall Station.[a]

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1940	2.37	3.07	5.55	2.06	3.36	4.96	7.92	10.43	14.13	0.32	0.42	3.91	58.50
1941	5.73	3.86	3.68	5.62	3.30	4.87	13.23	6.71	8.54	2.92	1.66	1.52	61.64
1942	2.80	3.51	4.55	5.64	1.99	9.51	4.81	5.66	4.16	0.03	0.46	1.62	44.74
1943	0.35	0.37	2.72	3.91	3.43	5.02	8.04	8.07	3.07	2.67	1.69	0.20	39.54
1944	0.98	0.12	2.35	5.41	1.52	5.50	8.36	5.42	9.23	3.47	0.07	0.27	42.70
1945	1.82	0.27	0.17	3.20	2.22	7.07	9.47	6.86	8.38	4.92	0.53	0.57	45.48
1946	0.68	0.76	2.53	0.27	7.52	5.74	6.90	4.49	7.77	1.16	2.16	0.90	40.88
1947	0.70	1.64	8.73	0.55	4.80	15.02	6.43	10.74	10.57	6.18	4.33	1.51	71.20
1948	4.16	0.38	0.62	3.15	2.24	4.67	6.00	3.94	21.55	2.42	0.57	0.57	50.27
1949	0.05	0.03	0.46	1.64	3.13	6.56	9.40	12.51	10.22	0.73	0.96	2.74	48.43
1950	0.06	0.72	1.40	2.88	3.29	4.55	7.53	8.86	2.77	5.54	1.57	1.45	40.62
1951	0.15	1.99	0.82	3.31	4.47	5.02	11.63	5.03	6.20	7.74	1.36	0.11	47.83
1952	0.92	5.02	1.50	2.25	10.74	7.56	7.05	8.09	6.35	11.11	0.19	0.46	61.24
1953	1.45	2.57	0.76	4.03	2.78	6.52	9.13	5.65	14.16	9.67	0.55	1.25	58.52
1954	0.38	1.72	2.24	3.52	11.96	12.53	10.58	5.96	6.48	2.63	1.19	1.89	61.08
1955	2.78	1.27	1.26	1.72	3.91	13.17	5.80	3.59	7.07	2.55	0.28	1.18	44.58
1956	0.86	1.04	0.40	1.58	1.13	5.43	3.53	4.67	5.18	6.47	0.13	0.52	30.94
1957	1.74	3.73	6.09	4.06	5.58	4.35	6.59	7.59	9.50	1.20	0.24	7.58	58.25
1958	6.04	0.84	7.03	5.84	4.91	5.93	8.32	4.12	3.09	4.59	0.47	5.77	56.95
1959	1.09	1.08	5.82	1.99	6.07	10.16	5.60	6.12	12.00	12.36	1.29	1.02	64.60
1960	0.31	4.31	1.37	6.55	2.77	11.35	11.11	6.37	11.30	5.99	1.21	0.69	63.33
1961	2.71	2.16	3.56	2.44	6.12	7.17	3.74	4.73	2.64	0.66	1.41	0.33	37.67
1962	0.88	0.47	3.57	2.60	2.33	11.46	5.46	7.71	8.78	1.20	4.03	0.22	48.71
1963	0.86	3.64	0.49	0.80	8.82	6.92	1.08	6.06	3.52	0.65	2.68	4.20	39.72
1964	2.55	4.75	0.61	0.67	2.34	5.20	4.78	8.89	3.46	2.74	0.65	0.72	37.36
1965	0.42	3.59	3.16	1.76	1.11	10.16	5.57	2.78	4.71	9.06	0.34	1.89	44.55
1966	5.47	3.67	0.42	3.01	5.97	9.26	10.93	11.19	6.76	2.62	0.11	0.40	59.81
1967	0.84	1.69	0.24	0.14	2.58	11.27	7.02	3.74	8.53	3.37	0.08	1.95	41.45
1968	0.58	1.72	1.03	0.85	8.64	10.73	7.13	4.23	6.81	3.21	2.25	0.21	47.39
1969	1.76	2.28	6.19	0.69	4.10	10.09	3.68	10.04	8.49	11.75	1.46	3.82	64.35
1970	3.55	2.40	12.63	0.02	2.98	8.74	5.91	7.35	3.46	4.70	0.13	0.28	52.15
1971	0.25	0.51	0.37	0.14	1.50	13.86	7.28	8.29	7.18	6.35	0.90	1.20	47.83
1972	0.30	1.55	2.24	2.34	7.52	10.50	2.77	6.40	0.93	0.40	2.21	1.39	38.55
1973	2.72	2.73	3.34	1.02	5.88	10.48	8.01	5.58	8.43	1.38	0.03	1.52	51.12
1974	0.14	1.36	0.08	0.97	3.00	14.91	18.56	7.99	5.91	1.35	1.64	1.71	57.62
1975	0.20	1.95	0.74	1.22	4.89	5.29	7.00	3.13	11.11	4.88	0.27	0.38	41.06
1976	0.65	1.41	1.59	1.81	4.43	3.10	9.98	12.31	5.74	0.80	1.88	1.99	45.69
1977	4.87	1.38	1.12	0.20	5.17	3.74	6.19	5.51	6.29	1.01	5.33	4.74	45.55
1978	1.78	1.39	2.64	2.06	8.38	5.43	9.32	2.67	6.40	2.23	2.13	4.39	48.82
1979	5.83	0.23	2.30	0.84	7.64	1.09	1.45	5.66	17.69	2.06	1.83	1.96	48.58
1980	2.76	1.08	2.32	5.29	2.23	3.10	7.58	7.61	6.88	1.47	2.20	0.62	43.14

Table B-5. Monthly Mean Rainfall (inches) at the Moore Haven Rainfall Station.[a]

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1981	0.87	1.52	1.28	0.38	2.06	3.33	3.70	10.29	4.54	0.24	1.27	0.15	29.63
1982	0.55	2.81	6.70	3.04	10.13	11.07	10.81	3.09	5.07	5.38	0.26	0.76	59.67
1983	4.22	8.04	5.57	1.75	0.38	7.46	4.36	5.95	3.36	4.29	1.61	2.78	49.77
1984	0.33	4.06	5.20	2.63	6.50	4.92	11.34	6.32	2.84	0.46	2.97	0.09	47.66
1985	0.60	0.41	2.11	7.04	1.11	4.51	8.15	5.34	6.17	1.88	1.41	3.22	41.95
1986	2.34	0.91	6.48	0.24	1.59	12.04	3.59	7.89	6.04	4.91	0.41	2.48	48.92
1987	3.65	1.93	6.59	0.00	1.33	4.18	6.42	3.77	9.91	6.06	8.53	0.59	52.96
1988	1.50	2.57	2.92	0.76	1.54	2.87	6.35	5.81	1.62	0.80	4.15	0.72	31.61
1989	1.62	0.10	2.76	5.02	1.62	5.76	6.45	3.01	8.33	2.93	0.35	2.19	40.14
1990	0.04	2.79	0.68	3.03	2.57	5.47	9.23	9.13	5.42	3.02	0.88	0.39	42.65
1991	5.57	0.90	3.93	4.47	6.58	6.18	6.93	8.02	3.05	4.90	1.85	0.33	52.71
1992	1.02	3.54	3.25	2.79	1.65	28.02	1.77	8.29	1.33	1.33	13.40	0.60	66.99
1993	2.42	0.09	1.56	0.00	1.36	2.54	3.18	6.07	4.09	1.87	0.79	0.90	24.87
1994	3.56	1.88	4.53	2.07	4.62	7.60	3.68	3.09	10.55	3.34	3.26	4.41	52.59
1995	2.56	3.55	1.71	1.99	2.33	6.92	11.44	9.34	5.24	8.03	0.27	0.54	53.92
1996	2.85	1.11	3.81	1.65	7.17	8.50	3.28	6.10	1.75	2.56	0.49	0.64	39.91
1997	1.02	0.74	1.79	4.95	7.56	4.62	5.64	8.15	7.84	0.45	4.54	3.95	51.25
1998	1.16	6.72											
Mean	1.87	2.07	2.92	2.41	4.26	7.65	7.02	6.59	6.94	3.60	1.71	1.63	48.61

a. More recent data for these data series can be obtained from the hydrologic data base DBHYDRO. For more information contact Angela Chong (SFWMD) at (561) 682-6514.

Table B-6. Monthly Mean Rainfall (inches) at the Clewiston (HGS2) Rainfall Station.[a]

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1949	0.26	0.64	0.58	0.99	2.50	13.24	6.82	10.78	9.64	0.75	1.10	3.98	51.28
1950	0.11	0.20	1.34	1.81	7.28	3.39	3.71	4.75	3.92	9.03	2.03	1.16	38.73
1951	0.14	1.51	0.81	3.52	3.78	4.47	10.64	7.18	6.22	9.60	1.14	0.26	49.27
1952	0.77	5.44	1.28	1.68	5.34	5.05	4.53	9.42	9.43	8.59	0.32	0.24	52.09
1953	1.77	2.27	0.55	3.25	2.97	7.51	7.02	11.11	10.43	6.75	0.56	0.93	55.12
1954	0.38	1.55	2.66	6.71	6.34	9.98	9.86	5.59	10.35	2.47	2.30	1.69	59.88
1955	1.49	0.92	1.17	1.50	4.87	12.12	7.16	5.52	7.23	1.18	0.58	2.09	45.83
1956	0.80	1.01	0.15	2.19	2.78	4.46	5.41	5.91	2.78	5.38	0.27	0.24	31.38
1957	3.50	2.78	4.11	2.96	11.00	7.88	8.89	5.60	8.64	2.44	1.19	7.91	66.90
1958	7.67	0.64	7.32	4.38	4.85	5.89	7.75	7.43	4.65	3.93	0.44	5.48	60.43
1959	0.91	0.34	6.86	1.92	8.95	10.71	6.50	8.94	8.66	8.54	4.24	0.55	67.12
1960	0.20	4.49	1.16	7.06	1.99	11.55	10.20	6.14	9.28	5.66	1.68	0.95	60.36
1961	3.18	1.63	3.01	3.08	9.43	4.84	5.31	7.25	4.31	1.67	0.43	0.20	44.34
1962	1.56	0.88	2.88	2.29	3.12	7.31	7.40	7.29	10.12	2.14	1.07	0.20	46.26
1963	0.52	3.77	0.12	0.12	4.71	4.12	1.92	4.12	4.58	0.85	1.79	4.20	30.82
1964	2.11	2.46	1.21	5.48	2.83	5.96	5.07	4.53	3.72	3.74	0.37	0.92	38.40
1965	0.67	5.33	2.65	2.92	1.27	12.77	5.76	4.28	6.47	8.07	0.25	1.15	51.59
1966	3.38	2.39	0.56	1.70	5.29	11.99	4.79	13.27	5.89	4.92	0.22	0.49	54.89
1967	0.86	3.70	1.77	0.02	1.82	11.01	6.04	6.50	5.37	3.84	0.12	1.43	42.48
1968	0.27	2.07	0.75	0.80	7.93	10.79	8.82	1.83	5.26	4.20	2.31	0.04	45.07
1969	2.56	1.86	6.52	0.22	4.96	4.91	3.53	7.08	4.71	9.06	1.45	2.24	49.10
1970	2.29	1.89	14.16	0.00	5.57	5.42	5.13	7.41	2.60	2.56	0.03	0.23	47.29
1971	0.45	1.15	0.22	0.13	5.14	3.56	11.08	4.71	4.87	2.75	2.64	0.45	37.15
1972	0.79	1.31	1.50	3.61	5.38	9.00	6.37	5.76	0.79	1.29	2.86	1.32	39.98
1973	2.04	2.76	2.68	0.83	3.88	5.41	7.06	6.71	5.39	1.04	0.20	1.59	39.59
1974	0.17	0.24	0.37	0.89	1.86	16.27	11.63	9.00	4.72	1.91	1.36	1.09	49.51
1975	0.46	2.19	0.55	2.06	9.99	5.88	8.65	3.29	7.89	2.00	0.22	0.18	43.36
1976	0.41	1.76	0.01	1.55	7.55	5.91	3.30	3.31	2.38	1.30	2.24	1.94	31.66
1977	2.98	1.59	2.37	0.24	9.13	5.08	5.09	6.80	8.40	1.94	11.14	4.06	58.82
1978	2.29	1.26	2.53	1.66	8.68	4.87	6.72	9.99	3.24	2.44	3.06	4.06	50.80
1979	5.35	0.16	0.84	0.85	3.60	1.06	2.51	4.72	13.69	1.60	5.74	1.68	41.80
1980	6.19	1.15	2.21	4.70	3.56	3.16	4.66	5.65	3.22	1.58	3.09	0.78	39.95
1981	0.68	1.53	2.17	0.20	2.23	4.70	2.25	11.96	3.31	1.03	2.09	0.10	32.25
1982	0.77	2.46	4.31	1.28	13.13	11.11	6.31	4.54	6.92	1.86	0.70	1.09	54.48
1983	3.97	8.09	5.15	1.16	0.74	9.33	7.63	4.15	3.83	6.69	1.65	3.54	55.93
1984	0.21	3.63	5.64	5.63	9.72	2.95	12.69	3.51	7.68	0.24	1.24	0.05	53.19
1985	0.55	0.36	2.74	3.15	4.64	4.14	9.64	8.55	8.13	4.60	1.50	2.16	50.16
1986	3.21	0.82	5.10	0.25	1.99	13.03	6.75	6.86	5.18	2.11	0.54	2.73	48.57
1987	3.04	1.67	4.58	0.03	0.86	3.83	3.12	7.17	2.83	5.17	9.86	0.31	42.47
1988	1.66	2.05	2.56	0.34	1.96	8.77	10.65	12.78	1.96	0.37	2.35	0.54	45.99
1989	1.12	0.01	3.11	7.67	2.48	4.87	5.23	7.97	8.43	2.86	0.32	1.80	45.87
1990	0.67	2.19	1.77	3.07	5.68	6.70	4.16	6.06	4.34	3.05	0.43	0.90	39.02
1991	5.30	2.35	4.03	4.97	5.63	6.80	6.45	6.08	0.58	2.25	2.64	0.47	47.55
1992	1.13	4.94	3.67	2.80	1.21	15.36	2.99	8.51	2.81	0.37	1.64	0.45	45.88
1993	5.99	2.62	3.89	1.55	3.35	5.33	6.80	5.37	3.78	6.76	1.28	0.76	47.48
1994	2.87												
Mean	1.91	2.09	2.75	2.29	4.93	7.39	6.53	6.79	5.75	3.57	1.84	1.53	47.36

a. More recent data for these data series can be obtained from the hydrologic data base DBHYDRO. For more information contact Angela Chong (SFWMD) at (561) 682-6514.

Table B-7. Monthly Mean Rainfall (inches) at the Devil's Gardens Rainfall Station[a].

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1956	0.88	0.97	1.24	1.69	3.99	6.25	7.02	8.46	5.88	3.57	0.63	0.34	40.92
1957	2.35	4.75	5.87	3.20	7.51	12.40	6.75	7.33	8.66	3.32	0.69	8.50	71.33
1958	7.10	1.13	11.07	2.52	3.78	6.46	9.98	4.84	4.98	2.30	0.72	4.95	59.83
1959	1.36	0.75	4.94	2.08	6.66	9.23	9.00	9.96	10.01	12.34	1.36	0.57	68.26
1960	0.22	2.49	1.03	4.58	3.52	10.76	12.95	8.68	12.21	2.02	1.82	0.69	60.97
1961	2.93	1.85	3.22	0.93	8.88	7.69	4.37	5.95	1.97	1.04	0.54	0.55	39.92
1962	1.43	1.47	2.68	1.12	2.76	10.06	5.22	6.71	10.59	4.47	1.48	0.26	48.25
1963	0.91	4.52	0.29	0.36	7.67	7.88	1.53	8.72	4.79	1.17	1.29	3.91	43.04
1964	2.35	2.85	2.01	2.68	3.33	5.00	6.75	7.53	4.76	3.70	0.82	1.94	43.72
1965	0.61	3.50	4.80	1.15	4.04	12.58	10.99	8.52	6.25	6.18	0.77	1.51	60.90
1966	4.81	2.50	0.59	2.94	3.88	16.55	10.71	9.12	3.94	4.38	0.14	0.32	59.88
1967	1.48	4.68	0.75	0.05	2.21	15.60	8.80	2.32	10.71	3.20	0.19	2.07	52.06
1968	0.61	3.13	1.49	0.92	8.90	12.16	9.58	4.10	6.46	4.11	2.36	0.17	53.99
1969	2.14	1.98	5.21	1.34	2.22	15.48	6.98	7.53	3.76	8.64	1.12	2.38	58.78
1970	4.83	1.16	14.13	0.00	11.26	5.85	7.41	4.91	5.21	6.01	0.00	0.30	61.07
1971	0.25	1.35	0.03	0.25	4.40	11.26	7.70	6.83	7.00	4.52	1.46	0.72	45.77
1972	1.75	1.15	4.26	2.07	3.39	10.04	3.40	7.30	2.06	2.98	3.02	1.19	42.61
1973	2.78	1.52	1.58	0.61	6.16	5.66	7.43	4.64	5.62	2.23	0.35	2.13	40.71
1974	0.39	0.76	0.27	1.19	5.88	18.10	11.46	9.05	5.94	0.69	2.98	1.40	58.11
1975	0.24	1.12	1.14	2.80	6.40	11.01	8.80	3.48	11.17	4.95	0.52	0.50	52.13
1976	0.90	1.61	1.47	1.24	10.19	6.33	4.29	5.74	5.68	1.58	1.48	1.97	42.48
1977	3.24	1.07	0.39	0.16	5.07	5.55	7.90	11.58	10.68	1.32	3.87	3.25	54.08
1978	2.35	1.18	2.74	1.44	5.32	7.77	9.64	9.05	5.34	5.14	1.83	4.85	56.65
1979	4.14	0.61	1.44	0.78	6.70	2.64	4.17	10.12	13.76	1.31	5.37	2.15	53.19
1980	5.92	2.21	2.79	6.17	2.69	4.25	8.04	3.63	6.70	0.67	3.04	0.84	46.95
1981	0.48	1.94	1.82	0.25	1.71	9.38	2.35	9.28	4.67	0.21	5.50	0.13	37.72
1982	0.52	2.29	2.85	3.65	11.30	18.87	8.86	5.79	7.00	5.31	1.05	0.44	67.93
1983	3.69	8.68	5.98	2.15	0.95	12.68	5.76	8.77	4.98	4.89	1.98	4.09	64.60
1984	0.17	4.31	3.99	2.60	6.26	6.33	11.52	5.68	7.83	1.12	3.76	0.00	53.57
1985	0.68	0.60	1.48	5.85	1.99	10.78	8.50	3.53	6.95	2.10	1.00	2.10	45.56
1986	3.30	0.72	7.06	0.30	3.02	16.40	6.51	14.58	3.40	8.00	0.80	2.60	66.69
1987	4.80	2.50	7.50	0.00	2.10	4.31	3.10	6.60	7.56	5.30	9.40	0.30	53.47
1988	0.80	2.80	3.50	2.40	0.60	5.00	10.10	12.10	1.05	1.00	7.55	0.00	46.90
1989	0.95	0.00	4.58	2.85	5.20	7.45	3.70	8.13	7.40	1.39	0.40	1.90	43.95
1990	1.00	1.80	0.40	2.45	4.03	5.61	6.95	12.10	1.70	3.30	0.40	0.05	39.79
1991	6.90	1.02	4.90	3.60	8.00	10.00	11.40	5.10	4.48	3.00	2.90	0.31	61.61
1992	6.50	3.00	2.80	4.58	0.90	13.30	6.25	5.40	5.12	1.00	2.21	1.00	52.06
1993	4.50	1.20	0.20	2.60	3.80	3.30	10.93	6.20	7.30	8.40	2.40	1.20	52.03
1994	2.00	2.80	1.90	5.50	2.30	5.30	9.20	7.30	9.70	4.10	4.00	6.25	60.35
1995	5.10	1.10	2.20	3.70	1.30	9.40	10.20	8.70	8.60	13.57	0.00	0.60	64.47
1996	2.89	0.70	4.30	0.70	10.10	8.40	5.40	8.80	4.90	7.40	0.52	0.15	54.26
1997	0.00	2.30	2.67	5.65	2.50	6.17	11.05	6.83	5.43	1.00	4.00	4.64	52.24
Mean	2.39	2.10	3.18	2.17	4.83	9.27	7.68	7.40	6.48	3.88	2.04	1.74	53.16

a. More recent data for these data series can be obtained from the hydrologic data base DBHYDRO. For more information contact Angela Chong (SFWMD) at (561) 682-6514.

Table B-8. Monthly Mean Rainfall (inches) at the Everglades Rainfall Station.[a]

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1940	3.08	2.68	1.42	0.65	2.65	12.61	3.78	6.26	16.01	0.42	0.00	5.13	54.69
1941	5.10	3.46	4.61	6.17	0.00	4.22	3.34	4.92	9.38	7.06	2.05	0.00	50.31
1942	2.42	1.90	1.76	0.70	2.88	12.24	5.74	3.74	2.70	0.32	1.35	0.75	36.50
1943	2.04	1.26	0.67	3.86	2.87	10.02	5.79	4.98	3.71	3.99	1.10	0.35	40.64
1944	0.82	0.04	1.25	1.11	6.24	8.58	4.61	6.71	5.09	5.31	0.19	2.29	42.24
1945	3.38	0.92	0.04	5.91	0.97	4.77	10.41	8.03	16.17	4.15	0.65	2.02	57.42
1946	1.02	1.27	1.22	0.45	4.85	10.63	11.99	7.90	10.24	2.00	2.17	2.53	56.27
1947	0.78	1.49	5.77	5.95	3.28	11.88	7.99	8.16	12.38	10.96	7.62	1.93	78.19
1948	1.88	0.14	0.19	2.73	3.45	4.02	12.48	7.74	18.90	3.74	1.57	0.65	57.49
1949	0.04	0.10	0.05	1.17	4.54	12.54	13.03	9.45	13.86	2.81	0.48	3.75	61.82
1950	0.02	1.42	0.22	0.68	2.81	4.18	10.33	7.68	5.31	7.41	1.59	2.61	44.26
1951	0.46	0.24	0.71	4.47	2.41	2.54	10.56	5.76	6.16	2.89	1.07	0.23	37.50
1952	0.43	5.36	3.37	1.21	3.10	7.17	9.13	2.97	15.28	8.94	0.77	1.04	58.77
1953	2.79	1.91	6.20	7.56	2.09	6.54	5.83	8.65	14.44	3.44	1.10	1.53	62.08
1954	0.05	1.58	6.00	7.87	11.33	9.56	7.52	7.28	9.52	3.03	0.79	0.91	65.44
1955	0.73	0.35	0.14	2.17	4.00	13.59	6.63	7.17	9.20	3.64	0.75	2.11	50.48
1956	1.64	0.78	0.09	4.67	8.60	3.43	4.77	6.62	3.84	4.57	0.77	0.14	39.92
1957	0.39	4.84	0.75	1.64	6.98	5.99	6.92	7.34	6.69	6.68	0.14	2.15	50.51
1958	6.81	1.07	5.30	0.81	12.88	8.45	8.68	13.02	8.69	5.11	0.47	4.05	75.34
1959	1.89	0.50	2.06	0.97	8.87	16.41	7.90	8.34	5.35	8.30	3.04	0.36	63.99
1960	0.34	1.42	3.09	3.84	2.24	9.68	17.45	3.12	14.41	5.59	4.16	1.01	66.35
1961	2.15	0.60	0.65	0.00	4.54	6.05	10.41	6.08	7.45	2.40	1.00	0.10	41.43
1962	1.00	0.25	2.30	0.65	2.40	14.35	9.07	7.39	14.12	2.90	1.79	0.67	56.89
1963	1.06	7.83	0.05	0.19	5.82	3.17	2.75	7.58	18.80	1.17	2.43	1.87	52.72
1964	1.49	1.37	0.92	0.23	6.35	10.94	9.70	5.36	6.30	5.63	1.41	0.64	50.34
1965	0.78	2.99	0.66	2.24	1.49	6.54	8.58	6.74	7.74	5.16	0.63	0.37	43.92
1966	3.91	2.09	0.39	3.17	4.54	20.78	14.55	3.45	6.33	4.20	0.17	0.18	63.76
1967	1.20	1.60	0.61	0.00	0.25	13.33	8.63	4.68	9.38	2.97	1.46	1.46	45.57
1968	1.65	2.84	1.14	0.26	9.43	16.12	5.47	7.31	14.59	9.03	1.15	0.15	69.14
1969	1.80	1.53	2.06	2.08	5.45	23.47	5.25	11.12	3.71	6.06	0.57	0.51	63.61
1970	1.79	1.24	15.21	0.00	5.21	3.41	10.94	4.55	5.82	4.76	0.43	0.00	53.36
1971	0.44	0.79	0.12	0.11	3.47	5.53	5.60	10.75	8.89	6.85	0.47	0.66	43.68
1972	1.33	3.03	3.87	1.96	5.31	16.08	5.27	9.29	11.63	1.63	4.91	1.20	65.51
1973	2.58	0.71	2.39	1.06	1.34	8.42	10.46	10.40	7.89	0.31	0.54	2.58	48.68
1974	0.35	0.00	0.00	2.27	5.68	14.75	9.43	6.30	5.74	0.11	0.36	4.15	49.14
1975	0.23	0.09	2.16	1.02	4.26	6.95	5.78	4.57	14.32	4.04	0.23	0.15	43.80
1976	0.34	1.80	1.04	1.90	5.31	10.29	5.45	5.85	5.23	4.44	0.83	2.05	44.53
1977	1.46	0.71	0.03	1.80	4.34	11.80	14.72	6.96	9.58	0.33	1.26	2.57	55.56
1978	2.17	3.92	3.93	1.79	3.39	12.10	6.88	6.48	10.31	5.71	2.91	2.96	62.55
1979	2.42	0.44	0.65	1.63	5.97	7.72	9.19	12.63	10.06	3.62	1.66	2.97	58.96
1980	1.25	1.06	2.10	2.76	4.55	0.60	8.24	8.24	5.47	0.32	2.91	1.04	38.54

Table B-8. (Continued) Monthly Mean Rainfall (inches) at the Everglades Rainfall Station.[a]

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1981	0.69	1.87	1.55	0.04	1.83	7.72	7.04	13.12	8.81	1.83	0.47	0.17	45.14
1982	0.31	1.21	1.74	4.58	5.48	17.71	9.64	11.61	6.21	4.74	1.42	0.65	65.30
1983	6.10	5.84	3.62	0.95	0.66	10.72	8.00	9.11	16.03	12.20	1.78	3.54	78.55
1984	0.45	0.80	3.53	0.85	4.25	5.75	13.99	8.61	6.61	4.17	1.35	0.18	50.54
1985	1.28	0.45	1.14	2.10	3.93	8.26	14.02	3.04	3.11	3.63	2.05	1.19	44.20
1986	2.42	1.94	1.66	1.23	0.49	16.44	4.61	11.60	4.19	5.56	1.27	7.62	59.03
1987	1.01	1.74	6.29	0.04	5.33	5.38	4.77	9.71	7.15	1.76	5.13	0.10	48.41
1988	1.16	1.44	0.95	1.65	2.60	5.63	3.05	6.12	5.73	1.66	1.57	0.98	32.54
1989	0.72	0.21	1.68	3.88	0.23	7.73	8.93	5.82	7.72	4.97	0.38	1.12	43.39
1990	0.10	0.40	0.86	0.81	4.03	8.84	8.42	12.40	5.50	4.18	0.75	0.09	46.38
1991	3.76	2.31	0.56	2.43	4.76	15.01	13.84	5.42	5.75	2.15	0.82	0.55	57.36
1992	0.34	3.93	2.34	3.29	0.48	17.16	4.50	15.22	6.04	1.59	1.36	0.08	56.33
1993	5.56	1.84	1.56	3.46	5.29	3.33	5.80	11.17	12.45	4.75	0.93	0.44	56.58
1994	4.18	1.19	1.58	6.27	3.33	9.81	5.04	5.54	9.80	4.67	6.13	4.25	61.79
1995	2.89	0.30	1.14	3.61	10.18	20.44	5.78	14.64	8.65	9.11	0.20	0.35	77.29
1996	1.85	0.17	1.60	1.67	7.14	14.45	3.73	4.65	5.84	1.71	0.07	0.90	43.78
1997	2.04	1.20	5.54	0.86	2.30	7.78	5.08	7.38					
Mean	1.73	1.63	2.11	2.20	4.28	9.89	8.06	7.70	8.95	4.22	1.48	1.47	53.74

a. More recent data for these data series can be obtained from the hydrologic data base DBHYDRO. For more information contact Angela Chong (SFWMD) at (561) 682-6514.

Table B-9. Monthly Mean Rainfall (inches) at the LaBelle Rainfall Station.[a]

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1940	2.50	3.31	4.56	2.04	0.71	5.21	5.91	7.43	14.18	1.22	0.24	3.18	50.49
1941	3.86	3.36	4.92	7.22	3.21	7.51	9.10	5.92	5.88	2.18	2.14	0.67	55.97
1942	1.82	3.00	3.17	3.10	1.63	12.12	5.23	4.53	4.07	0.31	0.27	4.63	43.88
1943	1.05	0.40	2.39	5.42	7.73	9.75	12.47	7.12	2.92	4.01	0.97	2.30	56.53
1944	1.61	0.03	2.78	1.94	3.07	11.20	9.65	9.21	5.53	4.35	0.55	0.23	50.15
1945	1.94	0.56	1.45	1.82	1.24	12.59	15.14	13.71	8.77	5.38	0.18	0.83	63.61
1946	0.70	2.81	2.11	1.05	6.96	10.27	8.66	7.07	7.98	3.33	1.70	0.81	53.45
1947	0.76	1.74	8.84	3.24	4.22	13.87	6.47	9.94	15.91	3.18	2.09	2.06	72.32
1948	4.07	0.00	0.77	3.68	2.42	5.43	9.39	7.94	18.51	3.78	1.29	1.14	58.42
1949	0.00	0.39	0.91	4.75	1.63	8.91	11.98	13.88	9.04	0.83	1.50	0.30	54.12
1950	0.05	0.94	0.72	2.25	2.59	3.33	5.45	6.01	3.69	8.01	1.86	4.39	39.29
1951	0.08	1.80	1.52	4.41	0.73	4.16	11.40	5.09	7.79	10.49	2.08	0.10	49.65
1952	1.03	4.22	1.44	1.26	8.69	5.86	7.51	1.30	9.77	13.46	0.45	0.79	55.78
1953	1.83	2.15	1.62	1.91	1.12	12.93	6.54	13.90	9.80	7.89	0.60	1.55	61.84
1954	0.22	2.76	2.15	5.05	3.64	13.17	12.82	2.21	7.70	2.62	1.96	2.09	56.39
1955	3.63	2.46	0.82	1.09	9.24	11.00	5.89	5.28	6.17	2.87	0.37	2.80	51.62
1956	0.85	1.51	2.78	2.59	2.60	3.82	7.76	7.03	5.94	5.55	0.32	0.92	41.67
1957	1.29	5.59	6.86	3.09	8.16	5.26	6.99	6.90	10.56	2.95	0.59	4.85	63.09
1958	5.36	1.29	7.03	3.44	7.17	8.65	7.40	4.35	4.53	3.58	1.37	4.36	58.53
1959	2.05	1.21	7.35	0.87	5.45	13.58	10.23	6.90	8.00	7.69	1.32	1.07	65.72
1960	0.49	4.09	1.52	3.18	6.48	4.40	13.07	5.25	9.36	4.17	1.58	0.81	54.40
1961	3.16	1.10	1.76	2.08	5.01	4.79	5.73	5.14	3.86	0.66	0.62	0.34	34.25
1962	0.84	1.10	4.84	1.61	3.42	17.75	6.56	7.19	12.52	1.61	4.15	0.32	61.91
1963	0.77	3.93	0.47	0.20	8.26	8.90	3.09	6.48	3.78	1.15	3.96	3.32	44.31
1964	2.47	4.97	0.52	2.84	2.31	8.60	7.64	11.10	3.91	0.87	0.43	0.89	46.55
1965	0.72	2.81	4.03	3.40	0.56	17.11	9.44	9.67	7.51	5.52	0.34	1.09	62.20
1966	2.49	2.91	1.01	3.60	7.57	14.11	5.64	8.31	15.06	3.04	0.14	0.96	64.84
1967	2.98	2.93	0.19	0.13	1.76	10.42	9.35	7.49	5.23	5.28	0.42	2.43	48.61
1968	0.10	1.79	2.22	0.26	9.19	10.87	12.54	7.64	4.29	4.82	2.84	0.12	56.68
1969	1.75	1.77	7.37	0.21	4.47	10.86	5.97	7.56	3.67	6.39	0.53	3.46	54.01
1970	4.83	2.73	13.49	1.27	7.52	2.95	6.56	6.95	2.85	1.64	0.22	0.32	51.33
1971	0.53	1.82	0.41	0.70	7.46	11.79	7.40	8.76	6.41	5.92	0.13	1.04	52.37
1972	0.83	2.40	1.27	3.28	1.14	10.51	4.47	8.02	3.14	2.04	6.61	1.66	45.37
1973	2.61	2.85	3.66	1.55	2.32	5.79	9.30	8.24	5.62	2.23	0.35	1.02	45.54
1974	0.10	0.81	0.04	1.42	7.86	16.34	9.43	6.77	5.62	0.84	1.64	1.72	52.59
1975	0.16	0.75	0.76	3.90	4.16	6.34	8.33	6.00	4.41	6.27	0.29	0.60	41.97
1976	0.17	1.30	3.16	0.99	5.80	4.54	8.16	4.26	7.78	2.06	2.50	1.88	42.60
1977	4.03	0.51	0.12	0.14	5.32	4.18	9.34	7.41	6.76	0.38	2.21	3.85	44.25
1978	2.31	1.97	3.31	0.95	5.16	6.75	9.51	4.47	9.05	0.87	1.74	4.72	50.81
1979	5.64	0.46	1.90	1.33	8.57	6.94	3.09	7.10	14.11	3.30	2.06	3.18	57.68
1980	2.15	1.77	2.54	3.47	3.81	1.41	9.23	9.08	4.50	1.80	3.83	0.75	44.34

Table B-9. (Continued) Monthly Mean Rainfall (inches) at the LaBelle Rainfall Station.[a]

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1981	0.99	1.79	1.51	0.16	0.92	8.47	5.03	11.46	4.78	0.35	1.84	0.55	37.85
1982	0.70	1.14	3.93	2.31	10.68	11.70	5.27	6.89	5.27	1.61	0.22	1.08	50.80
1983	3.87	11.58	7.47	1.59	1.64	15.26	3.10	7.76	7.04	3.67	1.86	3.23	68.07
1984	0.47	2.52	5.29	2.01	5.59	10.61	12.34	2.79	5.61	1.19	5.17	0.59	54.18
1985	0.72	0.61	2.22	4.07	2.39	7.93	6.44	8.05	6.84	1.94	1.62	1.31	44.14
1986	2.99	0.91	5.26	0.27	1.14	13.78	6.84	13.75	6.22	3.72	0.36	3.55	58.79
1987	3.52	2.28	10.55	0.07	4.40	3.19	11.45	4.94	7.76	9.08	9.04	0.52	66.80
1988	2.70	1.84	4.40	0.86	4.35	4.42	5.19	10.64	1.66	0.81	6.34	1.81	45.02
1989	1.14	0.68	4.63	4.09	3.09	9.95	8.04	8.59	7.69	8.51	0.65	1.81	58.87
1990	0.11	3.18	0.26	5.14	3.09	11.76	8.94	11.28	2.23	2.58	0.72	0.18	49.47
1991	7.03	1.26	2.61	4.96	8.07	9.26	12.88	11.12	9.80	3.96	2.18	0.05	73.18
1992	2.21	3.36	3.13	3.81	1.35	16.99	3.87	6.13	5.33	1.24	0.79	1.13	49.34
1993	5.91	1.63	3.01	2.02	0.06	8.26	4.27	11.20	7.59	5.85	1.60	1.10	52.50
1994	2.28	3.92	2.49	3.46	1.50	10.86	5.45	8.72	9.39	5.95	2.47	3.47	59.96
1995	3.56	1.25	1.45	2.75	1.90	14.25	16.73	9.70	6.46	11.58	0.75	0.20	70.58
1996	3.95	0.95	3.78	1.10	6.30	10.80	3.37	11.29	3.37	5.20	1.12	0.00	51.23
1997	0.27	1.42	1.30	9.22	5.01	11.12	13.03	5.50					46.87
Mean	2.00	2.15	3.14	2.49	4.34	9.35	8.14	7.73	7.07	3.89	1.67	1.65	53.64

a. More recent data for these data series can be obtained from the hydrologic data base DBHYDRO. For more information contact Angela Chong (SFWMD) at (561) 682-6514.

Table B-10. Monthly Mean Rainfall (inches) at the Fort Myers Rainfall Station.[a]

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1940	3.79	4.00	4.41	1.73	0.73	10.52	3.50	8.69	13.02	0.61	0.13	5.42	56.55
1941	3.02	3.82	6.88	7.66	1.16	7.12	15.28	7.46	6.09	0.96	2.48	0.99	62.92
1942	1.60	3.35	2.31	4.54	3.38	11.15	10.66	9.18	5.37	0.50	0.08	1.80	53.92
1943	0.74	0.71	1.61	4.45	5.96	16.06	12.24	8.59	5.68	3.56	2.37	0.48	62.45
1944	1.20	0.00	3.76	0.85	4.00	3.73	5.09	5.89	3.56	5.77	0.00	0.32	34.17
1945	2.19	0.68	0.10	0.21	1.58	11.97	12.41	11.06	5.71	5.19	0.03	1.45	52.58
1946	0.35	2.24	0.19	0.01	6.71	10.19	5.78	6.47	5.21	1.34	3.39	0.57	42.45
1947	0.83	2.92	8.94	2.82	6.47	12.84	11.17	9.40	16.32	4.97	2.05	1.44	80.17
1948	4.16	0.06	0.83	1.57	2.19	5.06	10.08	4.98	14.05	3.90	0.45	0.63	47.96
1949	0.01	0.07	0.13	5.50	4.03	7.53	13.32	7.60	12.70	3.60	1.27	1.62	57.38
1950	0.00	0.08	0.49	0.08	4.14	4.84	6.83	5.93	8.32	3.26	0.02	2.20	36.19
1951	0.38	1.96	1.13	2.71	2.14	9.19	11.44	10.30	3.48	11.91	1.14	0.14	55.92
1952	1.28	4.34	2.05	0.78	1.75	7.95	5.74	8.39	12.35	8.34	0.75	0.71	54.43
1953	1.71	2.01	0.68	2.28	0.41	12.81	9.34	4.32	15.58	6.68	1.07	1.18	58.07
1954	0.30	2.53	2.13	3.49	4.08	4.78	9.19	6.84	10.31	1.82	2.33	1.93	49.73
1955	2.68	1.16	0.32	0.97	3.23	8.53	8.76	4.29	10.50	2.15	0.52	0.85	43.96
1956	0.57	1.06	0.05	3.50	4.76	4.67	5.34	8.03	6.00	4.42	1.35	0.10	39.85
1957	0.78	3.68	4.73	2.69	7.97	4.85	12.52	9.39	8.77	3.19	1.52	3.55	63.64
1958	6.04	1.26	10.31	2.18	6.22	7.37	10.92	4.12	8.89	4.57	1.43	3.36	66.67
1959	1.48	1.72	6.33	1.75	4.74	16.10	6.17	5.75	6.89	12.04	1.92	1.79	66.68
1960	0.46	3.61	1.87	3.83	2.20	5.20	13.76	5.66	11.93	3.01	2.02	0.73	54.28
1961	3.31	1.88	3.58	0.46	4.92	9.75	9.82	13.41	2.80	3.16	1.12	0.53	54.74
1962	0.43	0.54	2.65	1.37	0.34	12.08	6.01	10.89	14.54	5.44	3.01	0.85	58.15
1963	0.81	4.65	0.59	0.27	7.58	7.70	4.06	3.98	7.49	0.05	3.45	2.27	42.90
1964	2.88	3.30	2.12	0.80	0.50	4.58	2.28	4.26	9.45	1.38	0.22	1.06	32.83
1965	1.24	2.99	2.91	2.39	4.70	7.78	12.05	6.57	4.35	4.42	0.58	0.85	50.83
1966	3.39	1.06	0.37	3.03	1.61	12.42	8.22	8.10	4.18	2.14	0.18	0.29	44.99
1967	1.15	2.15	0.72	0.00	1.46	7.41	6.69	15.86	7.04	3.08	0.92	2.91	49.39
1968	0.40	1.94	0.65	0.57	10.32	15.03	9.85	11.44	8.92	7.99	2.88	0.16	70.15
1969	1.44	2.87	4.74	0.15	4.71	10.63	7.11	8.49	16.60	11.03	0.22	3.95	71.94
1970	4.36	2.20	18.58	0.00	6.36	7.47	4.74	4.82	8.29	1.19	0.46	0.37	58.84
1971	0.85	1.55	0.55	0.70	3.77	6.18	9.50	8.06	9.21	6.49	0.16	0.30	47.32
1972	0.77	2.14	4.72	0.27	5.20	7.86	9.72	16.22	2.33	2.20	3.85	1.43	56.71
1973	3.14	2.23	3.89	1.71	0.78	3.99	9.57	8.66	8.38	0.16	0.10	1.72	44.33
1974	0.36	0.81	0.03	0.11	2.40	20.10	14.47	7.70	4.31	0.19	1.46	0.89	52.83
1975	0.26	0.27	1.47	0.80	2.78	10.55	10.81	7.74	12.59	3.05	0.49	0.69	51.50
1976	0.21	1.20	0.91	0.90	5.22	10.59	6.14	8.95	8.81	1.96	2.10	1.68	48.67
1977	3.53	0.15	0.09	0.76	6.51	8.96	9.60	10.58	9.21	0.43	1.50	2.74	54.06
1978	2.48	3.36	3.43	2.35	2.52	6.75	10.29	10.90	5.18	1.45	0.04	4.35	53.10
1979	7.45	1.94	0.43	3.12	5.32	8.31	5.96	14.79	13.65	0.39	0.46	5.16	66.98
1980	2.44	1.04	3.59	1.52	8.73	1.99	7.02	8.79	4.64	1.54	3.15	0.55	45.00

Table B-10. (Continued) Monthly Mean Rainfall (inches) at the Fort Myers Rainfall Station.[a]

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
1981	0.80	1.65	1.29	0.08	3.07	11.79	8.24	16.73	6.70	0.40	0.71	0.73	52.19
1982	0.78	3.34	3.32	3.91	2.08	15.01	11.33	10.56	9.29	5.00	1.11	0.27	66.00
1983	4.50	10.82	7.41	1.34	0.62	17.92	4.77	6.46	9.72	4.39	3.66	3.24	74.85
1984	0.15	3.15	6.38	1.09	2.80	8.65	8.99	5.50	7.89	0.65	0.71	0.02	45.98
1985	0.68	0.44	2.06	1.47	1.21	3.76	8.78	7.79	11.71	6.78	2.20	0.66	47.54
1986	0.90	1.01	3.59	0.53	4.01	13.94	6.73	11.16	5.43	3.56	0.78	5.22	56.86
1987	2.29	2.86	5.86	0.14	4.11	9.69	14.38	8.54	7.50	5.10	8.06	0.48	69.01
1988	2.19	1.47	2.44	1.36	0.62	7.16	5.13	9.21	3.15	0.40	2.83	0.26	36.22
1989	1.65	0.36	2.88	0.32	8.10	7.83	8.69	8.95	5.67	2.63	0.65	2.16	49.89
1990	0.47	3.37	0.87	0.39	3.66	9.02	6.47	14.97	7.40	2.28	0.01	0.13	49.04
1991	7.95	0.72	1.13	5.01	8.48	11.22	14.51	5.87	7.98	4.01	0.32	0.30	67.50
1992	1.75	3.89	4.87	2.08	0.97	18.73	8.59	7.59	3.68	1.24	1.19	0.87	55.45
1993	5.36	3.35	3.61	2.40	2.71	6.63	7.23	6.57	8.29	6.85	0.78	0.78	54.56
1994	2.92	2.17	0.99	5.68	0.34	4.73	9.70	9.18	7.67	2.96	2.50	3.82	52.66
1995	3.12	1.40	0.88	5.34	1.38	13.97	12.14	13.90	9.58	8.93	0.08	1.01	71.73
1996	2.51	0.55	3.06	2.84	3.01	11.54	3.01	8.29	8.33	3.37	0.19	0.37	47.07
1997	1.31	1.59	1.21	3.99	2.67	8.91	7.53	4.50	8.10	0.25	6.09	5.93	52.08
Mean	1.96	2.10	2.88	1.95	3.68	9.36	8.79	8.59	8.29	3.59	1.46	1.56	54.20

a. More recent data for these data series can be obtained from the hydrologic data base DBHYDRO. For more information contact Angela Chong (SFWMD) at (561) 682-6514.

FREQUENCY ANALYSIS

1-in-10 Year Drought Event

Water supply needs of existing and future reasonable-beneficial uses are determined based upon meeting the needs of a 1-in-10 year drought event (Section 373.0361, (2)(a)1 F.S.). However, this section did not describe the methodlology for determining 1-in-10 criteria. A 1-in-10 year drought event is defined as rainfall with a probability of exceedance of 90 percent for a twelve month period. This means that there is only a ten percent chance that such a small amount of rain will fall in any given year. Model simulations were used to analyze potential impacts on wetlands and aquifer levels within the LWC Planning Area under both average and 1-in-10 year drought event rainfall conditions.

Statistical Method

The statistical approach utilized here requires selection of an initial month and an analysis of twelve cumulative rainfall data sets following this month. March was selected as the beginning of the rainfall year because it is a critical month in the growth cycle of citrus. The method used to calculate 1-in-10 rainfall is most precise at the beginning of the calculation period, therefore a calculation year starting in March is used. A statistical rainfall frequency analysis was performed on the March rainfall data for each station. Similar analyses were performed on historical rainfall for durations of two months (March through April) through twelve months (March through the following February). Estimates of 10 percent drought frequency rainfall were made for each duration and individual month amounts were obtained by subtraction of consecutive cumulative amounts. For example, the November rainfall amount was obtained by subtracting the cumulative March-November drought frequency estimate from the cumulative March-October estimate. This analysis produces a set of monthly values that has a constant cumulative drought frequency of 10 percent. With the exception of the initial month of March, drought frequencies were not determined using the individual monthly rainfall amounts.

Each rainfall time series was fitted to the logarithmic-normal probability distribution. The logarithmic-normal distribution is useful in defining many hydrologic random variables where the values of the variate are the result of underlying multiplicative factors and are known to be strictly positive (Alfredo et al., 1975). This distribution has been previously used to define rainfall. A nonparametric test was performed on each of the time series to assess the goodness-of-fit to the assumed underlying probability distribution. The values for 1-in-10 year drought events are listed in **Table B-11** and the statistical 1-in-10 year drought event plots for the nine rainfall stations are presented in **Figure B-3**.

Table B-11. Statistical 1-in-10 Year Drought Events (inches) for Rainfall Stations.[a]

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
Clewiston	1.7	2.0	0.3	1.0	3.5	5.8	4.5	6.3	4.9	3.0	2.2	1.3	36.7
Devils Garden	1.5	1.8	0.4	1.0	4.1	7.1	6.2	7.6	6.0	2.1	2.5	1.4	41.6
Everglades	1.4	1.5	0.1	1.0	2.8	7.1	6.9	6.9	7.9	3.1	1.2	1.1	41.0
Fort Myers	1.3	1.7	0.3	0.7	2.9	7.2	6.8	7.4	8.0	2.4	1.2	1.3	41.2
Immokalee	1.9	1.5	0.5	0.7	2.5	7.5	6.8	6.5	5.5	1.6	1.6	1.2	37.8
LaBelle	1.4	1.8	0.5	1.2	3.5	7.4	7.0	7.3	5.5	2.9	1.8	1.9	42.2
Moore Haven	1.4	1.8	0.5	1.1	2.9	5.5	5.5	6.1	6.0	2.4	1.6	1.3	36.2
Naples	1.5	1.6	0.1	0.7	3.0	5.6	6.8	7.2	7.5	3.6	1.2	1.0	39.6
Punta Gorda	2.2	1.7	0.7	0.9	2.9	7.1	6.2	6.9	5.8	2.6	1.2	1.6	40.0

a. Calculations Start with March.

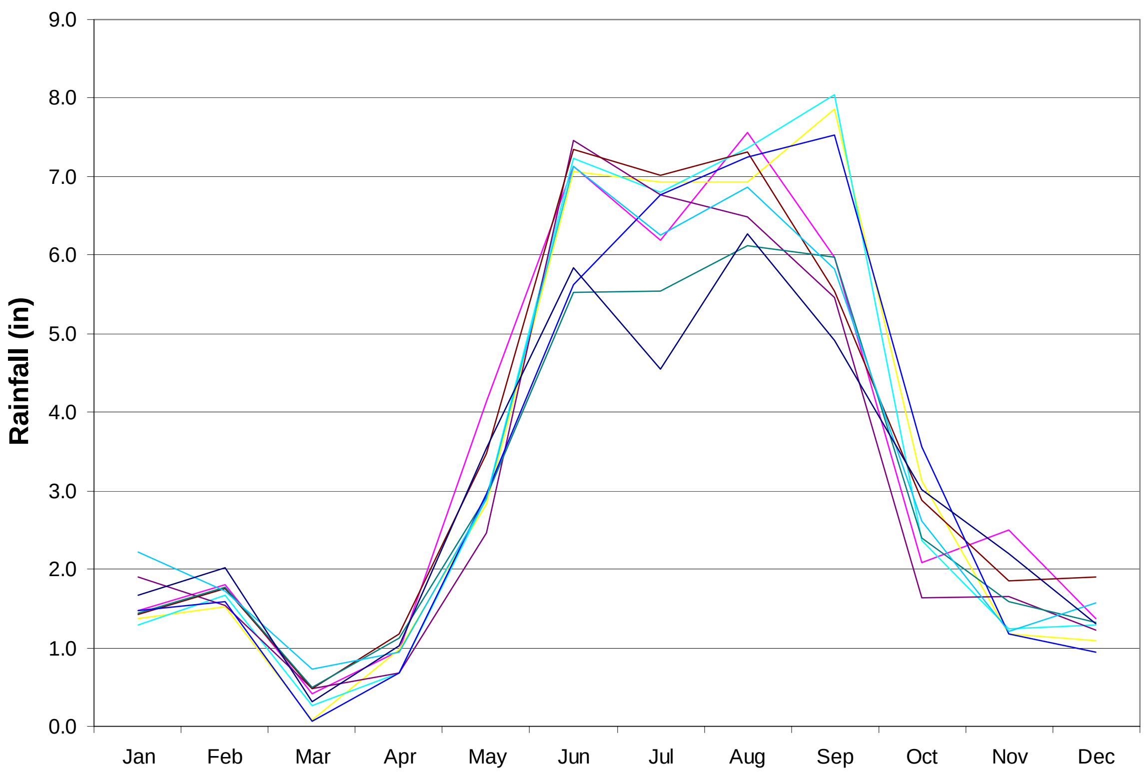


Figure B-3. Statistical 1-in-10 Year Drought Events for Rainfall Stations.

REFERENCES CITED

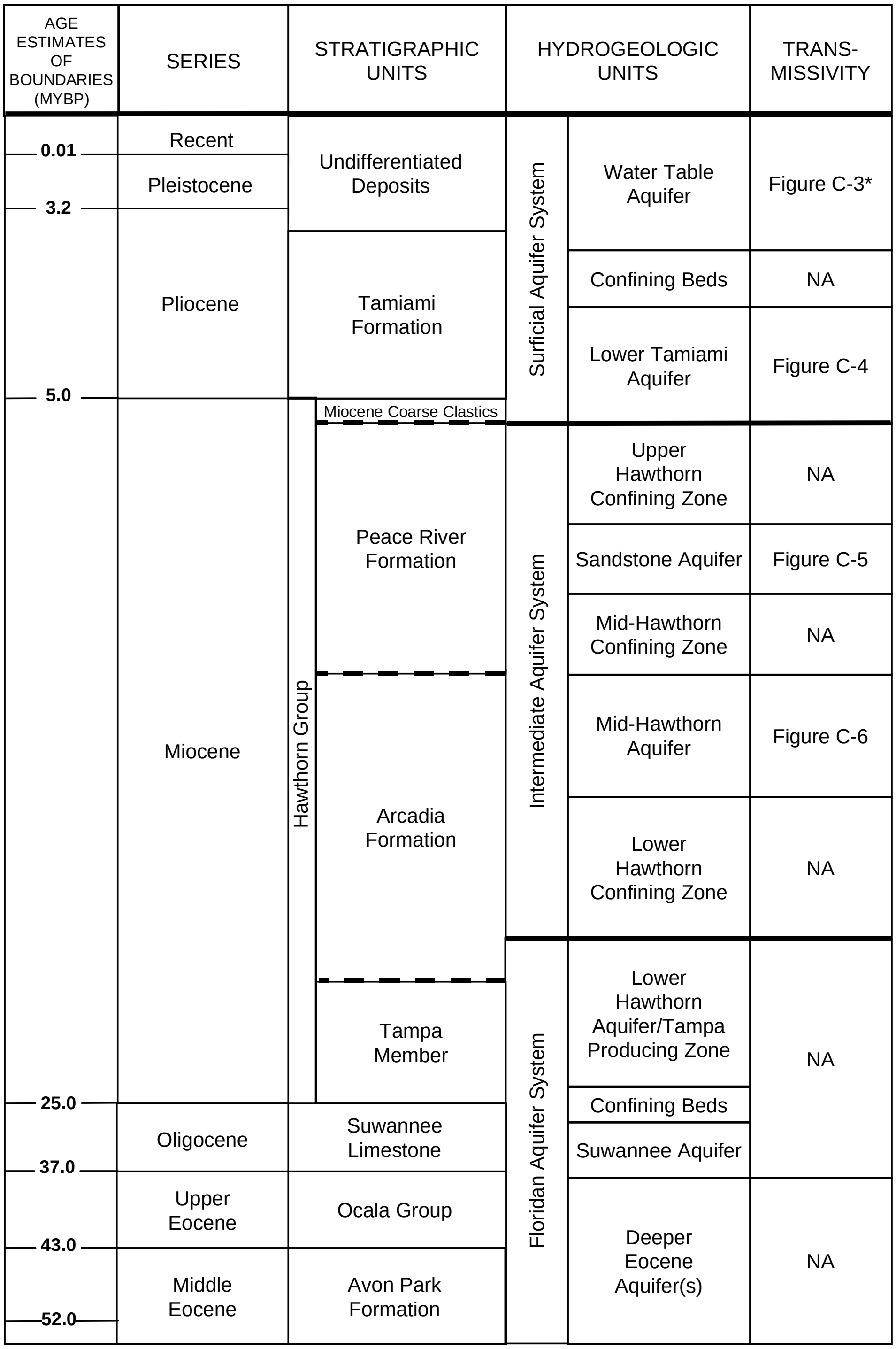
Alfredo, H., S. Ang, and W.H. Tang. 1975. *Probability Concepts in Engineering Planning and Design*. New York: Wiley and Sons.

Appendix C
GROUND WATER RESOURCES GRAPHICS

This appendix presents maps displaying the hydrologic characteristics of the aquifer systems found in the Lower West Coast (LWC) Planning Area: the Surficial Aquifer System (SAS), the Intermediate Aquifer System (IAS), and the Floridan Aquifer System (FAS). Additional generalized information can be found in Chapter 3 of the LWC Water Supply Plan Support Document for Charlotte, Collier, Glades, Hendry, and Lee counties. This appendix includes the following:

- A ground water resources graphic that depicts temporal and physical relationships between these different aquifer systems (**Figure C-1**)
- A generalized stratigraphic cross section showing the elevation and thickness of each of the aquifer systems (**Figure C-2**)
- Maps that display the hydraulic conductivity, transmissivity, thickness, and elevations of the different aquifer systems (**Figures C-3** to **C-16**)
- A shaded relief map of the LWC Planning Area depicting topographic surface elevation (**Figure C-17**)
- A table presenting individual permit allocations in the LWC Planning Area (**Table C-1**)

Information on ambient ground water quality, contamination sites, and saltwater intrusion are presented in Appendix G.



NA = Either the unit is a confining zone, or insufficient data was available.
MYBP - Million years before present.
* Hydraulic Conductivity

Dates are referenced to Decade of North American Geology Time Scale (Geology, 9-83).

Figure C-1. Temporal and Physical Relationship Between Major Aquifer Systems in the Lower West Coast Planning Area.

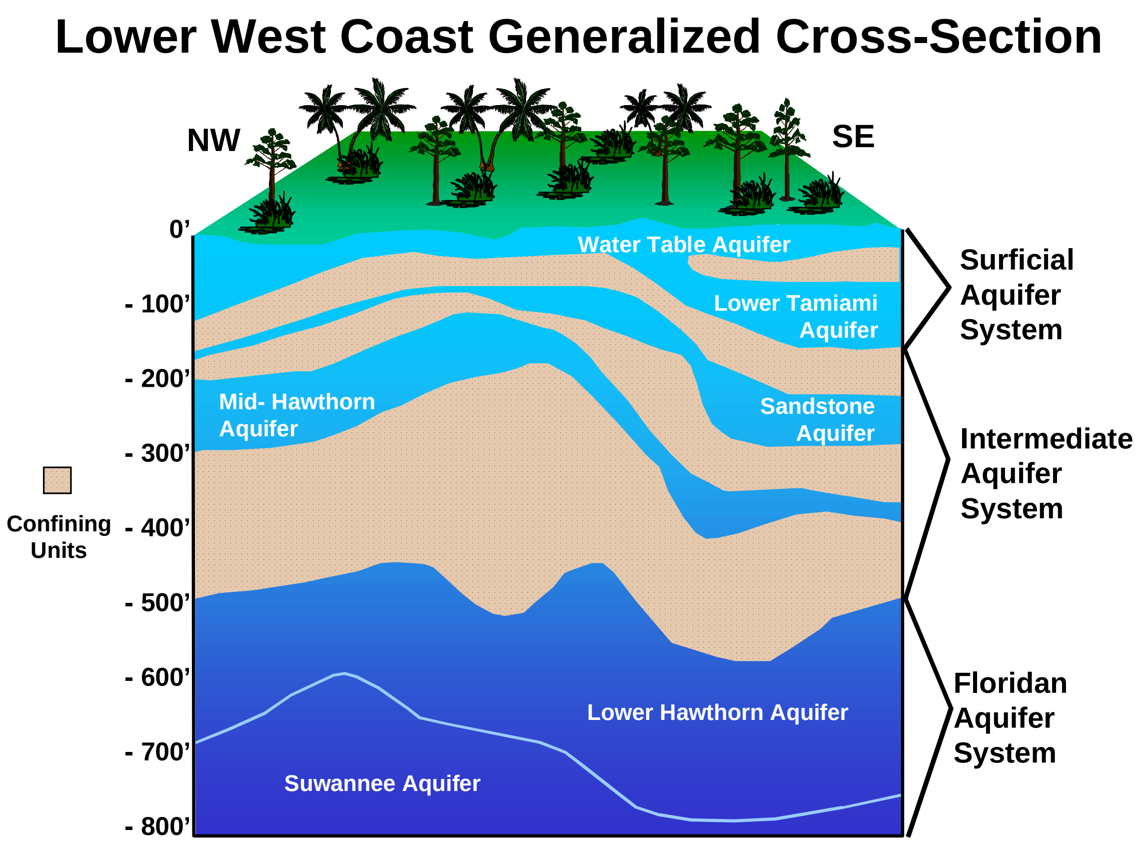


Figure C-2. Generalized Cross Section of Aquifers in the Lower West Coast Planning Area.

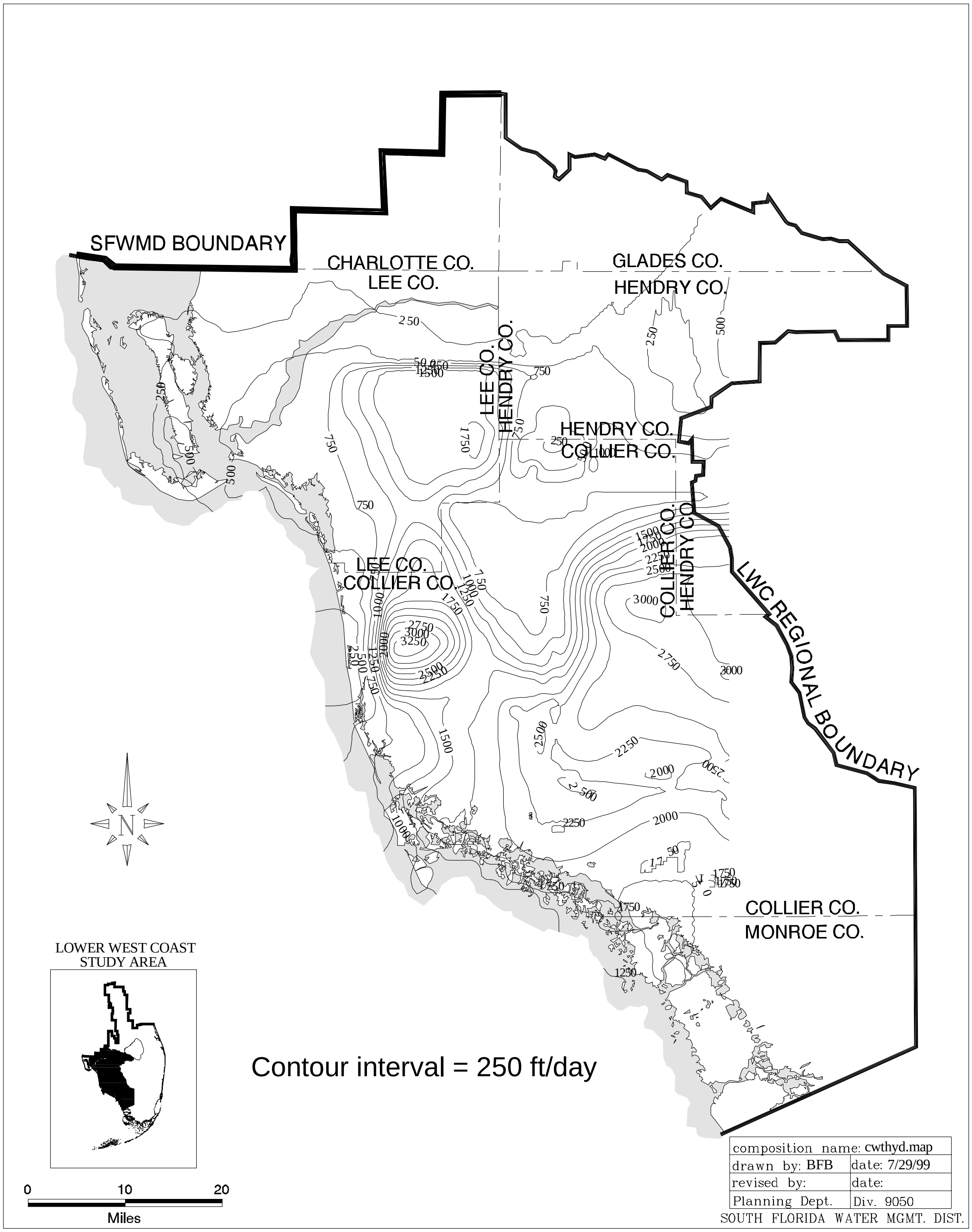


Figure C-3. Hydraulic Conductivity of the Water Table Aquifer (ft/day).

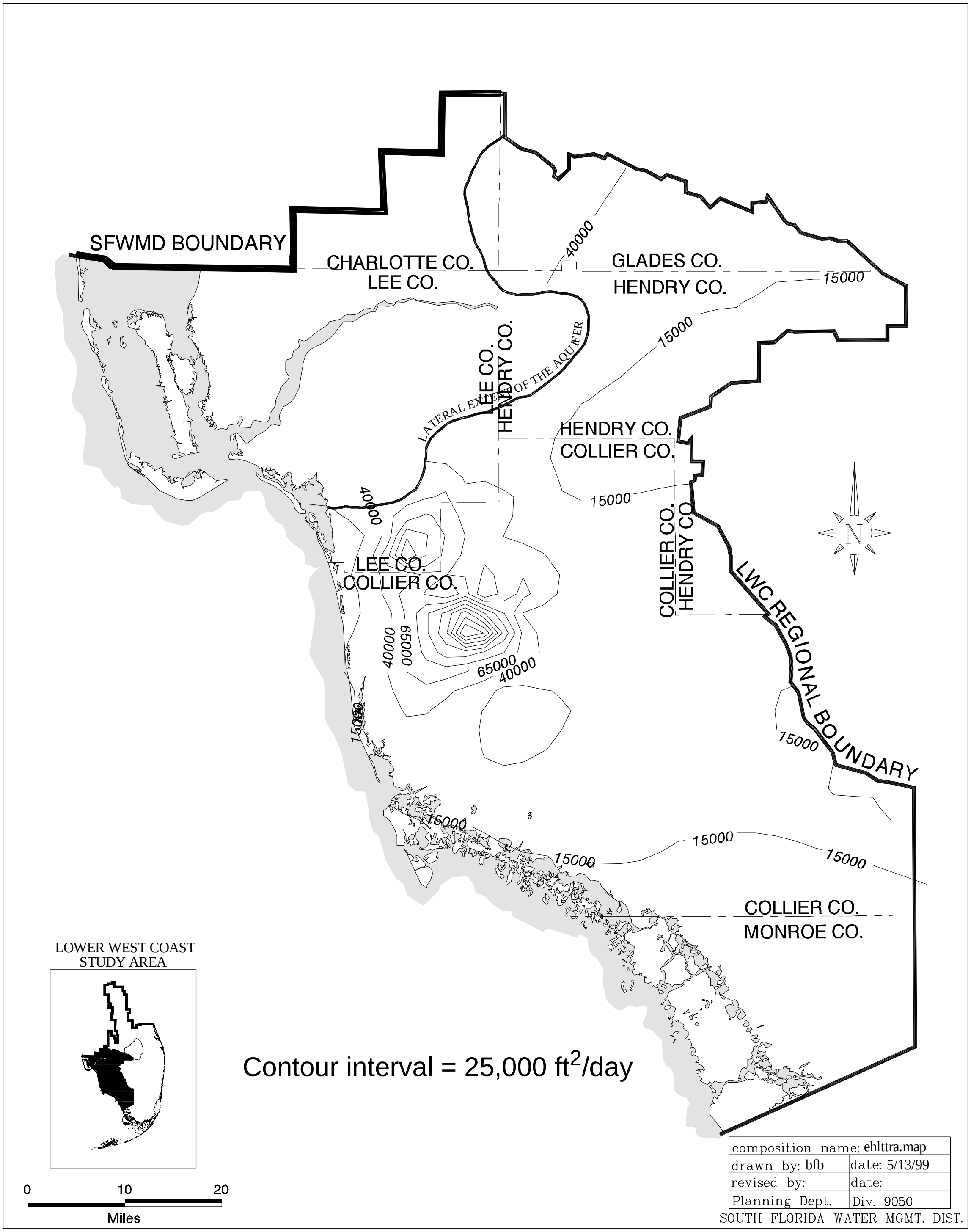


Figure C-4. Transmissivity of the Lower Tamiami Aquifer (ft^2/day).

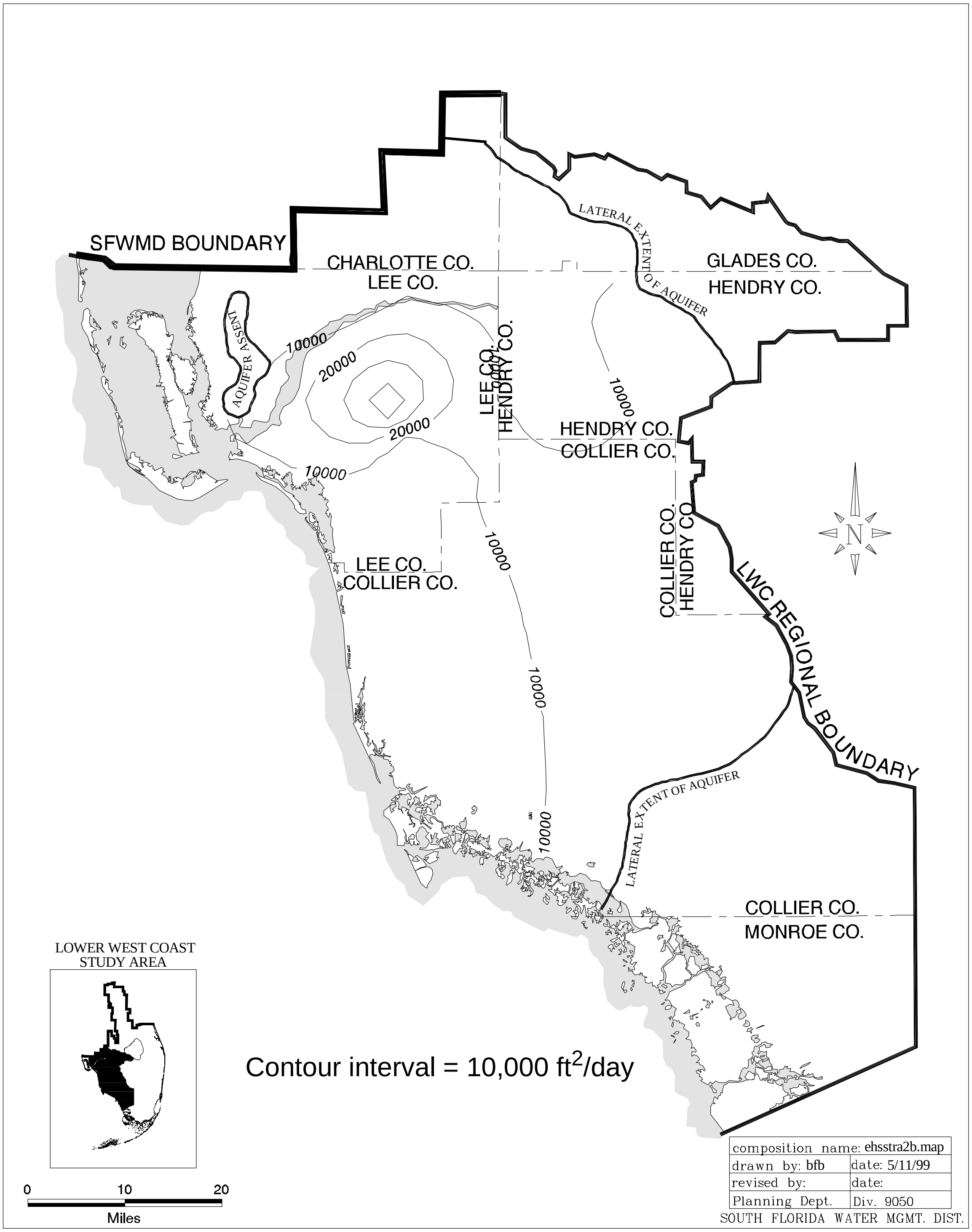


Figure C-5. Transmissivity of the Sandstone Aquifer (ft^2/day).

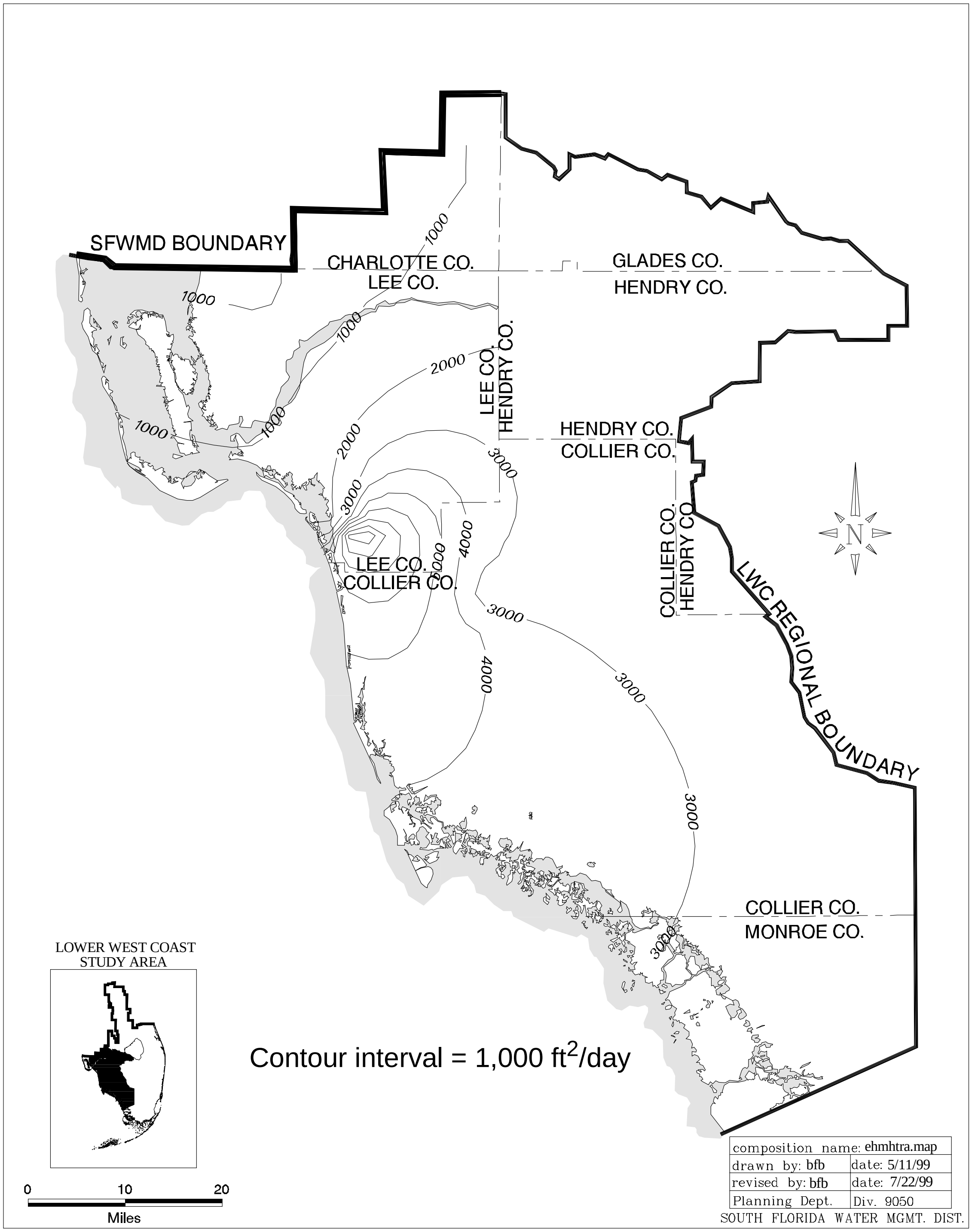


Figure C-6. Transmissivity of the Mid-Hawthorn Aquifer (ft^2/day).

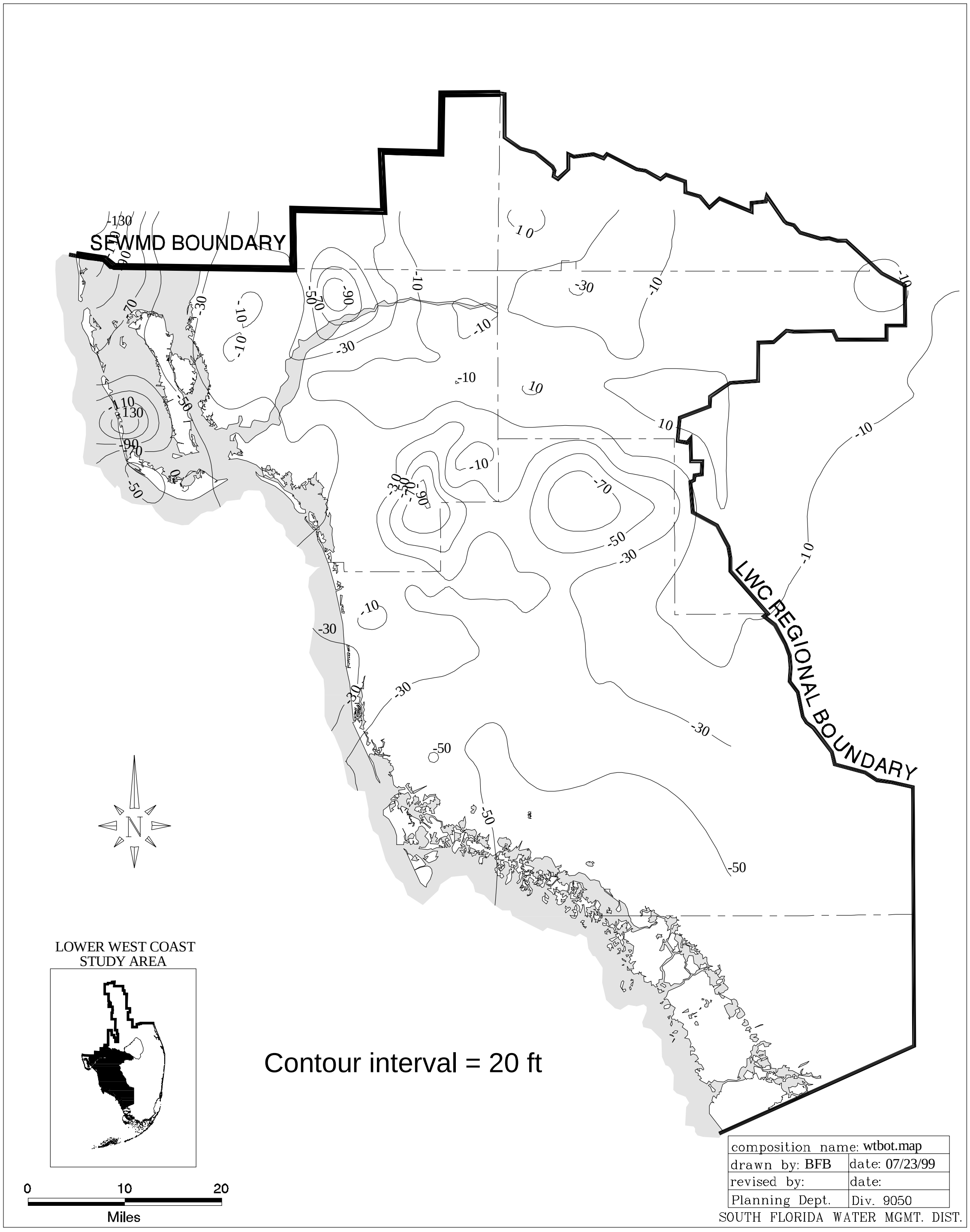


Figure C-7. Bottom of Water Table Aquifer (in feet, NGVD).

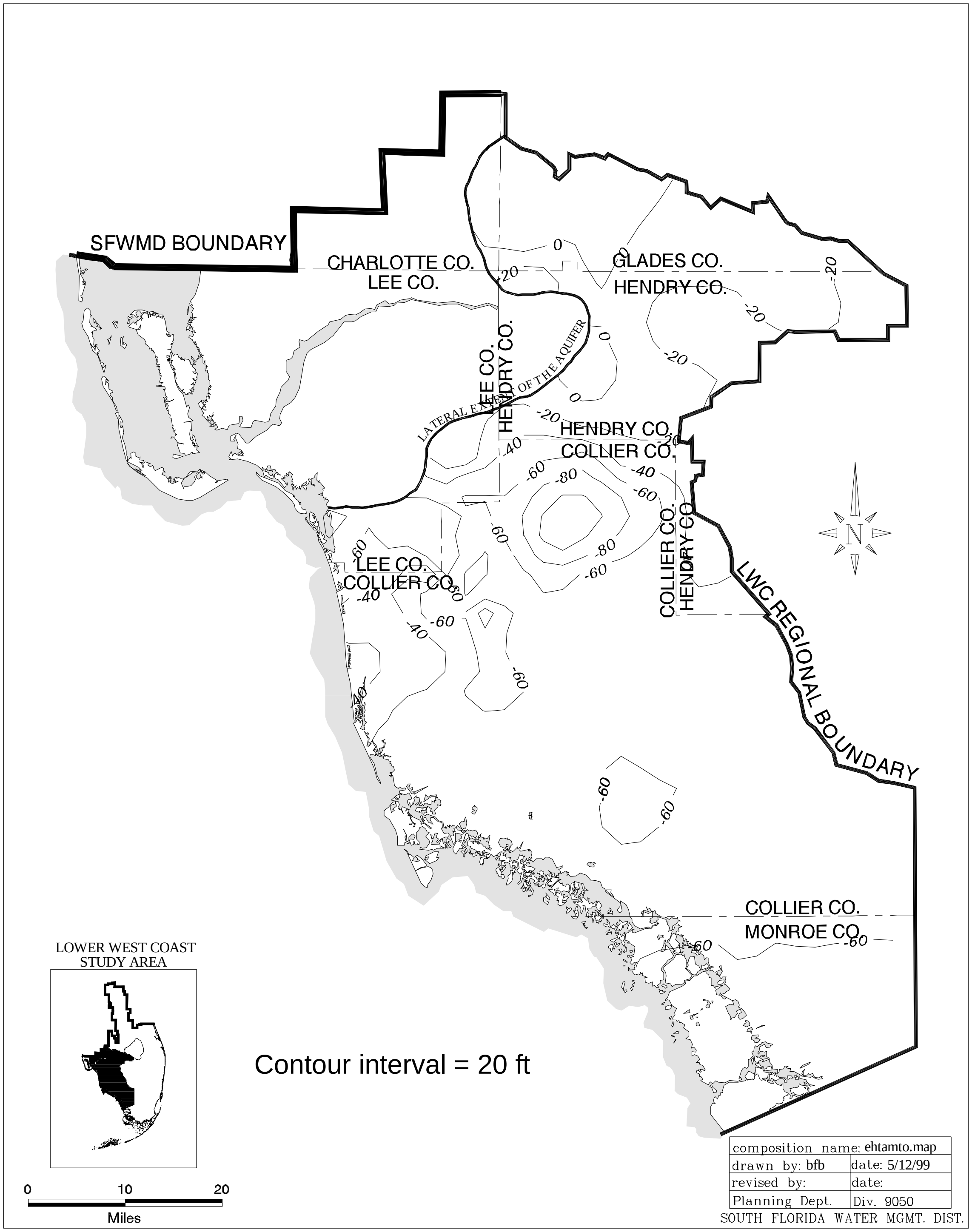


Figure C-8. Top of Lower Tamiami Aquifer (in feet, NGVD).

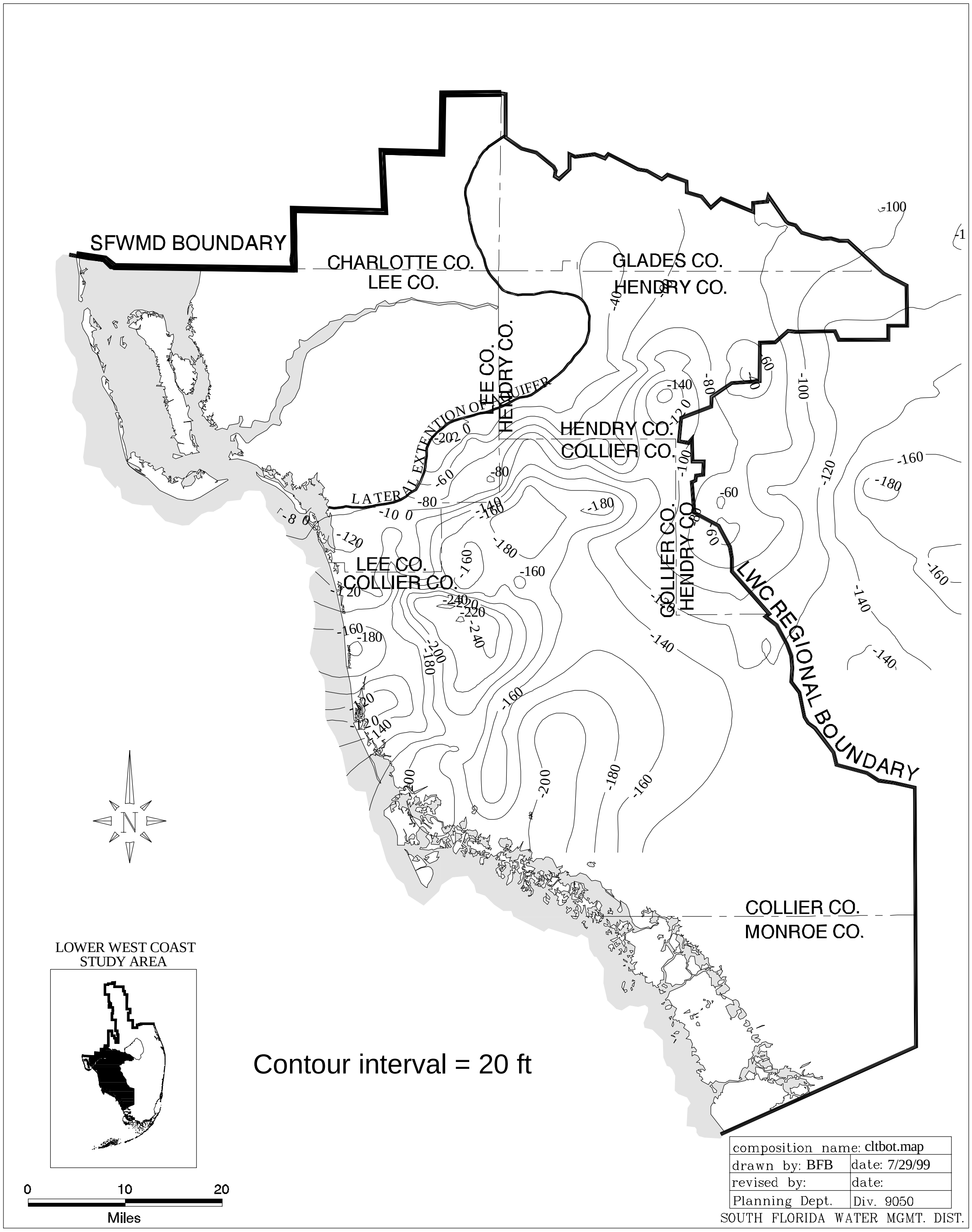


Figure C-9. Bottom of Lower Tamiami Aquifer (in feet, NGVD).

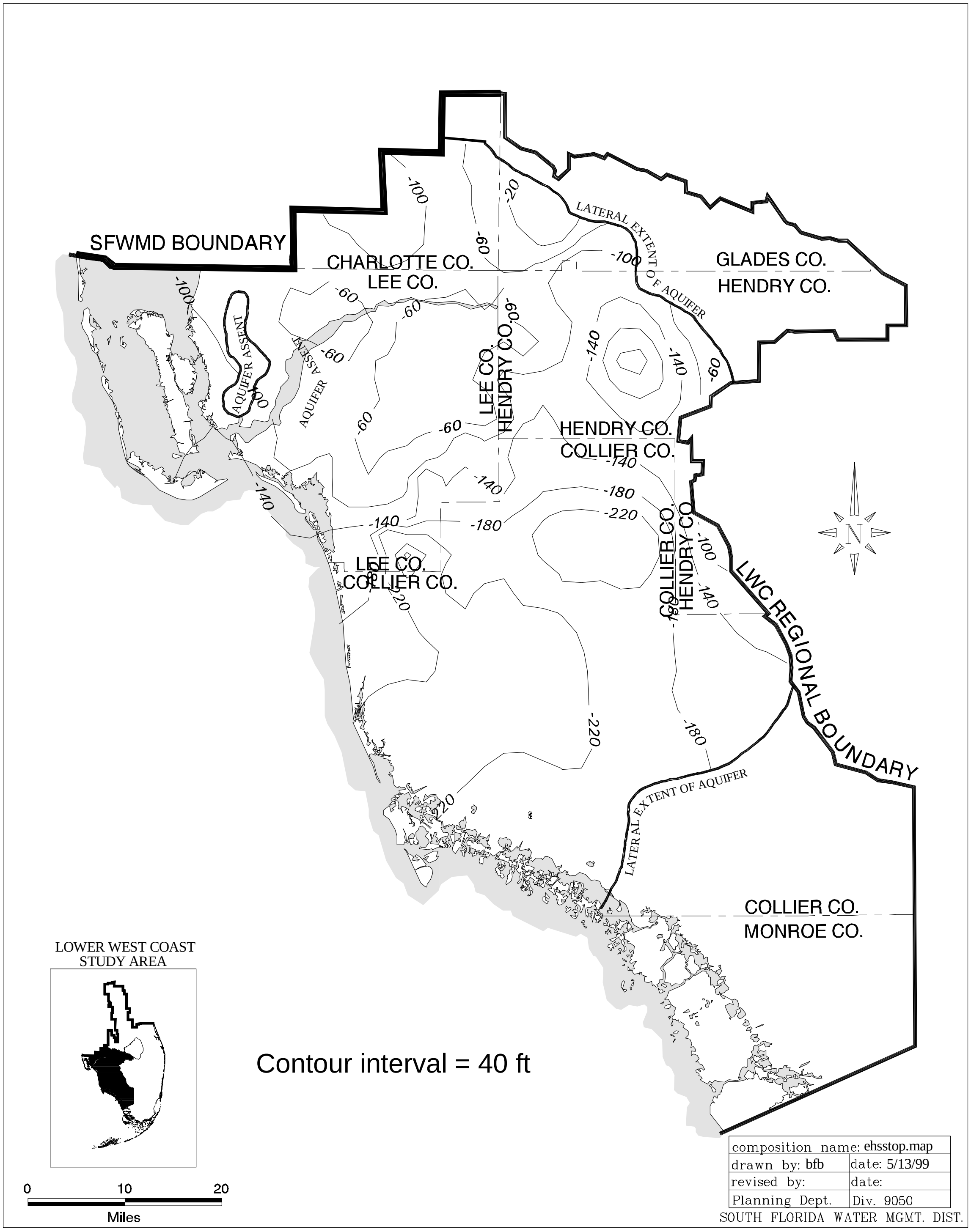


Figure C-10. Top of Sandstone Aquifer (in feet, NGVD).

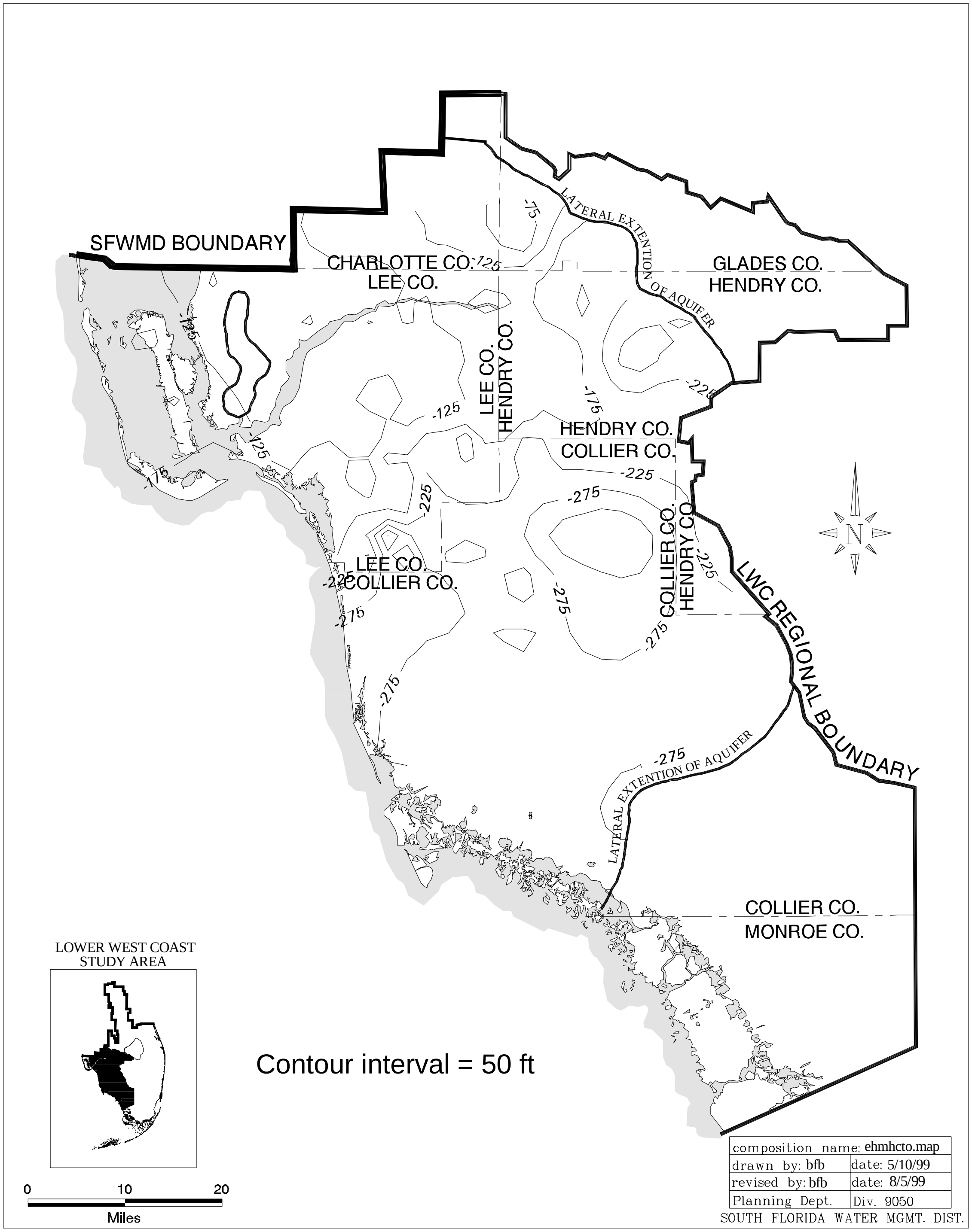


Figure C-11. Bottom of Sandstone Aquifer (in feet, NGVD).

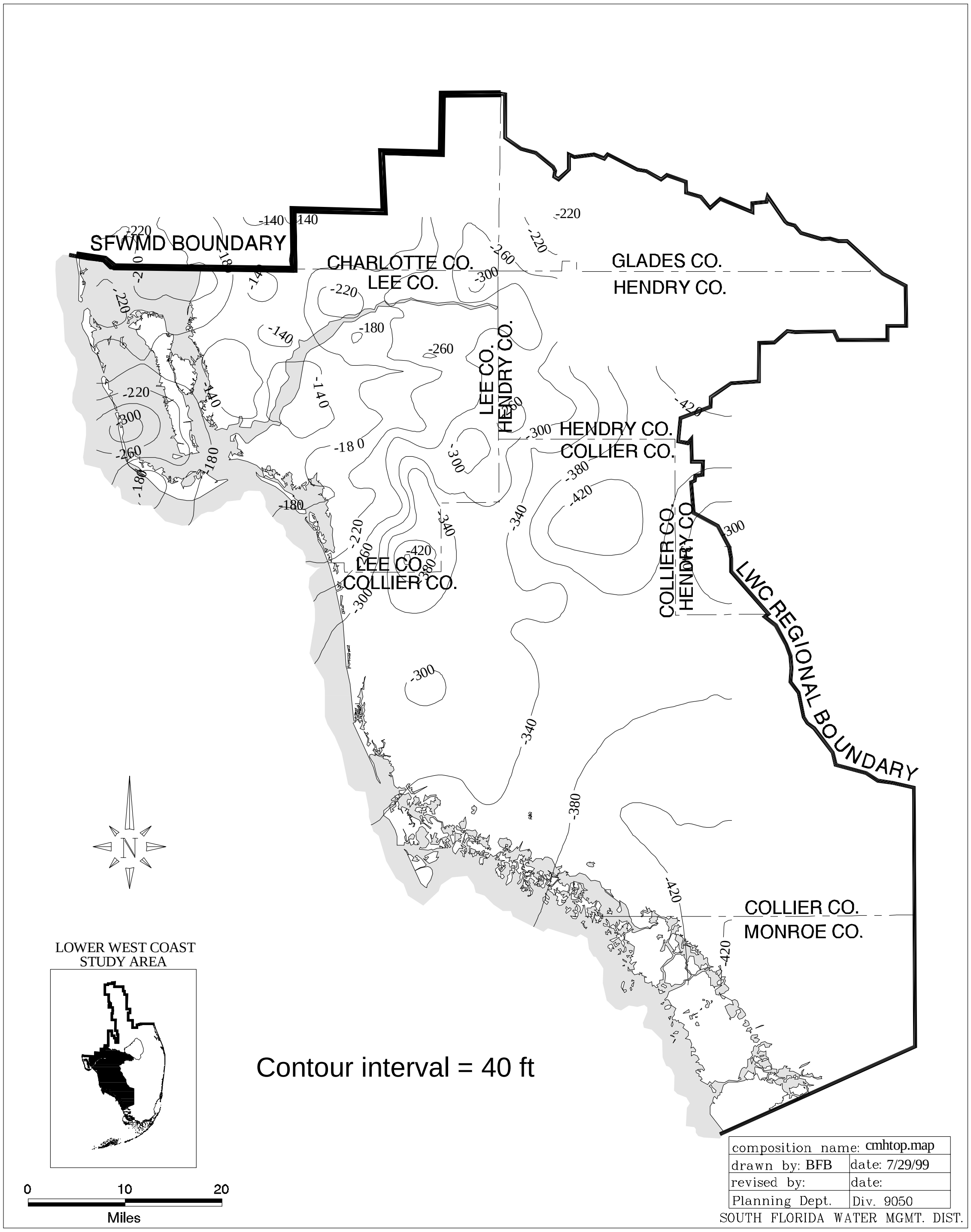


Figure C-12. Top of Mid-Hawthorn Aquifer (in feet, NGVD).

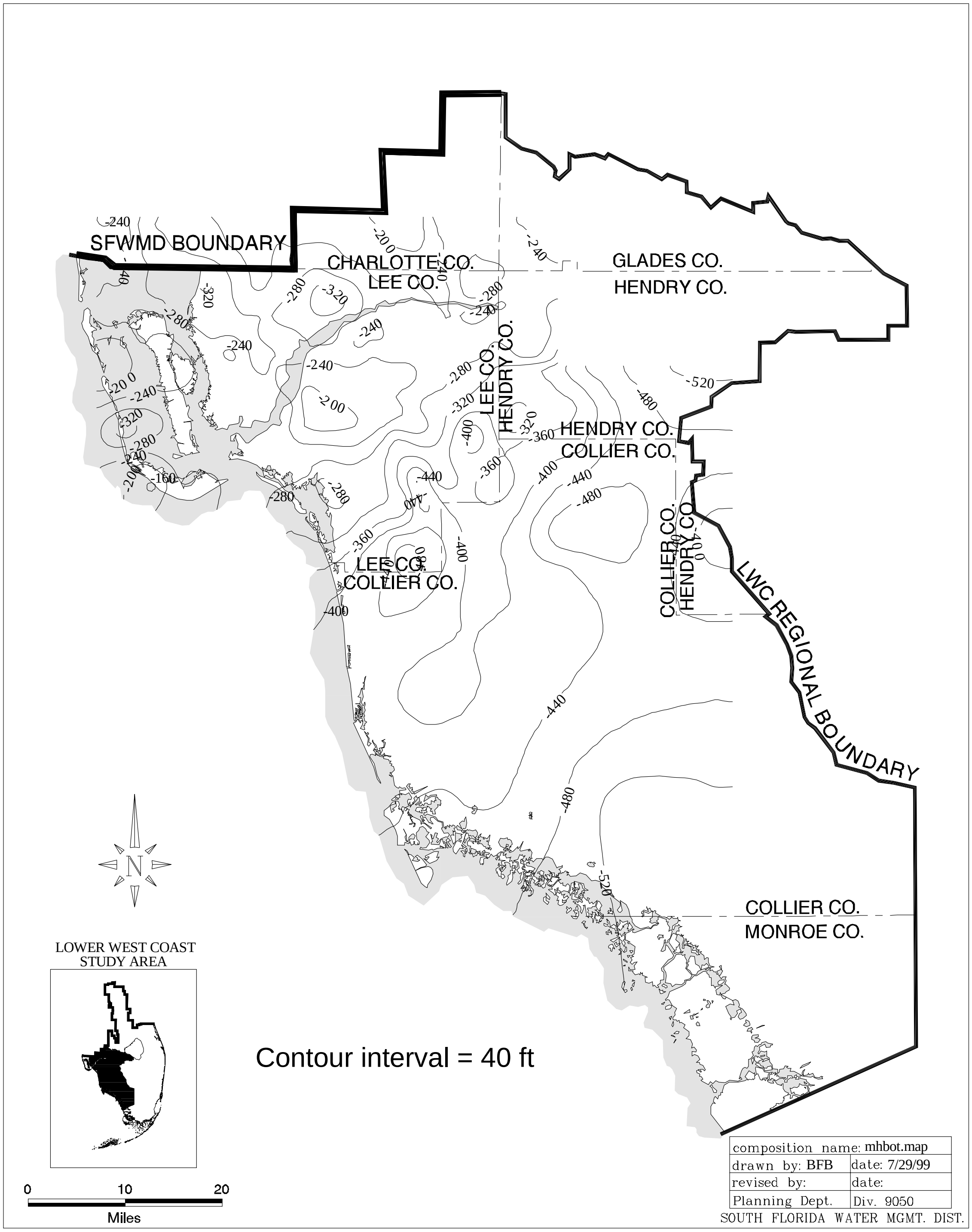


Figure C-13. Bottom of Mid-Hawthorn Aquifer (in feet, NGVD).

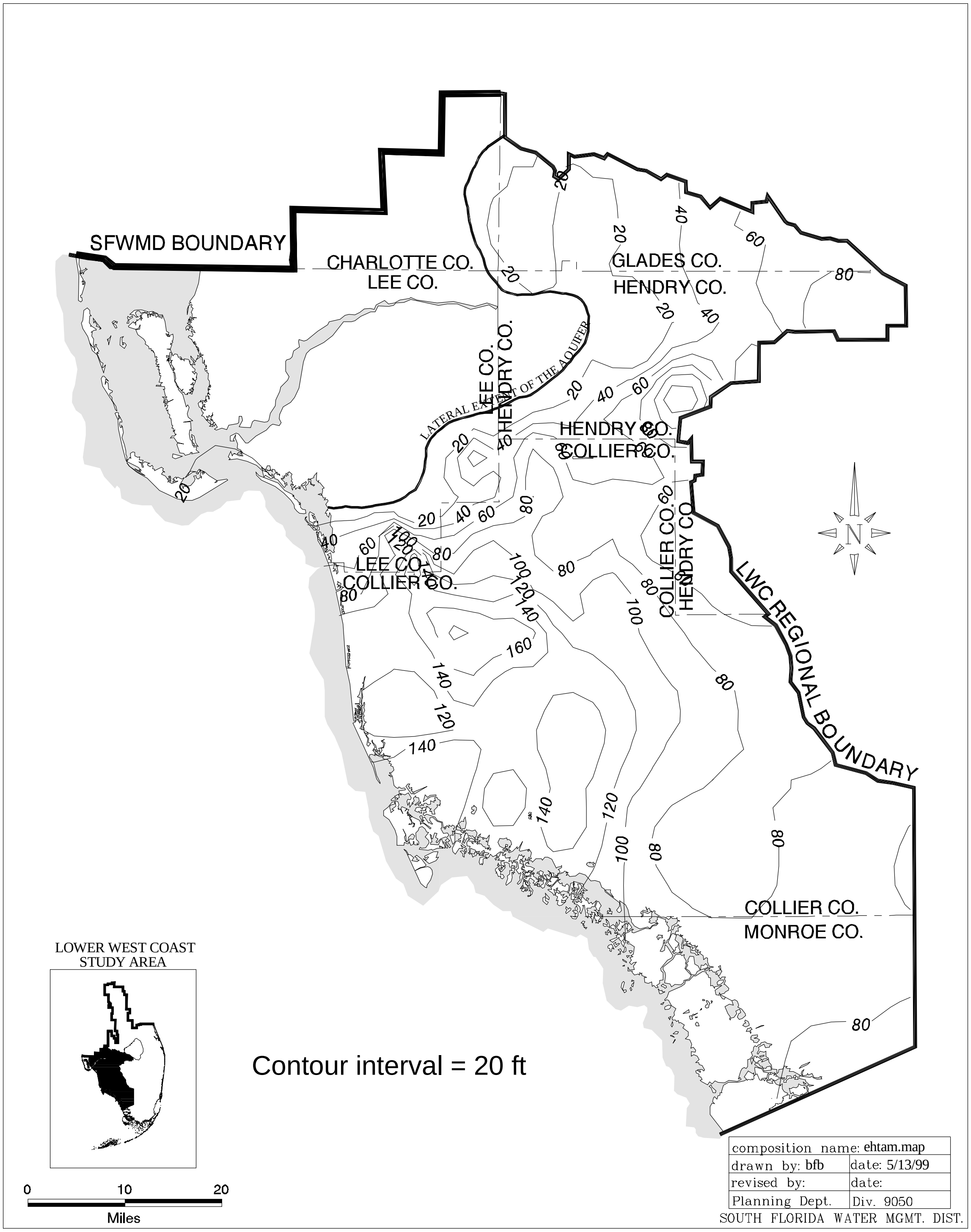


Figure C-14. Thickness of Lower Tamiami Aquifer (in feet).

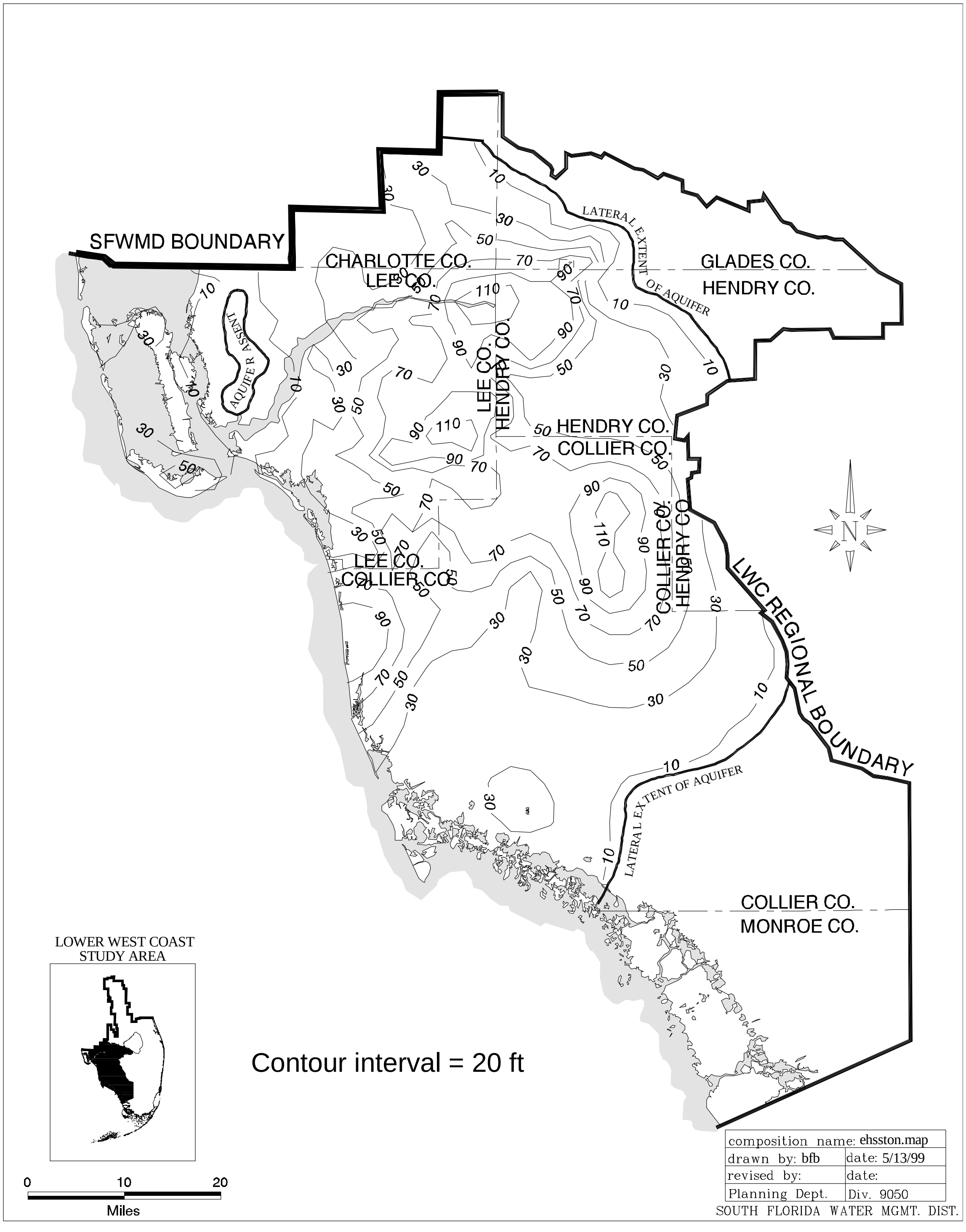


Figure C-15. Thickness of Sandstone Aquifer (in feet).

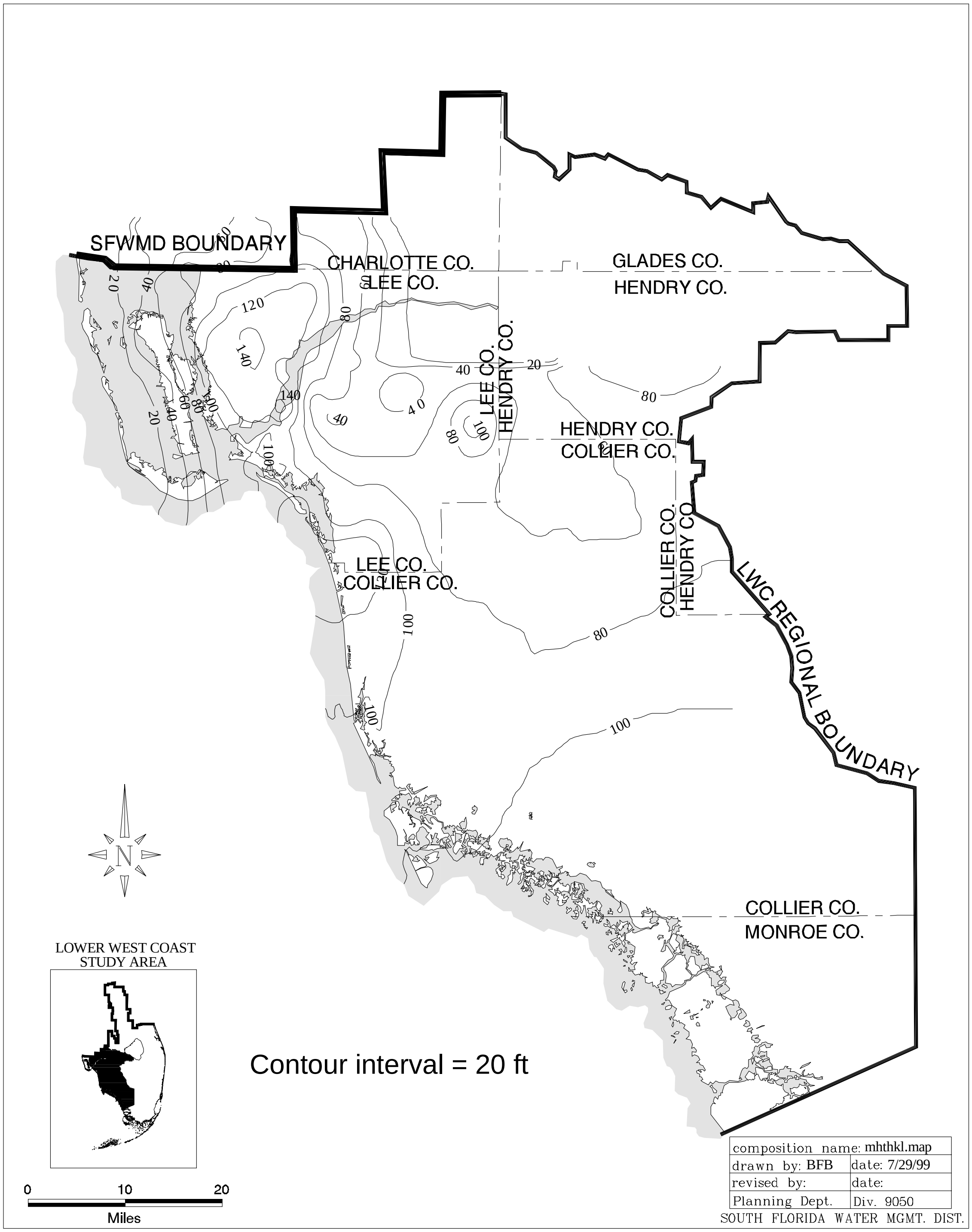


Figure C-16. Thickness of Mid-Hawthorn Aquifer (in feet).

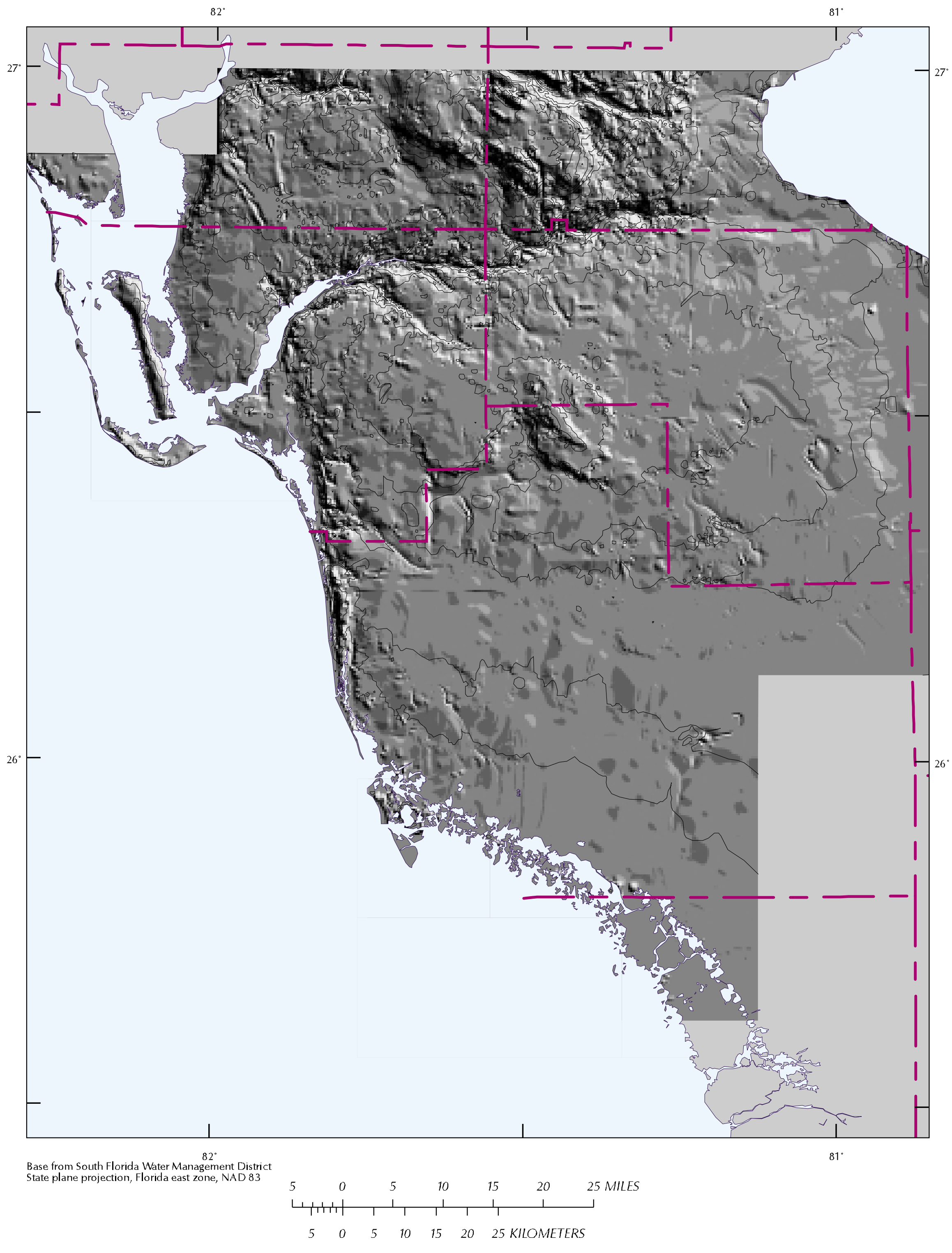


Figure C-17. Shaded Relief Map of the Lower West Coast Planning Area Showing Surface Elevation, Based on Topographic Data from 1:24,000 Scale U.S. Geological Survey Maps.

Table C-1. Individual Permit Allocations in the Lower West Coast Planning Area.

Water Use Category	Allocation (MGD)					Number of Permits			
	Ground Water	Surface Water	Both	Total	% of Total	Ground Water	Surface Water	Both	Total
Collier County (in the LWC Planning Area)									
Agriculture	204.63	0.76	70.35	275.73	50.68	114	5	21	140
Aquaculture	1.03	0.00	0.00	1.03	0.19	1	0	0	1
Nursery	0.77	0.00	0.23	1.00	0.18	12	0	3	15
Golf	1.29	4.03	18.41	23.73	4.36	3	11	32	46
Landscape	5.11	3.08	9.18	17.37	3.19	39	26	56	121
Livestock	0.00	0.00	0.00	0.00	0.00	0	0	0	0
Dewatering	0.00	133.33	0.00	133.33	24.50	0	13	0	13
Public Water Supply	63.92	0.00	7.00	70.92	13.04	11	0	1	12
Industrial	0.50	6.67	1.20	8.37	1.54	10	2	1	13
Recreation	0.00	0.00	0.00	0.00	0.00	0	0	0	0
Mining	0.00	12.60	0.00	12.60	2.32	0	1	0	1
Other	0.01	0.00	0.00	0.01	0.00	1	0	0	1
Total	277.25	160.47	106.37	544.09	100.00	191	58	114	363
Glades County (in the LWC Planning Area)									
Agriculture	30.52	105.67	33.20	169.38	68.83	41	35	11	87
Aquaculture	0.00	0.00	0.00	0.00	0.00	0	0	0	0
Nursery	0.00	0.00	0.00	0.00	0.00	0	0	0	0
Golf	0.00	0.61	0.00	0.61	0.25	0	1	0	1
Landscape	0.00	0.00	0.00	0.00	0.00	0	0	0	0
Livestock	0.00	0.00	0.00	0.00	0.00	0	0	0	0
Dewatering	0.00	4.18	0.00	4.18	1.70	0	1	0	1
Public Water Supply	0.81	0.00	0.00	0.81	0.33	4	0	0	4
Industrial	1.201	18.72	3.23	23.15	9.40	1	1	1	3
Recreation	0.00	0.00	0.00	0.00	0.00	0	0	0	0
Mining	0.00	0.00	0.00	0.00	0.00	0	0	0	0
Other	0.00	47.98	0.00	47.98	19.50	0	2	0	2
Total	32.52	177.16	36.43	246.11	100.00	46	40	12	98
Hendry County (in the LWC Planning Area)									
Agriculture	155.44	429.48	230.35	815.26	80.54	106	64	59	229
Aquaculture	0.00	0.00	0.00	0.00	0.00	1	0	0	1

Table C-1. (Continued) Individual Permit Allocations in the Lower West Coast Planning Area.

Water Use Category	Allocation (MGD)					Number of Permits			
	Ground Water	Surface Water	Both	Total	% of Total	Ground Water	Surface Water	Both	Total
Nursery	0.27	0.00	0.00	0.27	0.03	0	0	0	0
Golf	0.00	0.00	0.00	0.00	0.00	0	0	0	0
Landscape	0.06	0.30	0.16	0.52	0.05	2	2	1	5
Livestock	0.00	0.00	0.00	0.00	0.00	0	0	0	0
Dewatering	0.00	0.10	0.00	0.10	0.01	0	1	0	1
Public Water Supply	3.40	0.04	0.00	3.44	0.34	7	1	0	8
Industrial	1.67	0.00	0.16	1.84	0.18	7	0	1	8
Recreation	0.00	0.00	0.00	0.00	0.00	0	0	0	0
Mining	0.00	0.00	0.00	0.00	0.00	0	0	0	0
Other	0.00	190.81	0.00	190.81	18.85	0	2	0	2
Total	160.84	620.72	230.68	1,012.24	100.00	123	70	61	254
Lee County (in the LWC Planning Area)									
Agriculture	38.08	5.07	30.27	73.42	8.17	129	16	30	175
Aquaculture	0.00	0.00	0.00	0.00	0.00	0	0	0	0
Nursery	0.69	0.14	2.08	2.91	0.32	12	3	7	22
Golf	1.80	2.34	13.64	17.78	1.98	6	10	34	50
Landscape	3.76	1.78	9.97	15.51	1.73	67	30	52	149
Livestock	0.00	0.00	0.00	0.00	0.00	0	0	1	1
Dewatering	0.00	35.63	0.00	35.63	3.96	0	12	0	12
Public Water Supply	25.39	1.81	52.41	79.60	8.86	13	1	6	20
Industrial	1.07	6.00	666.64	673.71	74.96	19	1	4	24
Recreation	0.00	0.00	0.00	0.00	0.00	0	0	0	0
Mining	0.00	0.24	0.00	0.24	0.03	0	1	0	1
Other	0.00	0.00	0.00	0.00	0.00	0	0	0	0
Total	70.78	53.02	775.01	898.80	100.00	246	74	134	454
Lower West Coast Planning Area									
Agriculture	428.66	540.97	364.17	1,333.80	49.38	390	120	121	631
Aquaculture	1.03	0.00	0.00	1.03	0.04	2	0	0	2
Nursery	1.72	0.14	2.31	4.17	0.15	24	3	10	37
Golf	3.09	6.98	32.04	42.12	1.56	9	22	66	97
Landscape	8.93	5.16	19.31	33.40	1.24	108	58	109	275

Table C-1. (Continued) Individual Permit Allocations in the Lower West Coast Planning Area.

Water Use Category	Allocation (MGD)					Number of Permits			
	Ground Water	Surface Water	Both	Total	% of Total	Ground Water	Surface Water	Both	Total
Livestock	0.00	0.00	0.00	0.00	0.00	0	0	1	1
Dewatering	0.00	173.23	0.00	173.23	6.41	0	27	0	27
Public Water Supply	93.52	1.85	59.41	154.77	5.73	35	2	7	44
Industrial	4.44	31.39	671.24	707.06	26.18	37	4	7	48
Recreation	0.00	0.00	0.00	0.00	0.00	0	0	0	0
Mining	0.00	12.84	0.00	12.84	0.48	0	2	0	2
Other	0.01	238.79	0.00	238.80	8.84	1	4	0	5
Total	541.40	1,011.36	1,148.47	2,701.23	100.00	606	242	321	1,169

Appendix D
POTABLE WATER AND WASTEWATER TREATMENT FACILITIES

POTABLE WATER TREATMENT FACILITIES

Most potable water in the Lower West Coast (LWC) Planning Area is treated in large, regional water treatment facilities. This section will focus on 31 such facilities in operation and one planned facility which is included in the Lee County water use permit. All have permitted capacities of 0.5 million gallons per day (MGD) or greater. These facilities are located in the urbanized areas of the LWC Planning Area (**Figures D-1** through **D-3**). While more than half of the facilities were privately owned in February 1994, a trend towards public ownership during the past few years has shifted the majority of ownership to public utilities. The most recent sale was the purchase of four facilities previously operated by Florida Cities Water Company by Lee County in April 1999.

The SFWMD has permitted annual allocations of approximately 57 billion gallons (156 MGD) for the LWC Planning Area for 1998. Sources of water include Lake Okeechobee, the C-43 Canal and several aquifers. The variety of the quality of the water from each of these sources requires different water treatment processes. The water treatment processes include lime softening, membrane softening, reverse osmosis, and aeration. Of the 31 facilities, 19 use lime softening, three use membrane softening, five use reverse osmosis and five use aeration. Both membrane softening and reverse osmosis are used at one facility. These facilities withdrew an average of 92 MGD in 1997. The combined FDEP permitted capacity of the treatment facilities is 160 MGD. An overall summary of the 31 regional potable water treatment facilities located within the LWC Planning Area is presented in **Table D-1**.

A more detailed description of each facility follows the summary table. For each facility the following information is presented:

- Address of the facility
- SFWMD and FDEP basic permit information, including FDEP permitted average daily flow[1]
- Average flow data for a one-year period starting October 1996 and ending in September 1997[2]
- The number, size, and approximate location of interconnects between utilities
- Known future plans
- Unique features of withdrawal sources, facilities, and operating practice
- Sources of information (SFWMD and FDEP permits were reviewed for all facilities)

1. All well planar coordinates are in NAD27.
2. This data year was selected because it matches the latest SFWMD reuse report. Not all data were successfully collected for each of the twelve months. The values presented are averages and when data was missing averages were made with the best available data.

Table D-1. Summary of the Regional Potable Water Treatment Facilities Located within the Lower West Coast Planning Area.

Facility	SFWMD Permit Number	SFWMD Annual Allocation MGY/365 (MGD)	SFWMD Annual Allocation (MGY)	FDEP Rated Capacity (MGD)	1997 Average Daily Raw Water Pumped (MGD)	Treatment Method	Withdrawal Source
Collier County							
Collier County North	11-01447-W	20.82	7,601	20.00	8.80	Membrane Softening & Reverse Osmosis	Lower Tamiami and Lower Hawthorn
Collier County South	11-00249-W	13.10	4,782	12.00	8.80	Lime Softening	Lower Tamiami
Everglades City	11-00160-W	0.12	44	0.86	0.18	Aeration	Surficial
Government Utility Authority Golden Gate	11-00148-W	1.68	614	0.95	1.23	Lime Softening	Lower Tamiami and Surficial
Immokalee 9th Street	11-00013-W	3.13	1,142	2.25	1.20	Aeration	Lower Tamiami and Sandstone
Immokalee Airport	11-00013-W	a	a	1.35	0.70	Aeration	Lower Tamiami
Immokalee Carson Road	11-00013-W	a	a	0.90	0.57	Aeration	Lower Tamiami
Marco Island Reverse Osmosis	11-01388-W	8.20	2,993	5.00	2.60	Reverse Osmosis	Lower Hawthorn
Marco Island Lime	11-00080-W	7.00	2,555	5.00	5.00	Lime Softening	Marco Lakes and infiltration gallery
Marco Shores	11-00080-W	a	a	0.72	N/A	Lime Softening	Marco Lakes and infiltration gallery
Naples	11-00017-W	17.73	6,471	30.00	16.00	Lime Softening	Lower Tamiami
Port of the Islands	11-00271-W	0.30	109	0.50	0.11	Lime Softening	Mid Hawthorn
County Total		51.26	18,710	79.53	45.18		
Hendry and Glades Counties							
Clewiston/ U.S. Sugar	26-00024-W	4.28	1,564	6.00	3.06	Lime Softening	Lake Okeechobee and Rim Canal
Hendry Correctional Institute	26-00164-W	1.95	710	0.60	0.42	Lime Softening	Lower Tamiami
LaBelle	26-00105-W	0.68	250	1.00	0.62	Lime Softening	Surficial
Moore Haven	22-00045-W	0.41	146	0.75	0.34	Lime Softening	Surficial
Port LaBelle	26-00096-W	0.32	117	0.50	0.19	Lime Softening	Sandstone
Total		7.64	2,787	8.85	4.63		
Lee County							
Bonita Springs	36-00008-W	3.89	1,419	5.61	2.46	Lime Softening	Lower Tamiami

a. Allocation is incorporated into previous permit references.

Table D-1. (Continued) Summary of the Regional Potable Water Treatment Facilities Located within the Lower West Coast Planning Area.

Facility	SFWMD Permit Number	SFWMD Annual Allocation MGY/365 (MGD)	SFWMD Annual Allocation (MGY)	FDEP Rated Capacity (MGD)	1997 Average Daily Raw Water Pumped (MGD)	Treatment Method	Withdrawal Source
Cape Coral	36-00046-W	28.85	10,530	15.00	8.22	Reverse Osmosis	Lower Hawthorn
Fort Myers	36-00035-W	11.08	4,043	12.00	7.08	Membrane Softening	C-43 Canal and recharged wellfield
Greater Pine Island	36-00045-W	1.69	616	1.50	1.27	Reverse Osmosis	Lower Hawthorn
Lee County Green Meadows	36-00150-W	7.65	2,791	9.00	5.80	Lime Softening	Sandstone, Surficial, and Mid-Hawthorn
Lee County College Parkway	36-00150-W	a	a	1.50	a	Lime Softening	Sandstone, Surficial, and Mid-Hawthorn
Gulf Corkscrew	36-00122-W	3.16	1,152	1.30	2.46	Membrane Softening	Sandstone and Surficial
Gulf San Carlos	36-00122-W	a	a	2.45	a	Lime Softening	Surficial
Island Water Association	36-00034-W	4.96	1,809	4.70	3.76	Reverse Osmosis	Floridan
Lee County Corkscrew	36-00003-W	12.22	4,462	10.00	6.34	Lime Softening	Sandstone and Surficial
Lee County North Fort Myers	36-00003-W	a	a	0.20	0.00	Aeration	Mid-Hawthorn and Sandstone
Lee County Olga	36-00003-W	a	a	5.00	3.09	Lime Softening	C-43 Canal
Lee County North Water Treatment Facility (proposed)	36-00003-W	a	a	proposed			C-43 Canal
Lehigh	36-00166-W	2.39	874	2.50	1.40	Lime Softening	Sandstone
Lee County Waterway	36-00152-W	1.07	392	1.50	0.87	Lime Softening	Surficial, Lower and Mid-Hawthorn
County Total		76.95	28,088	72.26	42.75		
Lower West Coast Total		135.85	49,585	160.64	92.58		

a. Allocation is incorporated into previous permit references.

Collier County

The locations of regional potable water treatment facilities within Collier County are shown in **Figure D-1**. This section contains summary sheets for each facility. The information on these sheets includes permit information, facility information, average flows, interconnections, and future plans. Following each summary sheet is a table or tables summarizing all of the source wells for the facility.

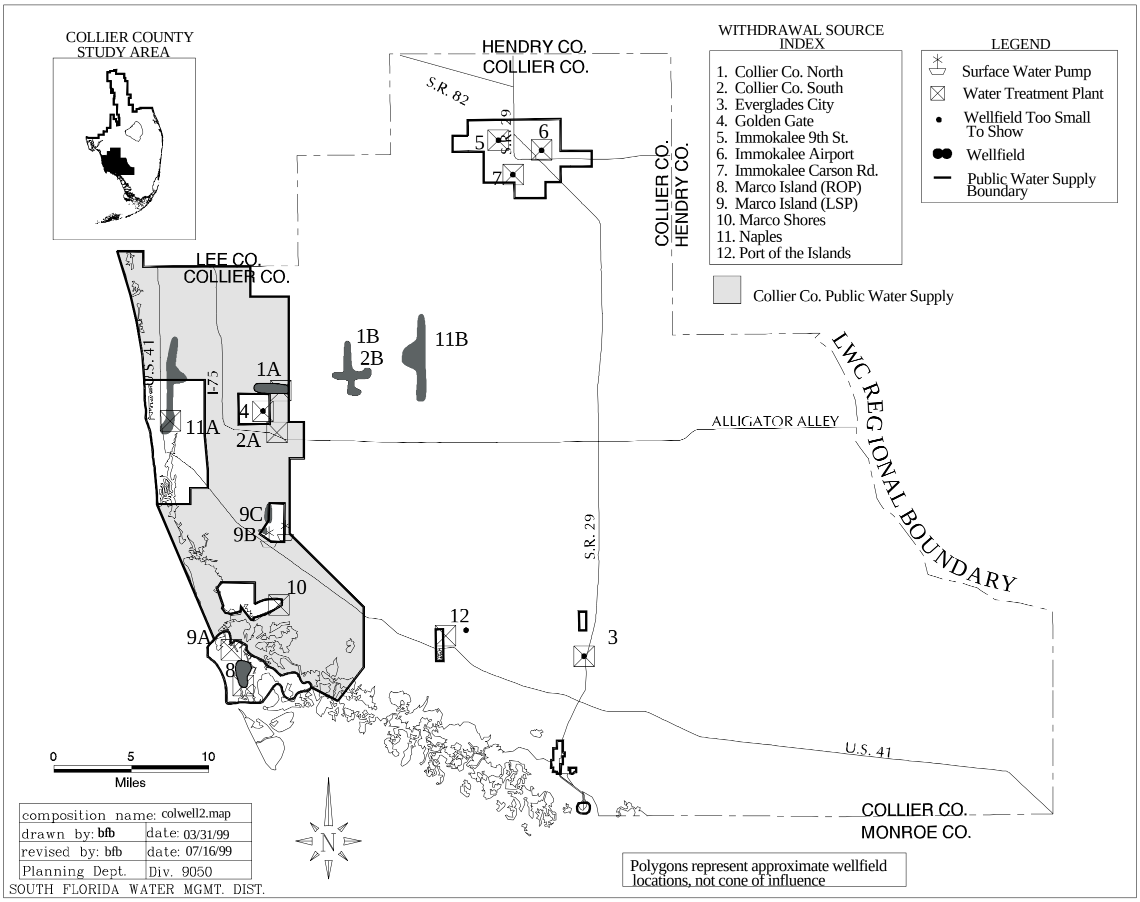


Figure D-1. Location of Regional Potable Water Treatment Facilities and Wellfields in Collier County.

Collier County North

SFWMD Permit Information 11-01447-W	
Permit Issue Date: 12/12/1996	Permit Expiration: 12/12/2016
Annual Allocation	4,782 MGY
Calculated Daily Allocation	13.1 MGD
Maximum Daily Allocation	20.00 MGD
Gallons Per Capita Per Day	195 GPCD
Maximum Day To Average Day Ratio	1.69
Withdrawal Source	Lower Hawthorn and Lower Tamiami
Source Limitations	None
Plant Information FDEP PWS Id:	5114069
FDEP Rated Capacity	20.00 MGD
Type of Treatment Method	Membrane Softening and Reverse Osmosis
Plant Address	8005 Vanderbilt Beach Rd. Extension, Naples, FL 33964
Average Flow Data: October 1996 – September 1997	
Average Daily Raw Water Pumpage	8.7 MGD
Average Treated Water Produced	7.4 MGD
Unaccounted For Losses	5%

Interconnections: Collier County has four interconnects: one provides one MGD in case of emergency to Marco Island; two 12 inch interconnects with the city of Naples (one at the intersection of County Road 951 and Airport Road and one off Rattlesnake Road in East Naples); and one with Bonita Springs at Bonita Beach Road.

Future: Currently a 12 MGD capacity membrane softening facilty and a 8 MGD reverse osmosis treatment facility.

Discussion: Both Collier County facilities (North and South) withdraw equally from the Collier County Golden Gate Wellfield. Collier County North has constructed a wellfield at the treatment facility site to supply the 8 MGD capacity reverse osmosis facility that went on line in the Summer 1999. Both Collier County facilities will continue to share the main wellfield.

Source: Collier County Utilities, SFWMD, and FDEP Permits

Table D-2. Collier County North Lower Hawthorn Potable Water Supply Wells (Wellfield 1A on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (NGVD)	Year Drilled
RO-1	N/A	N/A	Active	Lower Hawthorn	800	700	16	1,000	35	1996
RO-2	N/A	N/A	Active	Lower Hawthorn	800	700	16	1,000	35	1996
RO-3	N/A	N/A	Active	Lower Hawthorn	800	700	16	1,000	35	1996
RO-4	N/A	N/A	Active	Lower Hawthorn	800	700	16	1,000	35	1996
RO-5	N/A	N/A	Active	Lower Hawthorn	800	700	16	1,000	35	1996
RO-6	N/A	N/A	Active	Lower Hawthorn	800	700	16	1,000	35	1996
RO-7	N/A	N/A	Active	Lower Hawthorn	800	700	16	1,000	35	1996
RO-8	N/A	N/A	Active	Lower Hawthorn	800	700	16	1,000	35	1996
RO-9	N/A	N/A	Active	Lower Hawthorn	800	700	16	1,000	35	1996
RO-10	N/A	N/A	Active	Lower Hawthorn	800	700	16	1,000	35	1996
RO-11	N/A	N/A	Active	Lower Hawthorn	800	700	16	1,000	35	1996
RO-12	N/A	N/A	Proposed	Lower Hawthorn	800	700	16	1,000	35	N/A
RO-13	N/A	N/A	Proposed	Lower Hawthorn	800	700	16	1,000	35	N/A
RO-14	N/A	N/A	Proposed	Lower Hawthorn	800	700	16	1,000	35	N/A

Table D-3. Collier County Utilities Potable Water Supply Wells (Wellfields 1B and 2B on map).
Note: serves both the Collier County North and Collier County South facilities.

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (NGVD)	Year Drilled
1	296720 E	684150 N	Active	Lower Tamiami	96	50	16	700	-35	1983
2	298020 E	684100 N	Active	Lower Tamiami	100	50	16	700	-35	1983
3	298987 E	684110 N	Active	Lower Tamiami	100	51	16	700	-35	1983
4	300500 E	683852 N	Active	Lower Tamiami	102	52	16	700	-35	1983
5	301927 E	683811 N	Active	Lower Tamiami	108	50	16	700	-35	1983
6	301241 E	684117 N	Standby	Lower Tamiami	101	65	12	700	-35	1987
7	301238 E	685300 N	Standby	Lower Tamiami	106	65	12	700	-35	1987
8	301242 E	686469 N	Standby	Lower Tamiami	106	70	12	700	-35	1987
9	301201 E	687688 N	Active	Lower Tamiami	114	65	12	700	-35	1987
10	301192 E	688864 N	Active	Lower Tamiami	112	71	12	700	-35	1987
11	301230 E	689925 N	Active	Lower Tamiami	137	90	12	700	-35	1987
12	301187 E	691095 N	Active	Lower Tamiami	133	90	12	700	-35	1987
13	301210 E	692054 N	Active	Lower Tamiami	130	84	12	700	-35	1987
14	301194 E	693198 N	Active	Lower Tamiami	131	85	12	700	-35	1987
15	301167 E	694102 N	Active	Lower Tamiami	130	84	12	700	-35	1987
16	301181 E	695091 N	Active	Lower Tamiami	150	92	12	700	-35	1986
17	303912 E	683875 N	Active	Lower Tamiami	128	78	12	1,000	N/A	1991
18	305184 E	683839 N	Active	Lower Tamiami	126	80	12	1,000	N/A	1991
19	307663 E	684366 N	Active	Lower Tamiami	128	83	12	1,000	N/A	1991
20	307675 E	685586 N	Active	Lower Tamiami	131	83	12	1,000	N/A	1991
21	301946 E	683010 N	Active	Lower Tamiami	110	62	12	1,000	N/A	1993
22	301928 E	681865 N	Active	Lower Tamiami	101	62	12	1,000	N/A	1993
23	301896 E	680723 N	Active	Lower Tamiami	111	59	12	1,000	N/A	1993
24	301903 E	679820 N	Active	Lower Tamiami	109	58	12	1,000	N/A	1993
25	301846 E	678787 N	Active	Lower Tamiami	110	65	12	1,000	N/A	1993
26	302865 E	678538 N	Active	Lower Tamiami	106	65	12	1,000	N/A	1993
27	304193 E	678570 N	Active	Lower Tamiami	105	61	12	1,000	N/A	1993

Collier County South

SFWMD Permit Information 11-00249-W	
Permit Issue Date: 2/13/1997	Permit Expiration: 12/31/1999
Annual Allocation	7,601 MGY
Calculated Daily Allocation	20.82 MGD
Maximum Daily Allocation	31.97 MGD
Gallons Per Capita Per Day	180 GPCD
Maximum Day To Average Day Ratio	1.69
Withdrawal Source	Lower Tamiami
Source Limitations	None
Plant Information FDEP PWS Id:	5114069
FDEP Rated Capacity	12.00 MGD
Type of Treatment Method	Lime Softening
Plant Address	3851 Utilities Dr., Naples, FL 34117
Average Flow Data: October 1996 – September 1997	
Average Daily Raw Water Pumpage	8.70 MGD
Average Treated Water Produced	8.20 MGD
Unaccounted For Losses	5%

Interconnections: Collier County has four interconnects: one provides one MGD in case of emergency to Marco Island; two 12 inch interconnects with the city of Naples (one at the intersection of County Road 951 and Airport Road and one off Rattlesnake Road in East Naples); and one with Bonita Springs at Bonita Beach Road.

Future: Plans are being made to expand the capacity of this facility by 8 MGD using reverse osmosis treatment and the lower Hawthorn with a proposed ultimate reverse osmosis capacity of 20 MGD.

Discussion: Both Collier County facilities withdraw equally from the Collier County Golden Gate Wellfield.

Source: Collier County Utilities, SFWMD, and FDEP Permits

Everglades City

SFWMD Permit Information 11-00160-W	
Permit Issue Date: 9/10/1992	Permit Expiration: 9/10/2002
Annual Allocation	44 MGY
Calculated Daily Allocation	0.12 MGD
Maximum Daily Allocation	0.30 MGD
Gallons Per Capita Per Day	100 GPCD
Maximum Day To Average Day Ratio	2.5
Withdrawal Source	Water Table
Source Limitations	None
Plant Information FDEP PWS Id:	5110089
FDEP Rated Capacity	0.86 MGD
Type of Treatment Method	Aeration, filtration, and chlorination
Plant Address	Everglades City, P.O. Box 110, Everglades City, FL
Average Flow Data: October 1996 – September 1997	
Average Daily Raw Water Pumpage	0.18 MGD
Average Treated Water Produced	0.18 MGD
Unaccounted For Losses	Unreported

Interconnections: There are no interconnections.

Future: Implement a SALT program.

Discussion: Everglades City's water system withdraws water several miles inland, aerates, filters, and chlorinates the water. The water is then pumped approximately five miles through an 8 inch pipe to a chlorination booster and storage facility. It is then distributed to to Everglades City, Plantation Island and Chokoloskee Island.

Source: City of Everglades City, SFWMD, and FDEP Permits

Table D-4. Everglades City Potable Water Supply Wells (Wellfield 3 on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (NGVD)	Year Drilled
1	381069 E	588666 N	Active	Water Table	25	15	8	220	-21	1982
2	380704 E	588667 N	Active	Water Table	25	15	8	220	-21	1982
3	380339 E	588668 N	Active	Water Table	25	15	8	220	-21	1982

Government Utility Authority Golden Gate

SFWMD Permit Information 11-00148-W	
Permit Issue Date: 1/14/1993	Permit Expiration: 1/14/2003
Annual Allocation	614 MGY
Calculated Daily Allocation	1.68 MGD
Maximum Daily Allocation	2.29 MGD
Gallons Per Capita Per Day	124 GPCD
Maximum Day To Average Day Ratio	1.36
Withdrawal Source	Lower Tamiami and Surficial
Source Limitations	Lower Tamiami (0.2 MGD and 73 MGY); Surficial (1.2 MGD and 307 MGY).
Plant Information FDEP PWS Id:	5110117
FDEP Rated Capacity	0.95 MGD
Type of Treatment Method	Lime Softening
Plant Address	4300 Golden Gate Parkway, Naples FL 34116
Average Flow Data: October 1996 – September 1997	
Average Daily Raw Water Pumpage	1.23 MGD
Average Treated Water Produced	0.98 MGD
Unaccounted For Losses	Unreported

Interconnections: Golden Gate Estates has a 6 inch raw water interconnection with Naples.

Future: N/A

Discussion: Formerly referred to as Florida Cities Golden Gate.

Source: Florida Cities Water Company, SFWMD, and FDEP Permits

Table D-5. Government Utility Authority Golden Gate Potable Water Supply Wells (Wellfield 4 on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (NGVD)	Year Drilled
1	272240 E	671780 N	Active	Water Table	22	15	8	100	-0.8	1964
2	272240 E	671660 N	Active	Water Table	22	17	8	250	-0.9	1989
3	272620 E	671760 N	Active	Water Table	45	25	8	150	-3.5	1967
4	272435 E	671760 N	Active	Water Table	45	25	8	200	-3.4	1971
5	272520 E	671760 N	Active	Water Table	22	15	8	250	-3.5	1982
8	272650 E	671560 N	Active	Water Table	22	15	8	250	-3.5	1982
9	273840 E	672320 N	Proposed	Water Table	25	15	8	200	N/A	N/A
10	274090 E	672340 N	Proposed	Water Table	25	15	8	200	N/A	N/A
11	274340 E	672340 N	Proposed	Water Table	25	15	8	200	N/A	N/A

Immokalee 9th Street

SFWMD Permit Information 11-00013-W	
Permit Issue Date: 1/17/1991	Permit Expiration: 1/17/2000
Annual Allocation	1,142 MGY
Calculated Daily Allocation	3.13 MGD
Maximum Daily Allocation	4.51 MGD
Gallons Per Capita Per Day	166 GPCD
Maximum Day To Average Day Ratio	1.44
Withdrawal Source	Lower Tamiami and Sandstone
Source Limitations	None
Plant Information FDEP PWS Id:	5110142
FDEP Rated Capacity	2.25 MGD
Type of Treatment Method	Aeration
Plant Address	1020 Sanitation Rd., Immokalee, FL 34142
Average Flow Data: October 1996 – September 1997	
Average Daily Raw Water Pumpage	1.20 MGD
Average Treated Water Produced	1.16 MGD
Unaccounted For Losses	Unreported

Interconnections: The Immokalee 9th Street, Airport, and Carson Road facilities are interconnected.

Future: N/A

Discussion: Consumptive use permit includes allocations for Immokalee's 9th Street, Carson Road, and Airport facilities.

Source: Immokalee Water and Sewer District, SFWMD, and FDEP Permits

Table D-6. Immokalee 9th Street Potable Water Supply Wells (Wellfield 5 on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (NGVD)	Year Drilled
1	360094 E	754878 N	Active	Sandstone	275	236	4	110	-237	1966
7	759634 E	754561 N	Active	Lower Tamiami	225	140	6	300	-84	1985
8	360231 E	755285 N	Active	Sandstone	315	230	8	300	-231	1970
9	359944 E	754642 N	Active	Sandstone	275	250	8	240	-251	1971
10A	360016 E	754319 N	Active	Lower Tamiami	175	95	8	300	-96	1987
10-B	N/A	N/A	Active	Sandstone	310	220	8	350	-52	1996
11	360216 E	754630 N	Active	Sandstone	278	234	8	390	-235	1973
12	361131 E	755786 N	Active	Lower Tamiami	327	260	8	300	-113	1996
13	361445 E	756615 N	Active	Lower Tamiami	327	266	8	230	-152	1996

Immokalee Airport

SFWMD Permit Information	11-00013-W	
Permit Issue Date: 1/17/1991		Permit Expiration: 1/17/2000
Annual Allocation		See Immokalee 9th Street
Calculated Daily Allocation		See Immokalee 9th Street
Maximum Daily Allocation		See Immokalee 9th Street
Gallons Per Capita Per Day		See Immokalee 9th Street
Maximum Day To Average Day Ratio		See Immokalee 9th Street
Withdrawal Source	Lower Tamiami	
Source Limitations	None	
Plant Information FDEP PWS Id:		5110142
FDEP Rated Capacity		1.35 MGD
Type of Treatment Method	Aeration	
Plant Address	Airport Access Road, Immokalee, FL 34142	
Average Flow Data: October 1996 – September 1997		
Average Daily Raw Water Pumpage		0.70 MGD
Average Treated Water Produced		0.93 MGD
Unaccounted For Losses		Unreported

Interconnections: Same as Immokalee 9th Street.

Future: N/A

Discussion: N/A

Source: Immokalee Water and Sewer District, SFWMD, and FDEP Permits

Table D-7. Immokalee Airport Potable Water Supply Wells (Wellfield 6 on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (NGVD)	Year Drilled
201	365944 E	760365 N	Active	Lower Tamiami	187	107	8	320	-101	1986
202	366295 E	760377 N	Active	Lower Tamiami	187	108	8	320	-101	1986
203	362406 E	760379 N	Active	Lower Tamiami	155	115	8	300	-120	1992
204	361277 E	760333 N	Proposed	Lower Tamiami	200	140	8	N/A	-141	N/A

Immokalee Carson Road

SFWMD Permit Information 11-00013-W	
Permit Issue Date: 1/17/1991	Permit Expiration: 1/17/2000
Annual Allocation	See Immokalee 9th Street
Calculated Daily Allocation	See Immokalee 9th Street
Maximum Daily Allocation	See Immokalee 9th Street
Gallons Per Capita Per Day	See Immokalee 9th Street
Maximum Day To Average Day Ratio	See Immokalee 9th Street
Withdrawal Source	Lower Tamiami
Source Limitations	None
Plant Information FDEP PWS Id:	5110142
FDEP Rated Capacity	0.90 MGD
Type of Treatment Method	Aeration
Plant Address	Carson Rd., Immokalee, FL 34142
Average Flow Data: October 1996 – September 1997	
Average Daily Raw Water Pumpage	0.57 MGD
Average Treated Water Produced	0.63 MGD
Unaccounted For Losses	Unreported

Interconnections: Same as Immokalee 9th Street.

Future: N/A

Discussion: N/A

Source: Immokalee Water and Sewer District, SFWMD, and FDEP Permits

Table D-8. Immokalee Carson Road Potable Water Supply Wells (Wellfield 7 on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (NGVD)	Year Drilled
101	352425 E	763614 N	Plugged	Lower Tamiami	200	125	8	240	-126	1977
102	352286 E	763870 N	Standby	Lower Tamiami	N/A	154	6	340	-155	1984
103	352955 E	764177 N	Active	Lower Tamiami	210	140	8	220	-141	1986
104	352408 E	761216 N	Active	Lower Tamiami	210	128	8	350	-141	1991
105	352490 E	760179 N	Proposed	Lower Tamiami	200	140	8	N/A	N/A	N/A

Marco Island Reverse Osmosis Plant

SFWMD Permit Information 11-01388-W	
Permit Issue Date: 4/11/1996	Permit Expiration: 4/11/2016
Annual Allocation	2,993 MGY
Calculated Daily Allocation	8.20 MGD
Maximum Daily Allocation	8.20 MGD
Gallons Per Capita Per Day	313 GPCD
Maximum Day To Average Day Ratio	1
Withdrawal Source	Lower Hawthorn on Marco Island
Source Limitations	Lower Hawthorn 5.4 MGD. This wellfield has experienced TDS concentrations greater than 10,000 mg/L and has a demand management plan to keep withdrawals below this level.
Plant Information FDEP PWS Id:	5110183
FDEP Rated Capacity	5.00 MGD
Type of Treatment Method	Reverse Osmosis
Plant Address	415 Lily Court, Marco Island, FL 34145
Average Flow Data: October 1996 – September 1997	
Average Daily Raw Water Pumpage	2.60 MGD
Average Treated Water Produced	3.50 MGD*
Unaccounted For Losses	2%

Interconnections: There are no interconnections.

Future: Marco Island has several plans for long-term water supply. These include drilling new aquifer storage and recovery wells on the mainland/Marco Island, improve the existing reverse osmosis facility, develop a new freshwater wellfield on the mainland for blending fresh and brackish water. Marco Island's permit, 11-00080-W, is currently under review for a modification. Marco Island has a separate permit for the Lower Hawthorn wells that serve the reverse osmosis facility.

Discussion: Marco Island's reverse osmosis facility is located on Marco Island and withdraws water from the Lower Hawthorn Aquifer. Small service areas on Marco Island meter and purchase treated water from Florida Water Service's Marco Island facilities. These customers are North Marco Utility Company and Collier County.

*The Marco Island lime softening plant forwards water to the reverse osmosis plant for blending purposes allowing more water to be produced than raw water pumped.

Source: Florida Water Services, SFWMD, and FDEP Permits

Table D-9. Marco Island Lower Hawthorn Potable Water Supply Wells (Wellfield 8 on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (NGVD)	Year Drilled
1	265881 E	583075 N	Active	Lower Hawthorn	565	380	10	550	-110	1991
2	264323 E	583975 N	Active	Lower Hawthorn	574	395	10	550	-110	1989
3	265841 E	579638 N	Active	Lower Hawthorn	548	390	10	500	-110	1989
4	266763 E	579181 N	Active	Lower Hawthorn	547	392	10	550	-110	1991
5	265363 E	580710 N	Active	Lower Hawthorn	540	388	10	550	-120	1991
6	265881 E	583075 N	Active	Lower Hawthorn	596	415	10	550	-100	1991
7	264323 E	583975 N	Active	Lower Hawthorn	573	413	10	550	-100	1991
8	263919 E	585734 N	Active	Lower Hawthorn	574	378	10	550	-100	1992
9	266763 E	583903 N	Active	Lower Hawthorn	546	405	10	550	-100	1992
10	266309 E	584852 N	Active	Lower Hawthorn	580	423	10	550	-100	1992
11	270666 E	581216 N	Proposed	Lower Hawthorn	500	350	12	600	N/A	N/A
12	271470 E	582261 N	Proposed	Lower Hawthorn	500	350	12	600	N/A	N/A
13	272091 E	582338 N	Proposed	Lower Hawthorn	500	350	12	600	N/A	N/A
14	274580 E	583229 N	Proposed	Lower Hawthorn	500	350	12	600	N/A	N/A
15	275413 E	583197 N	Proposed	Lower Hawthorn	500	350	12	600	N/A	N/A

Marco Island Lime Softening Plant

SFWMD Permit Information	11-00080-W
Permit Issue Date: 5/13/1996	Permit Expiration: 1/17/1996
Annual Allocation	2,555 MGY
Calculated Daily Allocation	7.00 MGD
Maximum Daily Allocation	10.78 MGD
Gallons Per Capita Per Day	241 GPCD
Maximum Day To Average Day Ratio	1.54
Withdrawal Source	Man-made surface water lake and infiltration galleries on the mainland via pipeline.
Source Limitations	Marco Lakes - 5.3 MGD; Infiltration Gallery - 1.5 MGD
Plant Information FDEP PWS Id:	5110183
FDEP Rated Capacity	5.00 MGD
Type of Treatment Method	Lime Softening
Plant Address	100 Windward Dr., Marco Island, FL 34145
Average Flow Data: October 1996 – September 1997	
Average Daily Raw Water Pumpage	5.00 MGD
Average Treated Water Produced	3.40 MGD*
Unaccounted For Losses	2%

Interconnections: Marco Island has one interconnect with Collier County to provide one MGD in case of an emergency.

Future: Marco Island has several, yet to be consolidated, plans for long-term water supply. These include aquifer storage and recovery wells on the mainland/Marco Island, improve the existing reverse osmosis facility, develop a new freshwater wellfield on the mainland and develop a means of blending fresh and brackish water. Marco Island is considering an ASR project using Henderson Creek as a source.

Discussion: Marco Island's lime softening facility withdraws surface water from two sources on the mainland: the man-made Marco Lakes and the infiltration gallery. The raw water is forwarded in a pipeline to the lime softening facility on Marco Island. Marco Shores is also served by this raw water pipeline. Small service areas on Marco Island meter and purchase treated water from Florida Water Services' Marco Island facility. These customers are North Marco Utility Company and Collier County. The Marco Island lime softening facility forwards raw water to the Marco Island reverse osmosis plant for blending, accounting for the large difference between water pumped and water treated.

Source: Florida Water Services, SFWMD, and FDEP Permits

*Does not include water treated at the Marco Shores and reverse osmosis facility.

Table D-10. Marco Island Lime Facility and Marco Shores Surface Water Pumps at Marco Lakes (indicated by 9B on map).

Pump Number	Planar Coordinates		Status	Source	Diameter (in)	Pump Capacity GPM	Pump type	Depth of Intake
1	N/A	N/A	Active	Marco Lakes	10	3,000	Centrifugal	N/A
2	N/A	N/A	Active	Marco Lakes	10	3,000	Centrifugal	N/A
3	N/A	N/A	Active	Marco Lakes	10	2,300	Turbine	N/A
4	N/A	N/A	Active	Marco Lakes	10	2,300	Turbine	N/A
5	N/A	N/A	Active	Marco Lakes	10	1,500	Centrifugal	N/A
6	N/A	N/A	Active	Marco Lakes	10	5,000	Turbine	N/A
7	N/A	N/A	Active	Marco Lakes	10	7,000	Turbine	N/A

Table D-11. Marco Island Lime Facility and Marco Shores Surface Water Pumps at the Infiltration Gallery (indicated by 9C on map).

Pump Number	Planar Coordinates		Status	Source	Diameter (in)	Pump Capacity GPM	Pump type	Depth of Intake
10	N/A	N/A	Active	Infiltration Gallery	60	2,000	Turbine	19

Marco Shores

SFWMD Permit Information 11-00080-W		
Permit Issue Date: 5/13/1996	Permit Expiration: 1/17/1996	
Annual Allocation		See Marco Island
Calculated Daily Allocation		See Marco Island
Maximum Daily Allocation		See Marco Island
Gallons Per Capita Per Day		See Marco Island
Maximum Day To Average Day Ratio		See Marco Island
Withdrawal Source	Man-made surface water lake and infiltration galleries on the mainland via pipeline.	
Source Limitations	Subject to limitations of Marco Island: Marco Lakes 5.3 MGD, Infiltration Gallery 1.5 MGD.	
Plant Information FDEP PWS Id:		5110182
FDEP Rated Capacity		0.72 MGD
Type of Treatment Method	Lime Softening	
Plant Address	300 Mainsail Dr., Naples, FL 34113	
Average Flow Data: October 1996 – September 1997		
Average Daily Raw Water Pumpage		N/A
Average Treated Water Produced		unreported MGD
Unaccounted For Losses		2%

Interconnections: Marco Shores is served by the same pipeline that provides raw water to the Marco Island lime softening facility, which has one interconnect with Collier County to provide a MGD in case of emergency.

Future: N/A

Discussion: Marco Shores lime softening receives raw water from a pipeline that runs to Marco Island.

Source: Florida Water Services, SFWMD, and FDEP Permits

Naples

SFWMD Permit Information 11-00017-W		
Permit Issue Date: 3/9/1995		Permit Expiration: 12/31/1999
Annual Allocation		6,471 MGY
Calculated Daily Allocation		17.73 MGD
Maximum Daily Allocation		24.64 MGD
Gallons Per Capita Per Day		245 GPCD
Maximum Day To Average Day Ratio		1.39
Withdrawal Source	Lower Tamiami	
Source Limitations	11.60 MGD from Lower Tamiami in Coastal Ridge Wellfield (see discussion)	
Plant Information FDEP PWS Id:		5110198
FDEP Rated Capacity		30.00 MGD
Type of Treatment Method	Lime Softening	
Plant Address	1000 Flieschmann Blvd., Naples, FL	
Average Flow Data: October 1996 – September 1997		
Average Daily Raw Water Pumpage		16.00 MGD
Average Treated Water Produced		15.45 MGD
Unaccounted For Losses		4%

Interconnections: There are two interconnections with Collier County, a 12 inch at County Road 951 and Airport Road, and a 12 inch off Rattlesnake Road in East Naples.

Future: The city of Naples has a high percentage of potable water used for outdoor use. It plans to increase the use of reclaimed water for irrigation to lower the demand for potable water for irrigation uses.

Discussion: The Coastal Ridge Wellfield is in an area of concern for adverse impacts due to saline water intrusion. The city of Naples monitors the chloride concentrations in the wells at the southern end of this wellfield. This helps determine when to shift withdrawals to the inland East Golden Gate Wellfield.

Source: City of Naples, SFWMD, and FDEP Permits

Table D-12. Naples Coastal Ridge Potable Water Supply Wells (Wellfield 11A on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (NGVD)	Year Drilled
1	238766 E	668186 N	Active	Lower Tamiami	90	56	8	350	-44	1958
2	239901 E	669230 N	Active	Lower Tamiami	87	57	8	350	-44	1958
3	241552 E	669270 N	Active	Lower Tamiami	89	56	8	350	-44	1958
4	238650 E	670355 N	Active	Lower Tamiami	82	53	8	350	-44	1962
5	238881 E	671469 N	Active	Lower Tamiami	82	54	8	350	-44	1962
6	238913 E	672553 N	Active	Lower Tamiami	82	51	8	350	-44	1962
7	240312 E	674080 N	Active	Lower Tamiami	89	60	8	350	-44	1964
8	240333 E	674792 N	Active	Lower Tamiami	80	58	8	350	-44	1964
9	240280 E	675566 N	Active	Lower Tamiami	40	24	8	350	-44	1964
10	240333 E	676590 N	Active	Lower Tamiami	87	54	8	350	-44	1964
11	240343 E	677413 N	Active	Lower Tamiami	87	64	8	350	-44	1965
12	240270 E	677935 N	Active	Lower Tamiami	83	64	8	350	-44	1965
13	240227 E	678578 N	Active	Lower Tamiami	83	63	8	350	-44	1965
14	240248 E	679810 N	Active	Lower Tamiami	83	64	8	350	-44	1965
15	240217 E	680335 N	Active	Lower Tamiami	83	64	8	350	-44	1965
16	240206 E	681961 N	Active	Lower Tamiami	80	N/A	16	350	-44	1968
17	240312 E	682584 N	Active	Lower Tamiami	85	61	8	350	-44	1969
18	240312 E	683588 N	Active	Lower Tamiami	85	61	8	350	-44	1969
19	240564 E	685014 N	Active	Lower Tamiami	85	61	8	350	-44	1969
20	240627 E	686158 N	Active	Lower Tamiami	85	62	8	350	-44	1969
21	240711 E	686972 N	Active	Lower Tamiami	85	61	8	350	-44	1969
22	240743 E	687945 N	Active	Lower Tamiami	85	61	8	350	-44	1969
23	240911 E	689140 N	Active	Lower Tamiami	85	61	8	350	-44	1971
24	240974 E	680295 N	Active	Lower Tamiami	85	63	8	350	-44	1971
25	240037 E	681369 N	Active	Lower Tamiami	85	62	8	350	-44	1971
26	240132 E	692273 N	Active	Lower Tamiami	85	62	8	350	-44	1971
27	240300 E	693036 N	Active	Lower Tamiami	85	61	8	350	-44	1971
28	241363 E	694050 N	Active	Lower Tamiami	85	61	8	350	-24	1971
31	N/A	N/A	Active	Lower Tamiami	N/A	N/A	8	350	-24	1974
32	241529 E	681951 N	Active	Lower Tamiami	N/A	N/A	8	350	-24	1974
33	243529 E	681971 N	Active	Lower Tamiami	N/A	N/A	8	350	-24	1974
34	245674 E	682032 N	Active	Lower Tamiami	N/A	N/A	8	350	-24	1974
1A	236936 E	666881 N	Active	Lower Tamiami	96	58	6	350	-24	1953
2A	236526 E	666188 N	Active	Lower Tamiami	85	58	8	350	-24	1976
3A	235948 E	666208 N	Active	Lower Tamiami	76	55	6	350	-24	1954
4A	237756 E	667433 N	Active	Lower Tamiami	73	50	6	N/A	N/A	1956
5A	237062 E	665615 N	Active	Lower Tamiami	N/A	N/A	6	N/A	N/A	1956
6A	237378 E	666228 N	Active	Lower Tamiami	95	74	10	350	N/A	1968
7A	235674 E	665485 N	Active	Lower Tamiami	85	70	10	350	N/A	1968
8A	235590 E	664561 N	Active	Lower Tamiami	86	68	10	350	N/A	1968

Table D-13. Naples East Golden Gate Potable Water Supply Wells (Wellfield 11B on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (NGVD)	Year Drilled
1	325520 E	695470 N	Active	Lower Tamiami	71	42	14	500	-44	1978
2	325515 E	694099 N	Active	Lower Tamiami	93	48	14	500	-44	1978
3	324594 E	692824 N	Active	Lower Tamiami	80	39	14	500	-44	1978
4	325444 E	691335 N	Active	Lower Tamiami	81	42	14	700	-44	1978
5	325117 E	690093 N	Active	Lower Tamiami	98	42	14	900	-44	1978
6	325362 E	688529 N	Active	Lower Tamiami	101	42	14	700	-44	1978
7	325076 E	687190 N	Active	Lower Tamiami	109	47	14	900	-44	1978
8	325056 E	685936 N	Active	Lower Tamiami	133	42	14	900	-44	1978
9	326480 E	684459 N	Active	Lower Tamiami	82	42	14	700	-44	1978
10	324934 E	683141 N	Active	Lower Tamiami	131	42	14	700	-44	1978
11	324995 E	681920 N	Active	Lower Tamiami	112	37	14	600	-44	1981
12	325015 E	680667 N	Active	Lower Tamiami	100	37	14	700	-44	1981
13	324995 E	679285 N	Active	Lower Tamiami	100	40	14	700	-44	1981
14	324964 E	677861 N	Active	Lower Tamiami	80	38	14	700	-44	1981
15	326581 E	676639 N	To be plugged	Lower Tamiami	70	38	14	N/A	-44	1981
16	326478 E	697851 N	Active	Lower Tamiami	137	39	14	1,000	-44	1981
17	325545 E	699130 N	Active	Lower Tamiami	117	40	14	1,000	-44	1981
18	325545 E	70085 N	Active	Lower Tamiami	100	39	14	1,000	-44	1981
19	325545 E	701265 N	Active	Lower Tamiami	85	42	14	1,000	-44	1985
20	325474 E	703385 N	Active	Lower Tamiami	86	46	14	1,000	-44	1985
21	325474 E	703974 N	Active	Lower Tamiami	78	51	14	700	-44	1985
22	320387 E	680232 N	Active	Lower Tamiami	100	40	14	350	-44	1987
23	322110 E	6911196 N	Active	Lower Tamiami	100	40	14	750	-44	1987
24	320417 E	692663 N	Active	Lower Tamiami	100	40	14	400	-44	1987

Port of the Islands

SFWMD Permit Information 11-00271-W	
Permit Issue Date: 3/9/1995	Permit Expiration: 3/9/2005
Annual Allocation	109 MGY
Calculated Daily Allocation	0.30 MGD
Maximum Daily Allocation	0.45 MGD
Gallons Per Capita Per Day	100 GPCD
Maximum Day To Average Day Ratio	1.5
Withdrawal Source	Mid-Hawthorn
Source Limitations	None
Plant Information FDEP PWS Id:	5110230
FDEP Rated Capacity	0.50 MGD
Type of Treatment Method	Lime Softening
Plant Address	12600 Union Rd., Naples, FL 34114
Average Flow Data: October 1996 – September 1997	
Average Daily Raw Water Pumpage	Unreported
Average Treated Water Produced	0.11 MGD
Unaccounted For Losses	Unreported

Interconnections: There are no interconnections.

Future: N/A

Discussion: N/A

Source: Hole, Montes, and Associates Inc., Port of the Islands Utilities, SFWMD and FDEP Permits

Table D-14. Port of the Islands Potable Water Supply Wells (Wellfield 12 on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (NGVD)	Year Drilled
1	341288 E	597909 N	Active	Mid-Hawthorn	380	300	6	300	-300	1966
2	342232 E	597959 N	Active	Mid-Hawthorn	380	300	6	300	-300	1966

Hendry/Glades Counties

The locations of regional potable water treatment facilities within Hendry and Glades counties are shown in **Figure D-2**. This section contains summary sheets for each facility. The information on these sheets includes permit information, facility information, average flows, interconnections, and future plans. Following each summary sheet is a table or tables summarizing all of the source wells for the facility.

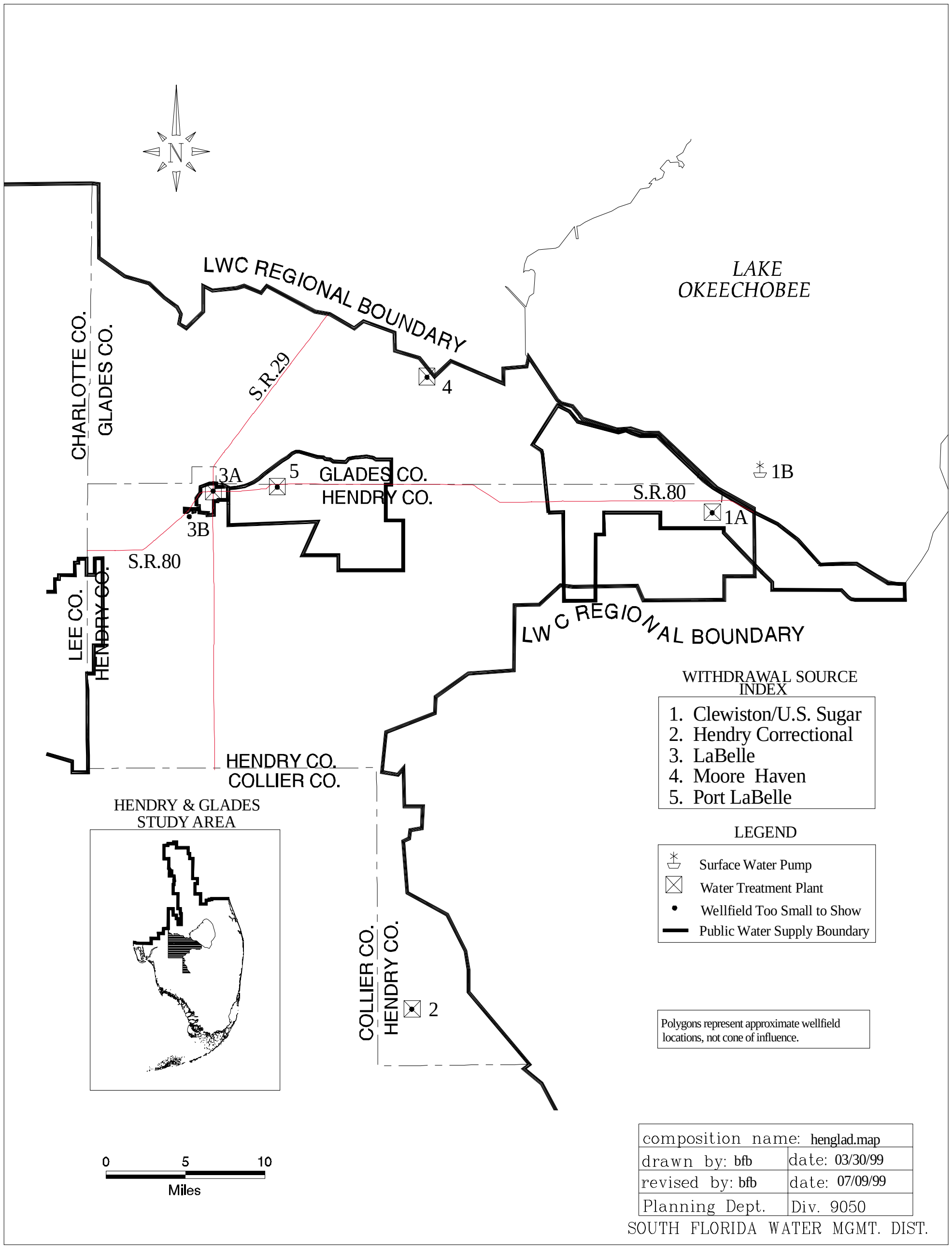


Figure D-2. Location of Regional Potable Water Treatment Facilities and Wellfields in Hendry and Glades Counties.

Clewiston/U.S. Sugar

SFWMD Permit Information 26-00024-W		
Permit Issue Date: 5/9/1996		Permit Expiration: 5/9/2006
Annual Allocation		1,564 MGY
Calculated Daily Allocation		4.28 MGD
Maximum Daily Allocation		7.46 MGD
Gallons Per Capita Per Day		68 GPCD
Maximum Day To Average Day Ratio		1.9
Withdrawal Source	Lake Okeechobee & Rim Canal	
Source Limitations	None	
Plant Information FDEP PWS Id:		5260927
FDEP Rated Capacity		6.00 MGD
Type of Treatment Method	Lime Softening	
Plant Address	One mile south of downtown Clewiston	
Average Flow Data: October 1996 – September 1997		
Average Daily Raw Water Pumpage		3.06 MGD
Average Treated Water Produced		2.85 MGD
Unaccounted For Losses		Unreported

Interconnections: There are no interconnections.

Future: Two surface water pumps will be added; one in the Lake Okeechobee Rim Canal and one in the Sugarland Drainage District's Lateral Canal 16.

Discussion: U.S. Sugar withdraws Lake Okeechobee water from a surface pump and pipeline approximately 2 miles northeast of Clewiston. The permit is an industrial and public water supply permit. The water provides for U.S. Sugar's industrial needs and the public water supply needs of Clewiston and the South Shore Water Association.

Source: U.S. Sugar Corporation, SFWMD, and FDEP Permits

Table D-15. Clewiston/U.S. Sugar Potable Water Supply Wells (Wellfield 1A on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (ft)	Year Drilled
1	520890 E	872550 N	Active	Lower Tamiami	135	110	12	725	N/A	1981
2	520200 E	871950 N	Active	Lower Tamiami	155	112	12	800	N/A	1981
3	521900 E	871650 N	Active	Lower Tamiami	155	112	12	800	N/A	1981
4	676637 E	874262 N	Active	Lower Tamiami	N/A	N/A	N/A	800	N/A	N/A

Table D-16. U.S. Sugar Corporation/Clewiston Surface Water Pumps (indicated by 1B on map).

Pump Number	Planar Coordinates		Source	Status	Pump Capacity GPM	Diameter	Elevation of Intake	Pump Type
1	539048 E	891156 N	Lake Okeechobee	Active	2,100	14	5.31	Centrifugal
2	539048 E	891156 N	Lake Okeechobee	Active	2,100	14	5.31	Centrifugal
3	539048 E	891156 N	Lake Okeechobee	Active	2,400	14	5.31	Centrifugal
4	539048 E	891156 N	Lake Okeechobee	Active	5,600	14	5.31	Centrifugal
5	523209 E	874069 N	Lateral Canal 16	Active	5,000	16	8	Mix Flow
6	531569 E	880029 N	Okeechobee Rim Canal	Active	5,000	12	6	Centrifugal

Hendry Correctional Institute

SFWMD Permit Information	26-00164-W
Permit Issue Date: 8/11/1994	Permit Expiration: 8/11/2004
Annual Allocation	710 MGY
Calculated Daily Allocation	1.95 MGD
Maximum Daily Allocation	2.35 MGD
Gallons Per Capita Per Day	396 GPCD
Maximum Day To Average Day Ratio	1.21
Withdrawal Source	Lower Tamiami
Source Limitations	None
Plant Information FDEP PWS Id:	5260319
FDEP Rated Capacity	0.60 MGD
Type of Treatment Method	Lime Softening
Plant Address	12551 Wainwright Dr., Immokalee, FL
Average Flow Data: October 1996 – September 1997	
Average Daily Raw Water Pumpage	0.42 MGD
Average Treated Water Produced	0.40 MGD
Unaccounted For Losses	N/A

Interconnections: There are no interconnections.

Future: Membrane treatment is proposed for expansion of needed capacity.

Discussion: Hendry Correctional Institute is currently unable to filter all water prior to treatment and must blend filtered and unfiltered water prior to treatment.

Source: Hendry Correctional Institute, SFWMD, and FDEP Permits

Table D-17. Hendry Correctional Institute Potable Water Supply Wells (Wellfield 2 on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (NGVD)	Year Drilled
1	416707 E	708653 N	Active	Lower Tamiami	85	63	4	30	-20	1978
2	417918 E	708645 N	Active	Lower Tamiami	85	63	4	30	-20	1978
3	416711 E	709929 N	Active	Lower Tamiami	85	63	4	30	-20	1978
4	417930 E	709852 N	Active	Lower Tamiami	85	63	4	30	-20	1978
5	416723 E	711120 N	Active	Lower Tamiami	85	63	4	30	-20	1978
6	416735 E	712364 N	Active	Lower Tamiami	85	63	4	30	-20	1978
7	416782 E	712340 N	Active	Lower Tamiami	85	63	4	30	-20	1978
8	417934 E	712319 N	Active	Lower Tamiami	85	63	4	30	-20	1978
9	416838 E	713543 N	Active	Lower Tamiami	85	63	4	30	-20	1978
10	417978 E	713527 N	Active	Lower Tamiami	85	63	4	30	-20	1978
11	415121 E	713821 N	Active	Lower Tamiami	140	107	6	100	N/A	1983
12	415109 E	711960 N	Active	Lower Tamiami	125	97	6	100	N/A	1983
13	415065 E	710313 N	Active	Lower Tamiami	125	97	6	100	N/A	1983
14	415026 E	708714 N	Abandoned	Lower Tamiami	125	97	6	100	N/A	1983
15	417440 E	715457 N	Active	Lower Tamiamir	125	97	10	500	-60	1995
16	417464 E	717064 N	Active	Lower Tamiami	125	97	10	500	-60	1995
17	417472 E	718703 N	Proposed	Lower Tamiami	125	97	10	400	-60	N/A
18	417396 E	712921 N	Proposed	Lower Tamiami	125	97	10	400	-60	N/A
19	417392 E	711302 N	Proposed	Lower Tamiami	125	97	10	400	-60	N/A

LaBelle

SFWMD Permit Information	26-00105-W
Permit Issue Date: 5/13/1999	Permit Expiration: 5/13/2004
Annual Allocation	250 MGY
Calculated Daily Allocation	0.68 MGD
Maximum Daily Allocation	0.92 MGD
Gallons Per Capita Per Day	119 GPCD
Maximum Day To Average Day Ratio	1.34
Withdrawal Source	Surficial
Source Limitations	None
Plant Information FDEP PWS Id:	5260050
FDEP Rated Capacity	1.00 MGD
Type of Treatment Method	Lime Softening and Free Chlorine
Plant Address	270 S. Main St., LaBelle, FL
Average Flow Data: October 1996 – September 1997	
Average Daily Raw Water Pumpage	0.62 MGD
Average Treated Water Produced	0.60 MGD
Unaccounted For Losses	3.20%

Interconnections: Port LaBelle and the city of LaBelle have one 6 inch interconnection.

Future: LaBelle has indicated they plan to plug their four wells in the southwest wellfield. They have put in two of four proposed wells and plan to put in the remaining two in the future.

Source: City of LaBelle, SFWMD,and FDEP Permits

Table D-18. LaBelle Potable Water Supply Wells (Wellfield 3A on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (NGVD)	Year Drilled
5	356274 E	881524 N	Active	Water Table	24	20	6	250	-18	1930
6	356293 E	881869 N	Active	Water Table	32	25	6	250	-20	1930
7	356692 E	881535 N	Active	Water Table	30	25	6	250	-20	1989
8	356238 E	881841 N	Proposed	Water Table	45	20	8	200	0	N/A
9	356293 E	881869 N	Proposed	Water Table	45	20	8	200	0	N/A
10	356692 E	881535 N	Active	Water Table	45	20	8	200	0	N/A
11	356692 E	881535 N	Proposed	Water Table	45	20	8	200	0	N/A

Table D-19. LaBelle Potable Water Supply Wells (Wellfield 3B on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (NGVD)	Year Drilled
1	348623 E	874231 N	Active	Water Table	26	20	12	290	-15	1978
2	348603 E	873963 N	Active	Water Table	26	20	12	140	-15	1981
3	348609 E	873626 N	Active	Water Table	26	20	12	290	-15	1978
4	348610 E	873325 N	Active	Water Table	26	20	12	290	-15	1981

Moore Haven

SFWMD Permit Information 22-00045-W	
Permit Issue Date: 7/15/1999	Permit Expiration:7/15/2009
Annual Allocation	146 MGY
Calculated Daily Allocation	0.41 MGD
Maximum Daily Allocation	0.70 MGD
Gallons Per Capita Per Day	137 GPCD
Maximum Day To Average Day Ratio	1.74
Withdrawal Source	Surficial
Source Limitations	None
Plant Information FDEP PWS Id:	5220192
FDEP Rated Capacity	0.75 MGD
Type of Treatment Method	Lime Softening
Plant Address	North Highway 27, MooreHaven, FL 33471
Average Flow Data: October 1996 – September 1997	
Average Daily Raw Water Pumpage	0.34 MGD
Average Treated Water Produced	0.32 MGD
Unaccounted For Losses	14.90%

Interconnections: There are no interconnections.

Future: N/A

Discussion: Moore Haven has just added two wells.

Source: Moore Haven Utility, Gee & Jensen, SFWMD,and FDEP Permits

Table D-20. Moore Haven Potable Water Supply Wells (Wellfield 4 on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (NGVD)	Year Drilled
GM-18	N/A	N/A	N/A	Surficial	110	55	10	400	N/A	1988
GM-20	N/A	N/A	N/A	Surficial	120	60	10	400	N/A	1988
N/A	N/A	N/A	N/A	Surficial	110	55	10	400	N/A	N/A
N/A	N/A	N/A	N/A	Surficial	120	60	10	400	N/A	N/A

Port LaBelle

SFWMD Permit Information	26-00096-W	
Permit Issue Date: 11/13/1997	Permit Expiration: 1/13/2007	
Annual Allocation	117 MGY	
Calculated Daily Allocation	0.32 MGD	
Maximum Daily Allocation	0.93 MGD	
Gallons Per Capita Per Day	88 GPCD	
Maximum Day To Average Day Ratio	2.9	
Withdrawal Source	Sandstone	
Source Limitations	None	
Plant Information FDEP PWS Id:	5260226	
FDEP Rated Capacity	0.50 MGD	
Type of Treatment Method	Lime Softening	
Plant Address	Port LaBelle Water Treatment Plant 6002, Cedarwood Parkway, P.O. Box 1760 , LaBelle, FL 33975	
Average Flow Data: October 1996 – September 1997		
Average Daily Raw Water Pumpage	0.19 MGD	
Average Treated Water Produced	0.17 MGD	
Unaccounted For Losses	8.50%	

Interconnections: Port LaBelle and the city of LaBelle have one 6 inch interconnection.

Future: N/A

Discussion: N/A

Source: Port LaBelle Utilities, SFWMD, and FDEP Permits

Table D-21. Port LaBelle Potable Water Supply Wells (Wellfield 5 on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (ft)	Year Drilled
1	377250 E	883997 N	Active	Sandstone	300	250	8	450	64	1973
2	377250 E	884598 N	Active	Sandstone	283	220	8	500	53	1983

Lee County

The locations of regional potable water treatment facilities within Lee County are shown in **Figure D-3**. This section contains summary sheets for each facility. The information on these sheets includes permit criteria, facility information, average flows, interconnections, and future plans. Following each summary sheet is a table or tables summarizing all of the source wells for the facility.

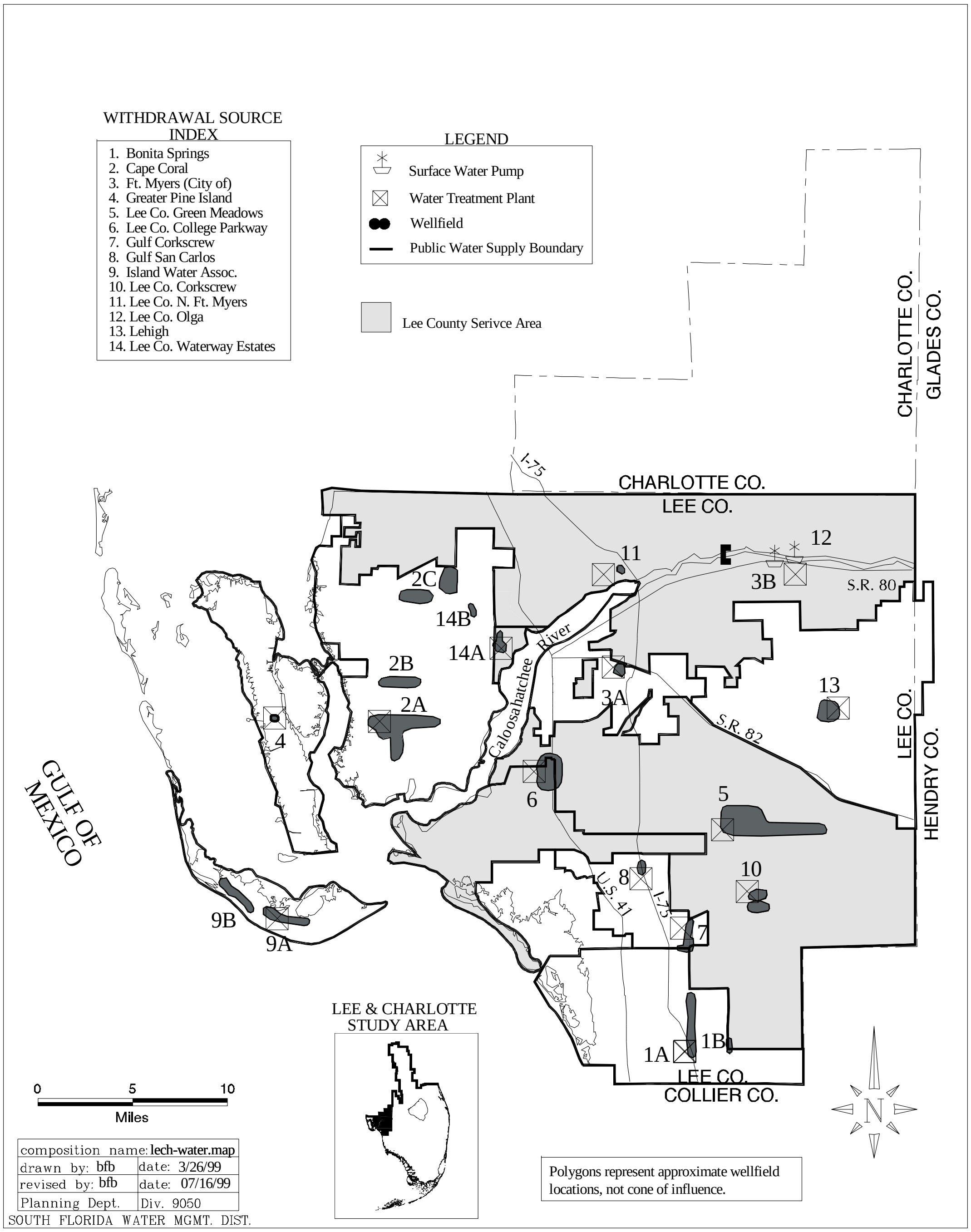


Figure D-3. Location of Regional Public Water Supply Facilities and Wellfields in Lee County.

Bonita Springs

SFWMD Permit Information	36-00008-W
Permit Issue Date: 11/13/1997	Permit Expiration: 11/13/2002
Annual Allocation	1,419 MGY
Calculated Daily Allocation	3.89 MGD
Maximum Daily Allocation	5.32 MGD
Gallons Per Capita Per Day	138 GPCD
Maximum Day To Average Day Ratio	1.37
Withdrawal Source	Lower Tamiami
Source Limitations	3.18 MGD and 983 MGY from the west wellfield
Plant Information FDEP PWS Id:	5360025
FDEP Rated Capacity	7.50 MGD
Type of Treatment Method	Lime Softening
Plant Address	11860 E. Terry St., Bonita Springs, FL 34135
Average Flow Data: October 1996 – September 1997	
Average Daily Raw Water Pumpage	2.46 MGD
Average Treated Water Produced	2.40 MGD
Unaccounted For Losses	6%

Interconnections: There are two interconnects: one with Gulf Utilities at Williams Road and Tamiami Road and a second with Collier County Utilities at Bonita Beach Road.

Future: Treatment method may be changed to membrane softening.

Discussion: Bonita Springs has requested a permit modification to increase their allocation due to high growth.

Source: Bonita Springs Utilities, SFWMD, and FDEP Permits

Table D-22. Bonita Springs Potable Water Supply Wells (Wellfield 1A on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (NGVD)	Year Drilled
1	252928 E	735224 N	Standby	Lower Tamiami	80	64	8	N/A	-60	1971
2	252837 E	734311 N	Standby	Lower Tamiami	80	65	8	N/A	-60	1971
3	252843 E	733364 N	Standby	Lower Tamiami	80	65	8	N/A	-60	1971
4	252887 E	732518 N	Standby	Lower Tamiami	80	64	8	N/A	-60	1971
5	252929 E	731571 N	Active	Lower Tamiami	80	64	8	350	-60	1971
6	252970 E	730686 N	Active	Lower Tamiami	80	58	8	150	-60	1971
7	252944 E	736127 N	Active	Lower Tamiami	90	66	12	250	-60	1983
8	253064 E	737561 N	Active	Lower Tamiami	85	70	8	125	-60	1979
9	253088 E	738541 N	Active	Lower Tamiami	85	70	8	150	-60	1979
10	252925 E	739369 N	Active	Lower Tamiami	90	66	12	300	-60	1983
11	253003 E	729812 N	Active	Lower Tamiami	97	67	12	350	-60	1983
12	253192 E	740872 N	Active	Lower Tamiami	100	72	12	325	-60	1988
13	253211 E	742037 N	Active	Lower Tamiami	100	78	12	325	-60	1988
14	252644 E	742940 N	Active	Lower Tamiami	100	80	12	325	-60	1988
15	252590 E	743963 N	Active	Lower Tamiami	100	85	12	325	-60	1988
16	252563 E	745032 N	Active	Lower Tamiami	100	85	12	325	-60	1988

Table D-23. Bonita Springs Potable Water Supply Wells (Wellfield 1B on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (NGVD)	Year Drilled
17	263387 E	732215 N	Active	Lower Tamiami	102	70	12	1,000	N/A	N/A
18	263387 E	732617 N	Active	Lower Tamiami	101	70	12	1,000	N/A	N/A
19	263387 E	732986 N	Active	Lower Tamiami	110	70	12	1,000	N/A	N/A
20	263337 E	733456 N	Active	Lower Tamiami	114	70	12	1,000	N/A	N/A
21	263761 E	731827 N	Active	Lower Tamiami	115	70	12	1,000	N/A	N/A
22	263761 E	731346 N	Active	Lower Tamiami	115	70	12	1,000	N/A	N/A
23	263395 E	731046 N	Active	Lower Tamiami	115	70	12	1,000	N/A	N/A
24	263414 E	730578 N	Active	Lower Tamiami	101	70	12	1,000	N/A	N/A

Cape Coral

SFWMD Permit Information	36-00046-W
Permit Issue Date: 1/14/1999	Permit Expiration: 1/14/2019
Annual Allocation	10,530 MGY
Calculated Daily Allocation	28.85 MGD
Maximum Daily Allocation	24.40 MGD
Gallons Per Capita Per Day	119 GPCD
Maximum Day To Average Day Ratio	1.44
Withdrawal Source	Lower Hawthorn and Canal System
Source Limitations	24.40 MGD from the Lower Hawthorn aquifer and 873 MG/month from the canal system
Plant Information FDEP PWS Id:	5360325
FDEP Rated Capacity	15.00 MGD
Type of Treatment Method	Reverse Osmosis
Plant Address	3300 SW 20th St., Cape Coral, FL
Average Flow Data: October 1996 – September 1997	
Average Daily Raw Water Pumpage	8.22 MGD
Average Treated Water Produced	7.31 MGD
Unaccounted For Losses	7%

Interconnections: There are two interconnects: a 10 inch with Waterway Estates at Hancock Bridge Parkway and 24th Avenue and a 8 inch with Greater Pine Island Water Association at Pine Island Road and Knott Road. Cape Coral reports these physically exist but are not currently in use.

Future: May soon add two wells at the existing reverse osmosis facility, a new wellfield containing 12 Lower Hawthorn wells and a 8 MGD reverse osmosis plant in North Cape Coral by 2008, and four new canal pump stations by 2020 for distribution of canal water for irrigation.

Discussion: Cape Coral operates a dual water system of potable and reclaimed for residential irrigation, Water Independence for Cape Coral (WICC). In addition, water from a secondary canal system is used to supplement the reclaimed water. Cape Coral's reverse osmosis treatment concentrate is discharged into the tidal Lake Finisterre, approximately one mile south of the facility.

Source: Cape Coral, SFWMD, and FDEP Permits

Table D-24. Cape Coral Potable Water Supply Wells (Wellfield 2A on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (NGVD)	Year Drilled
1	167540 E	821817 N	Active	Lower Hawthorn	745	362	10	540	-70	1975
2	167456 E	821564 N	Active	Lower Hawthorn	685	347	12	600	-70	1975
3	167498 E	821352 N	Active	Lower Hawthorn	705	345	12	550	-70	1975
4	166314 E	821902 N	Active	Lower Hawthorn	700	350	12	500	-70	1975
5	165680 E	821944 N	Active	Lower Hawthorn	765	345	12	500	-70	1975
6	165004 E	821944 N	Active	Lower Hawthorn	800	564	12	200	-70	1994
7	170668 E	820252 N	Active	Lower Hawthorn	752	357	12	425	-95	1982
8	170669 E	817756 N	Active	Lower Hawthorn	752	345	12	490	-95	1982
9	170627 E	815176 N	Active	Lower Hawthorn	748	350	12	500	-95	1982
10	167244 E	818645 N	Active	Lower Hawthorn	748	350	12	500	-95	1982
10a	166968 E	820589 N	Proposed	Lower Hawthorn	750	560	12	600	N/A	N/A
16	171472 E	821987 N	Active	Lower Hawthorn	707	456	12	600	-80	1984
17	172445 E	821987 N	Active	Lower Hawthorn	700	440	12	575	-80	1984
18	174432 E	822071 N	Active	Lower Hawthorn	722	495	12	525	-80	1984
19	177053 E	822071 N	Active	Lower Hawthorn	702	515	12	755	-80	1984
20	178448 E	822071 N	Active	Lower Hawthorn	720	500	12	600	-80	1984
21	179632 E	822240 N	Active	Lower Hawthorn	720	510	12	600	-80	1984
22	181239 E	822156 N	Active	Lower Hawthorn	642	515	12	475	-80	1984

Table D-25. Cape Coral Potable Water Supply Wells (Wellfield 2B on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (NGVD)	Year Drilled
11	168541 E	833016 N	Active	Lower Hawthorn	762	600	12	550	-80	1984
12	170246 E	832977 N	Active	Lower Hawthorn	742	599	12	560	-80	1984
13	171873 E	833093 N	Active	Lower Hawthorn	765	589	12	625	-80	1984
14	172842 E	833132 N	Active	Lower Hawthorn	702	520	12	515	-80	1984
15	174236 E	833171 N	Active	Lower Hawthorn	722	558	12	620	-80	1984
23	175709 E	833248 N	Active	Lower Hawthorn	652	420	12	700	-80	1990
24	167223 E	833054 N	Proposed	Lower Hawthorn	709	389	12	600	-80	1990
RO25	170696 E	834534 N	Proposed	Lower Hawthorn	750	560	12	600	N/A	N/A
RO26	167223 E	833054 N	Proposed	Lower Hawthorn	750	560	12	600	N/A	N/A

Table D-26. Cape Coral Potable Water Supply Wells (Wellfield 2C on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (NGVD)	Year Drilled
1n	166370 E	859985 N	Active	Lower Hawthorn	735	500	12	600	N/A	N/A
2n	192387 E	857302 N	Active	Lower Hawthorn	800	560	12	600	N/A	1990
3n	192424 E	858959 N	Active	Lower Hawthorn	1100	782	12	600	N/A	1990
4n	192497 E	860321 N	Proposed	Lower Hawthorn	800	550	12	600	N/A	N/A
5n	192534 E	862235 N	Proposed	Lower Hawthorn	800	550	12	600	N/A	N/A
6n	192681 E	864150 N	Proposed	Lower Hawthorn	800	550	12	600	N/A	N/A
7n	170650 E	854646 N	Proposed	Lower Hawthorn	800	550	12	600	N/A	N/A
8n	171755 E	854692 N	Proposed	Lower Hawthorn	800	550	12	600	N/A	N/A
9n	172905 E	854600 N	Proposed	Lower Hawthorn	800	500	12	600	N/A	N/A
10n	175759 E	854646 N	Proposed	Lower Hawthorn	800	500	12	600	N/A	N/A
11n	178474 E	854738 N	Proposed	Lower Hawthorn	800	500	12	600	N/A	N/A
12n	179579 E	854738 N	Proposed	Lower Hawthorn	800	500	12	600	N/A	N/A

Table D-27. Plugged Cape Coral Water Supply Wells (Wellfield 4 not on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (ft)	Year Drilled
2	168467 E	839489 N	Plugged	Mid-Hawthorn	280	85	6	100	60-70	1965
3	168146 E	840105 N	Plugged	Mid-Hawthorn	280	84	6	100	60-70	1965
4	168058 E	841311 N	Plugged	Mid-Hawthorn	290	84	6	110	60-70	1965
6	168962 E	838851 N	Plugged	Mid-Hawthorn	290	84	6	110	60-70	1965
7	169500 E	838864 N	Plugged	Mid-Hawthorn	290	84	6	120	60-70	1965
9	169043 E	837862 N	Plugged	Mid-Hawthorn	280	86	6	90	60-70	1965
10	169798 E	837456 N	Plugged	Mid-Hawthorn	280	82	6	100	60-70	1965
11	168310 E	837898 N	Plugged	Mid-Hawthorn	280	85	6	110	60-70	1965
12	169801 E	838203 N	Plugged	Mid-Hawthorn	280	84	6	90	60-70	1965

Fort Myers

SFWMD Permit Information 36-00035-w	
Permit Issue Date: 3/12/1998	Permit Expiration: 3/12/2002
Annual Allocation	4,043 MGY
Calculated Daily Allocation	11.08 MGD
Maximum Daily Allocation	15.72 MGD
Gallons Per Capita Per Day	160 GPCD
Maximum Day To Average Day Ratio	1.25
Withdrawal Source	C-43 Canal
Source Limitations	Surficial 3,718 MGY; Caloosahatchee 4,043 MGY
Plant Information FDEP PWS Id:	5360102
FDEP Rated Capacity	12.00 MGD
Type of Treatment Method	Membrane Softening
Plant Address	2751 Jacksonville St, Fort Myers, FL, 33916
Average Flow Data: October 1996 – September 1997	
Average Daily Raw Water Pumpage	7.08 MGD
Average Treated Water Produced	6.17 MGD
Unaccounted For Losses	11.70%

Interconnections: There are four interconnects with Lee County: a 6 inch at Armeda Avenue and Prospect Street, an 8 inch at Collins Street and Evans Avenue, a 10 inch at Colonial Boulevard, and a 6 inch at Nuna Avenue and New York Avenue.

Future: Fort Myers is pursuing development of a Floridan aquifer wellfield and reverse osmosis facility to replace their surface water source because of the variable quality and quantity of the water from the C-43 Canal.

Discussion: Fort Myers withdraws from the C-43 Canal then pipes it 13 miles to recharge the surfical aquifer wellfield through a series of canals. A surface water pump just east of the Franklin Lock withdraws from the C-43 Canal. Although Fort Myers has the ability to remove up to 500 mg/L of chlorides in the membrane softening process, the introduction of high chlorides to the wellfield causes concern for other users in the vicinity. Occasional freshwater releases from Lake Okeechobee are required to improve the water quality of this surface water source.

Source: City of Fort Myers, SFWMD, and FDEP Permits

Table D-28. Fort Myers Potable Water Supply Wells (Wellfield 3A on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (ft)	Year Drilled
2	233700 E	837407 N	Active	Water Table	31	10	12	500	N/A	1991
3	233137 E	837649 N	Active	Water Table	26	10	12	500	N/A	1991
4	233400 E	837023 N	Active	Water Table	31	8	12	500	N/A	1991
5	232928 E	837204 N	Active	Water Table	27	8	12	500	N/A	1991
6	233052 E	836748 N	Active	Water Table	29	10	12	500	N/A	1991
7	232510 E	836784 N	Active	Water Table	29	13	12	500	N/A	1991
8	232749 E	836368 N	Active	Water Table	29	10	12	500	N/A	1991
9	232152 E	836437 N	Active	Water Table	28	11	12	500	N/A	1991
10	232378 E	836026 N	Active	Water Table	30	10	12	500	N/A	1991
11	233418 E	836593 N	Active	Water Table	34	9	12	N/A	N/A	1991
12	233875 E	836436 N	Active	Water Table	30	10	12	500	N/A	1991
13	233647 E	836077 N	Active	Water Table	26	10	12	460	N/A	1991
15	233735 E	835653 N	Active	Water Table	26	11	12	460	N/A	1991
16	233468 E	835290 N	Active	Water Table	29	9	12	500	N/A	1991
17	232937 E	835446 N	Active	Water Table	27	10	12	500	N/A	1991
27	231795 E	836089 N	Active	Water Table	27	12	12	460	N/A	1991
28	232704 E	837627 N	Active	Water Table	20	6	12	460	N/A	1991
30	233317 E	835752 N	Active	Water Table	31	9	12	460	N/A	1991
31	232846 E	835939 N	Active	Water Table	31	10	12	500	N/A	1991
33	233727 E	836837 N	Active	Water Table	28	9	12	500	N/A	1991
Old 1	231515 E	834000 N	Primary	Water Table	40	15	12	500	N/A	1960
Old 2	231647 E	833752 N	Primary	Water Table	31	15	12	500	N/A	1960
Old 3	231183 E	833610 N	Primary	Water Table	29	15	12	500	N/A	1983
Old 6	233390 E	836120 N	Standby	Water Table	40	15	12	N/A	N/A	1947
Old 8	234205 E	836396 N	Standby	Water Table	31	15	12	N/A	N/A	1947
Old 10	234328 E	836093 N	Primary	Water Table	29	15	12	500	N/A	1952
Old 11	233485 E	835486 N	Primary	Water Table	40	15	12	500	N/A	1952
Old 13	233864 E	838290 N	Standby	Water Table	31	16	12	N/A	N/A	1952
Old 16	232234 E	834567 N	Primary	Water Table	29	15	12	500	N/A	1956
Old 17	232604 E	834757 N	Secondary	Water Table	40	15	12	N/A	N/A	1956
Old17-0	232736 E	834804 N	Standby	Water Table	31	15	12	N/A	N/A	1947
Old 20	231663 E	832578 N	Primary	Water Table	29	12	12	500	N/A	1956
Old 4-b	N/A	836993 N	Standby	Water Table	40	15	12	N/A	N/A	1947
HW1N	233096 E	834785 N	Standby	Water Table	14	14	12	N/A	N/A	1995
HW1S	232575 E	834558 N	Standby	Water Table	14	14	12	N/A	N/A	1995
HW1SE	232444 E	834454 N	Standby	Water Table	18	18	12	N/A	N/A	1995

Table D-29. Fort Myers Surface Water Pumps (indicated by 3B on map).

Pump Number	Planar Coordinates		Source	Status	Pump Capacity (GPM)	Intake Depth (in)	Elevation of Intake (NGVD)	Pump type
1	271490 E	866770 N	C-43	Active	7,000	18	1.5	Vertical
2	271490 E	866770 N	C-43	Active	7,000	18	1.5	Vertical
3	271490 E	866770 N	C-43	Active	7,000	18	1.5	Vertical

Greater Pine Island

SFWMD Permit Information 36-00045-W	
Permit Issue Date: 11/14/1996	Permit Expiration: 11/14/2006
Annual Allocation	616 MGY
Calculated Daily Allocation	1.69 MGD
Maximum Daily Allocation	2.21 MGD
Gallons Per Capita Per Day	157 GPCD
Maximum Day To Average Day Ratio	1.31
Withdrawal Source	Lower Hawthorn
Source Limitations	None
Plant Information FDEP PWS Id:	5360322
FDEP Rated Capacity	1.50 MGD
Type of Treatment Method	Reverse Osmosis
Plant Address	5281 Pine Island Road, Bokeelia, FL 33922
Average Flow Data: October 1996 – September 1997	
Average Daily Raw Water Pumpage	1.27 MGD
Average Treated Water Produced	1.08 MGD
Unaccounted For Losses	8.50%

Interconnections: There are two interconnects, an 8 inch with Cape Coral at Pine Island Road and Knott Road and a 10 inch with Island Water Association on Sanibel.

Future: N/A

Discussion: The wellfield which was in Cape Coral is no longer in use. All withdrawals now come from the three wells at the reverse osmosis facility. Percolation ponds are used for the reverse osmosis reject.

Source: Greater Pine Island Water Association, SFWMD, and FDEP Permits

Table D-30. Greater Pine Island Potable Water Supply Wells (Wellfield 4).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (ft)	Year Drilled
RO 2	161793 E	839108 N	Plugged	Mid-Hawthorn	850	350	12	750	60-70	1978
RO 3	161810 E	838918 N	Plugged	Mid-Hawthorn	750	450	10	780	60-70	1981
RO 4	137237 E	823434 N	Active	Mid-Hawthorn	739	583	12	700	55	1991
RO 5	136918 E	823301 N	Active	Mid-Hawthorn	770	563	12	700	55	1991
RO 6	136782 E	823448 N	Active	Mid-Hawthorn	737	598	12	700	77	1992
RO 7	137145 E	823190 N	Future	Mid-Hawthorn	740	598	12	700	N/A	N/A

Lee County Green Meadows and College Parkway

SFWMD Permit Information	36-00150-W
Permit Issue Date: 10/14/1993	Permit Expiration: 10/10/1998
Annual Allocation	2,791 MGY
Calculated Daily Allocation	7.65 MGD
Maximum Daily Allocation	12.47 MGD
Gallons Per Capita Per Day	132 GPCD
Maximum Day To Average Day Ratio	1.63
Withdrawal Source	Sandstone, Surficial and Mid-Hawthorn
Source Limitations	Sandstone 8.89 MGD, Surficial 3.58 MGD, Mid-Hawthorn 0.75
Plant Information FDEP PWS Id:	5360070
FDEP Rated Capacity	Green Meadows 9 MGD, College Parkway 1.5 MGD
Type of Treatment Method	Lime Softening
Plant Address	Green Meadows: 13001 Alico Rd., Fort Myers, FL 33913 College Parkway: 7401 College Pkwy, Fort Myers, FL 33903
Average Flow Data: October 1996 – September 1997	
Average Daily Raw Water Pumpage	5.80 MGD
Average Treated Water Produced	6.00 MGD
Unaccounted For Losses	6%

Interconnections: There are four interconnects: two with Lee County and two with Gulf Utilities. The two Lee County interconnects are both 8 inches and are at McGregor and Cypress Lakes, and Old Gladiolus Drive and U.S. 41 South. Two interconnects with Gulf are: an 8 inch at Alico Road and Lee Road and a 10 inch on Island Park Road.

Future: Lee County is currently conducting a feasibility analysis to determine expansion plans for Green Meadows and Corkscrew.

Discussion: College Parkway (also known as Cypress Lakes) and Green Meadows serve what is known as the South Fort Myers Service Area. They also serve San Carlos and Ester Island as the newly formed town of Fort Myers Beach. These two Florida Cities Water Company plants were sold to Lee County in April 1999.

Source: Florida Cities Water Company, SFWMD, and FDEP Permits

Table D-31. Lee County Green Meadows Potable Water Supply Wells (Wellfield 5).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (ft)	Year Drilled
1	262853 E	792637 N	Active	Sandstone	180	170	10	500	N/A	1974
1D	262853 E	792637 N	Active	Water Table	40	14	10	500	N/A	1983
2	263821 E	792182 N	Active	Sandstone	190	110	10	500	N/A	1974
2A	263821 E	792182 N	Active	Water Table	38	20	10	500	N/A	1983
3	263755 E	792923 N	Active	Sandstone	190	100	16	500	N/A	1975
3A	263755 E	792923 N	Active	Water Table	42	17	10	500	N/A	1983
3B	263755 E	792923 N	Active	Water Table	42	22	10	500	N/A	1983
4	265650 E	792218 N	Active	Sandstone	185	105	16	500	N/A	1975
4A	265650 E	792218 N	Active	Water Table	43	20	10	500	N/A	1983
5	267947 E	792224 N	Active	Sandstone	180	102	16	500	N/A	1981
5A	267947 E	792224 N	Active	Water Table	24	20	10	200	N/A	1991
6	270742 E	792196 N	Active	Sandstone	235	90	16	350	N/A	1981
6A	270742 E	792196 N	Active	Water Table	24	20	10	200	N/A	1991
7	273351 E	792329 N	Active	Sandstone	170	90	10	500	N/A	1981
7A	273351 E	792329 N	Active	Water Table	45	21	10	200	N/A	1991
8	275758 E	792218 N	Active	Sandstone	190	90	10	500	N/A	1989
8A	275758 E	792218 N	Active	Water Table	42	20	10	500	N/A	1989
9	278055 E	792224 N	Active	Sandstone	230	91	10	500	N/A	1983
9A	278055 E	792224 N	Active	Water Table	42	20	10	500	N/A	1983
10	280850 E	792196 N	Active	Sandstone	200	90	10	500	N/A	1990
10A	280850 E	792196 N	Active	Water Table	40	20	10	200	N/A	1990
11	283459 E	792329 N	Active	Sandstone	210	90	10	500	N/A	1990
11A	283459 E	792329 N	Active	Water Table	40	20	10	200	N/A	1990
12	286224 E	792184 N	Active	Sandstone	90	84	10	200	N/A	1991
12A	286224 E	792184 N	Active	Water Table	25	20	10	200	N/A	1991
13	288850 E	792305 N	Active	Sandstone	92	84	10	500	N/A	1991
13A	288850 E	792305 N	Active	Water Table	25	20	10	200	N/A	1991
15	262813 E	794767 N	Proposed	Sandstone	N/A	N/A	10	500	N/A	N/A
15A	262813 E	794767 N	Proposed	Water Table	40	20	10	200	N/A	N/A
16	262746 E	797339 N	Proposed	Sandstone	N/A	N/A	10	500	N/A	N/A
16A	262746 E	797339 N	Proposed	Water Table	40	N/A	10	200	N/A	N/A
17	265569 E	797317 N	Proposed	Sandstone	N/A	N/A	10	500	N/A	N/A
17A	265569 E	797317 N	Proposed	Water Table	40	N/A	10	200	N/A	N/A
18	267975 E	797329 N	Proposed	Sandstone	N/A	N/A	10	500	N/A	N/A
18A	267975 E	797329 N	Proposed	Water Table	40	N/A	10	200	N/A	N/A
19	270655 E	797309 N	Proposed	Sandstone	N/A	N/A	10	500	N/A	N/A
19A	270655 E	797309 N	Proposed	Water Table	40	N/A	10	200	N/A	N/A

Table D-32. Lee County College Parkway Potable Water Supply Wells (Wellfield 6 on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (ft)	Year Drilled
2	213510 E	804977 N	Active	Mid-Hawthorn	230	126	8	120	N/A	1970
3	213009 E	804654 N	Reserve	Mid-Hawthorn	220	135	8	not installed	N/A	1974
4	212574 E	805016 N	Active	Mid-Hawthorn	220	100	8	100	N/A	1973
5	213811 E	806716 N	Active	Mid-Hawthorn	238	116	8	80	N/A	1969
6	213573 E	806315 N	Active	Mid-Hawthorn	260	126	8	70	N/A	1973
7	214806 E	807725 N	Active	Mid-Hawthorn	220	126	8	100	N/A	1972
8	214345 E	807719 N	Reserve	Mid-Hawthorn	224	126	8	145	N/A	1972
12	212754 E	807693 N	Reserve	Mid-Hawthorn	220	120	8	110	N/A	1972
13	212319 E	807719 N	Reserve	Mid-Hawthorn	220	126	8	not installed	N/A	1972
14	212345 E	808177 N	Active	Mid-Hawthorn	220	130	8	65	N/A	1967
15	212535 E	809122 N	Reserve	Mid-Hawthorn	220	120	8	150	N/A	N/A
16	212897 E	810155 N	Reserve	Mid-Hawthorn	220	130	8	not installed	N/A	1974
17	212436 E	810057 N	Active	Mid-Hawthorn	285	220	8	120	N/A	1973
18	810170 E	210936 N	Reserve	Mid-Hawthorn	280	220	12	not installed	N/A	1973

Gulf Corkscrew

SFWMD Permit Information	36-00122-W
Permit Issue Date: 11/9/1995	Permit Expiration: 11/9/2000
Annual Allocation	1,152 MGY
Calculated Daily Allocation	3.16 MGD
Maximum Daily Allocation	4.83 MGD
Gallons Per Capita Per Day	105 GPCD
Maximum Day To Average Day Ratio	1.53
Withdrawal Source	Sandstone and Surficial
Source Limitations	Surficial Aquifer 2.32 MGD, none on the Sandstone.
Plant Information FDEP PWS Id:	5364097
FDEP Rated Capacity	1.80 MGD
Type of Treatment Method	Membrane Softening
Plant Address	11950 Corkscrew Rd., Estero, FL 33928
Average Flow Data: October 1996 – September 1997	
Average Daily Raw Water Pumpage	2.46 MGD
Average Treated Water Produced	2.41 MGD
Unaccounted For Losses	5.90%

Interconnections: There is one interconnect with Bonita Springs Utilities at Williams Road and Tamiami Road.

Future: Gulf Environmental Services Inc. is constructing a 24 inch treated water interconnect to the Lee County Corkscrew facility, connecting at Corkscrew Road near the Wildcat Run Development.

Discussion: The membrane softening reject goes to the Three Oaks Wastewater Treatment Facility.

Source: Gulf Environmental Inc., SFWMD, and FDEP Permits

Table D-33. Gulf Corkscrew Potable Water Supply Wells (Wellfield 7 on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (ft)	Year Drilled
1	252463E	761540 N	Active	Water Table	31	16	16	450	N/A	1988
2	252870 E	761218 N	Active	Water Table	40	19	16	450	N/A	1988
3	252882 E	760767 N	Active	Water Table	40	19	16	450	N/A	1988
4	252959 E	760289 N	Active	Water Table	39	19	16	450	N/A	1988
5	252915 E	759887 N	Active	Water Table	42	20	16	450	N/A	1988
6	252900 E	759230 N	Active	Water Table	32	22	16	450	N/A	1988
7	252153 E	759049 N	Active	Water Table	39	19	16	450	N/A	1988
8	251673 E	759136 N	Active	Water Table	30	20	16	450	N/A	1988
9	251130 E	759144 N	Active	Water Table	30	21	16	450	N/A	1988
10	250368 E	759173 N	Active	Water Table	30	18	16	450	N/A	1988
11	249603 E	759182 N	Active	Water Table	30	17	16	450	N/A	N/A
12	252760 E	766565 N	Active	Sandstone	123	83	6	60	N/A	1990
17	252060 E	764694 N	Proposed	Sandstone	125	85	6	60	N/A	N/A
18	252201 E	761793 N	Proposed	Sandstone	125	85	6	60	N/A	N/A
19	252197 E	759239 N	Proposed	Sandstone	125	85	6	60	N/A	N/A
20	250986 E	759161 N	Proposed	Sandstone	125	85	6	60	N/A	N/A

Gulf San Carlos

SFWMD Permit Information	36-00122-W
Permit Issue Date: 11/9/1995	Permit Expiration: 11/9/2000
Annual Allocation	See Gulf Corkscrew
Calculated Daily Allocation	See Gulf Corkscrew
Maximum Daily Allocation	See Gulf Corkscrew
Gallons Per Capita Per Day	See Gulf Corkscrew
Maximum Day To Average Day Ratio	See Gulf Corkscrew
Withdrawal Source	Surficial
Source Limitations	Surficial 2.5 MGD
Plant Information FDEP PWS Id:	5360243
FDEP Rated Capacity	2.415 MGD
Type of Treatment Method	Lime Softening
Plant Address	18513 Bartow Boulevard, Fort Myers, FL 33912
Average Flow Data: October 1996 – September 1997	
Average Daily Raw Water Pumpage	See Gulf Corkscrew
Average Treated Water Produced	See Gulf Corkscrew
Unaccounted For Losses	See Gulf Corkscrew

Interconnections: There are two interconnects with the Lee County College Parkway Water Treatment Facility. An 8 inch is at Alico Road and Lee Road. The other is a 10 inch on Island Park Road.

Future: N/A

Discussion: N/A

Source: Gulf Environmental Inc., SFWMD, and FDEP Permits

Table D-34. Gulf San Carlos Potable Water Supply Well (Wellfield 8 on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (ft)	Year Drilled
13	239211 E	780782 N	Active	Water Table	41	19	8	500	N/A	1988
14	239199 E	781178 N	Active	Water Table	45	22	8	500	N/A	1984
15	239198 E	781825 N	Active	Water Table	40	18	8	500	N/A	1980
16	239210 E	782620 N	Active	Water Table	40	19	8	375	N/A	1980

Island Water Association

SFWMD Permit Information	36-00034-W
Permit Issue Date: 11/13/1997	Permit Expiration: 11/13/2017
Annual Allocation	1,809 MGY
Calculated Daily Allocation	4.96 MGD
Maximum Daily Allocation	8.08 MGD
Gallons Per Capita Per Day	544 GPCD
Maximum Day To Average Day Ratio	1.63
Withdrawal Source	Floridan
Source Limitations	None
Plant Information FDEP PWS Id:	5360146
FDEP Rated Capacity	4.70 MGD
Type of Treatment Method	Reverse Osmosis
Plant Address	3651 Sanibel-Captiva Rd., Sanibel, FL 33957
Average Flow Data: October 1996 – September 1997	
Average Daily Raw Water Pumpage	3.76 MGD
Average Treated Water Produced	2.99 MGD
Unaccounted For Losses	6.40%

Interconnections: There is one 10 inch interconnect North to Greater Pine Island.

Future: Currently asking FDEP for a deep well injection permit to receive the reverse osmosis brine. In cooperation with the Sanibel Wastewater Treatment Facility, Island Water Association will share the deep well to accommodate unneeded reuse flows from the Sanibel Wastewater Treatment Facility, especially to accommodate wet weather conditions. Together they are considering development of a dual water distribution system to deliver reuse as irrigation water to residents in addition to golf irrigation.

Discussion: Island Water Association operates a reverse osmosis facility with the reject being discharged to the Gulf of Mexico.

Source: Island Water Association, SFWMD, and FDEP Permits

Table D-35. Island Water Association Potable Water Supply Wells (Wellfield 9A on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (ft)	Year Drilled
H3	137154 E	768267 N	Plugged	Lower Hawthorn	651	561	4		80	1973
H5	140823 E	766912 N	Active	Lower Hawthorn	676	508	6	300	168	1975
H6	142055 E	766627 N	Active	Lower Hawthorn	700	647	6	300	53	1975
H7	142988 E	766519 N	Active	Lower Hawthorn	702	642	6	300	57	1975
H8	143984 E	766434 N	Active	Lower Hawthorn	678	508	6	300	170	1975
H9	144722 E	766489 N	Active	Lower Hawthorn	675	504	6	300	171	1975
H10	145417 E	766684 N	Active	Lower Hawthorn	625	500	10	300	125	1975
H12	134684 E	769432 N	Active	Lower Hawthorn	650	610	10	300	40	1977
H13	138608 E	766919 N	Standby	Lower Hawthorn	588	502	10	300	86	1982
H14	133011 E	769760 N	Active	Lower Hawthorn	605	505	8	N/A	100	1988
H15	122708 E	776511 N	Active	Lower Hawthorn	610	440	10	300	170	1978
S1	136902 E	767590 N	Active	Suwannee	716	660	12	300	56	1978
S2	137228 E	767612 N	Monitor	Suwannee	696	661	8	550	35	1979
S3	136777 E	767752 N	Active	Suwannee	705	660	10	550	45	1981
S4	135193 E	768752 N	Active	Suwannee	720	668	10	550	52	1984

Table D-36. Island Water Association Potable Water Supply Wells (Wellfield 9B on map)

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (ft)	Year Drilled
S5	129774 E	770938 N	Active	Suwannee	770	664	10	550	106	1985
S6	130436 E	770938 N	Active	Suwannee	770	649	10	550	121	1988
S7	130182 E	769923 N	Active	Suwannee	770	639	10	550	131	1988
S8	124739 E	774373 N	Active	Suwannee	750	618	10	550	132	1991
S9	122794 E	776983 N	Future	Suwannee	750	620	10	525	160	N/A
S10	122601 E	777271 N	Future	Suwannee	750	620	10	525	160	N/A
S11	122413 E	777572 N	Future	Suwannee	750	620	10	525	160	N/A

Lee County Corkscrew

SFWMD Permit Information 36-00003-W	
Permit Issue Date: 2/12/1998	Permit Expiration: 2/12/2003
Annual Allocation	4,462 MGY
Calculated Daily Allocation	12.22 MGD
Maximum Daily Allocation	17.11 MGD
Gallons Per Capita Per Day	115 GPCD
Maximum Day To Average Day Ratio	1.4
Withdrawal Source	Surficial and Sandstone
Source Limitations	Surficial Aquifer 8.84 MGD, none on the Sandstone
Plant Information FDEP PWS Id:	5360170
FDEP Rated Capacity	10.00 MGD
Type of Treatment Method	Lime Softening
Plant Address	1601 Alico Rd., Estero, FL 33928
Average Flow Data: October 1996 – September 1997	
Average Daily Raw Water Pumpage	6.34 MGD
Average Treated Water Produced	6.30 MGD
Unaccounted For Losses	10%

Interconnections: Lee County has eight interconnects. Four of these interconnects are with the city of Fort Myers: a 6 inch at Armeda Avenue and Prospect Street, an 8 inch at Collins Street and Evans Avenue, a 10 inch at Colonial Boulevard, and a 6 inch at Nuna Avenue and New York Avenue. Two interconnects are with the College Parkway and Green Meadows facilities: an 8 inch at McGregor Boulevard and Cypress Lake Drive and an 8 inch at Old Gladiolus Drive and U.S. 41 South. One more interconnect exists with Waterway, on Pondella Road, a 4 inch at the U.S. 41 Bridge.

Future: Gulf Environmental Inc. is currently contracting to build a 24 inch treated water interconnect to the Lee County Corkscrew facility, connecting at Corkscrew Road near the Wildcat Run Development. Lee County is currently conducting a feasibility analysis to determine expansion plans for Green Meadows and Corkscrew.

Discussion: The Corkscrew and Olga service areas share water. The county has drilled the proposed four Surficial and four Sandstone wells in pairs in the Corkscrew Wellfield.

Source: Lee County Utilities, SFWMD, and FDEP Permits

Table D-37. Lee County Corkscrew Potable Water Supply Wells (Wellfield 10 on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (ft)	Year Drilled
1	269765 E	773808 N	Standby	Sandstone	205	135	12	350	100	1980
2	271683 E	774278 N	Active	Sandstone	250	160	12	350	100	1980
3	273369 E	774752 N	Active	Sandstone	270	180	12	350	100	1980
4	269867 E	770126 N	Active	Sandstone	295	185	12	350	100	1980
5	271720 E	770076 N	Active	Sandstone	295	205	12	350	100	1980
6	273462 E	770075 N	Active	Sandstone	300	210	12	350	100	1980
7	269827 E	771103 N	Active	Water Table	135	45	12	500	40	1980
8	270692 E	771140 N	Active	Water Table	140	50	12	500	40	1980
9	271625 E	771164 N	Active	Water Table	140	55	12	500	45	1980
10	272496 E	771175 N	Active	Water Table	150	60	12	500	45	1980
11	273381 E	771225 N	Active	Water Table	145	55	12	500	45	1980
12	269716 E	770131 N	Active	Water Table	140	50	12	500	45	1980
13	270709 E	770157 N	Active	Water Table	140	50	12	500	45	1980
14	271596 E	770100 N	Active	Water Table	150	55	12	500	45	1980
15	272486 E	770094 N	Active	Water Table	145	55	12	500	45	1980
16	273357 E	770073 N	Active	Water Table	150	60	12	500	45	1980
18	270504 E	773165 N	Active	Water Table	115	45	12	500	40	1982
19	271578 E	773135 N	Active	Water Table	120	50	12	500	45	1982
20	272459 E	773186 N	Active	Water Table	120	50	12	500	45	1982
21	270427 E	773948 N	Active	Water Table	105	35	12	500	30	1982
22	271476 E	774207 N	Active	Water Table	110	40	12	500	35	1982
23	272349 E	774477 N	Active	Water Table	115	45	12	500	40	1982
24	273114 E	774721 N	Active	Water Table	120	50	12	500	45	1982
25S	262945 E	770019 N	Active	Water Table	140	50	12	500	45	N/A
25D	262945 E	770019 N	Active	Sandstone	360	190	12	350	100	N/A
26S	263085 E	768209 N	Active	Water Table	140	50	12	500	45	N/A
26D	263085 E	768209 N	Active	Sandstone	300	190	12	350	100	N/A
27S	263083 E	765127 N	Active	Water Table	140	50	12	500	45	N/A
27D	263083 E	764450 N	Active	Sandstone	300	190	12	350	100	N/A
28S	263150 E	763007 N	Active	Water Table	140	50	12	500	45	N/A
28D	263150 E	762537 N	Active	Sandstone	300	190	12	350	100	N/A

Lee County North Fort Myers

SFWMD Permit Information 36-00003-W	
Permit Issue Date: 2/12/1998	Permit Expiration: 2/12/2003
Annual Allocation	See Corkscrew
Calculated Daily Allocation	See Corkscrew
Maximum Daily Allocation	See Corkscrew
Gallons Per Capita Per Day	See Corkscrew
Maximum Day To Average Day Ratio	See Corkscrew
Withdrawal Source	Mid-Hawthorn and Sandstone
Source Limitations	None
Plant Information FDEP PWS Id:	5360170
FDEP Rated Capacity	0.20 MGD
Type of Treatment Method	Aeration
Plant Address	In North Fort Myers at the intersection of Old Bayshore Rd. and Bayshore Rd.
Average Flow Data: October 1996 – September 1997	
Average Daily Raw Water Pumpage	0.00 MGD
Average Treated Water Produced	0.00 MGD
Unaccounted For Losses	N/A

Interconnections: There are no interconnections.

Future: No changes have been proposed for this facility.

Discussion: This water treatment facility provides emergency reserves and has not been used in the 1990's.

Source: Lee County Utilities, SFWMD, and FDEP Permits

Table D-38. Lee County North Fort Myers Emergency Facility Potable Water Supply Wells (Wellfield 11 on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (ft)	Year Drilled
2	226702 E	865374 N	Standby	Mid-Hawthorn	198	138	8	125	N/A	1979
3	226675 E	865253 N	Standby	Sandstone	105	64	8	15	60	1979

Lee County Olga

SFWMD Permit Information 36-00003-W	
Permit Issue Date: 2/12/1998	Permit Expiration: 2/12/2003
Annual Allocation	See Corkscrew
Calculated Daily Allocation	See Corkscrew
Maximum Daily Allocation	See Corkscrew
Gallons Per Capita Per Day	See Corkscrew
Maximum Day To Average Day Ratio	See Corkscrew
Withdrawal Source	C-43 Canal
Source Limitations	5.00 MGD
Plant Information FDEP PWS Id:	5360170
FDEP Rated Capacity	5.00 MGD
Type of Treatment Method	Lime Softening
Plant Address	1450 Werner Dr., Alva, FL 33920
Average Flow Data: October 1996 – September 1997	
Average Daily Raw Water Pumpage	3.08 MGD
Average Treated Water Produced	3.02 MGD
Unaccounted For Losses	10%

Interconnections: Lee County has eight interconnects. Four of these interconnects are with the city of Fort Myers: a 6 inch at Armeda Avenue and Prospect Street, an 8 inch at Collins Street and Evans Avenue, a 10 inch at Colonial Boulevard, and a 6 inch at Nuna Avenue and New York Avenue. Two interconnects are with the College Parkway and Green Meadows facilities: an 8 inch at McGregor Boulevard and Cypress Lake Drive and an 8 inch at Old Gladiolus Drive and U.S. 41 South. One more interconnect exists with Waterway, on Pondella Road, a 4 inch at the U.S. 41 Bridge.

Future: Lee County is in the process of developing aquifer storage and recovery wells to overcome the variability of the C-43 Canal source. Lee County also plans to expand the Olga plant capacity instead of building the proposed North Water Treatment Plant on the north side of the C-44 Canal.

Discussion: A surface water pump just east of the Franklin Lock withdraws from the C-43 Canal. Occasional freshwater releases from Lake Okeechobee are required to improve the water quality of this surface water source. The Olga and Corkscrew service areas share water.

Source: Lee County Utilities, SFWMD, and FDEP Permits

Table D-39. Lee County Olga Surface Water Pumps (indicated by 12 on the map).

Pump Number	Planar Coordinates		Source	Status	Pump Capacity GPM	Diameter (in)	Elevation of Intake (NGVD)	Pump type
1	N/A	N/A	C-43	Active	1,750	18	5.4	Vertical
2	N/A	N/A	C-43	Active	3,000	18	5.4	Vertical
3	N/A	N/A	C-43	Active	3,850	18	5.4	Vertical

Lee County North Water Treatment Plant (proposed)

SFWMD Permit Information 36-00003-W	
Permit Issue Date: 2/12/1998	Permit Expiration: 2/12/2003
Annual Allocation	
Calculated Daily Allocation	0 MGD
Maximum Daily Allocation	
Gallons Per Capita Per Day	
Maximum Day To Average Day Ratio	
Withdrawal Source	C-43 Canal
Source Limitations	5 MGD
Plant Information FDEP PWS Id:	
FDEP Rated Capacity	
Type of Treatment Method	
Plant Address	
Average Flow Data: October 1996 – September 1997	
Average Daily Raw Water Pumpage	
Average Treated Water Produced	
Unaccounted For Losses	

Interconnections: There are no interconnections.

Future: Lee County now plans to expand the Olga plant capacity instead of building the proposed North Water Treatment Plant on the north side of the C-44 Canal.

Discussion: The location of this proposed facility is not certain yet, map locations show it north of the C-43 Canal, 1 mile east of the Olga treatment facility.

Source: Lee County Utilities, SFWMD, and FDEP Permits

Lehigh

SFWMD Permit Information 36-00166-W	
Permit Issue Date: 11/14/1996	Permit Expiration: 11/14/2006
Annual Allocation	874 MGY
Calculated Daily Allocation	2.39 MGD
Maximum Daily Allocation	3.11 MGD
Gallons Per Capita Per Day	63 GPCD
Maximum Day To Average Day Ratio	1.30
Withdrawal Source	Sandstone
Source Limitations	None
Plant Information FDEP PWS Id:	5360172
FDEP Rated Capacity	2.50 MGD
Type of Treatment Method	Lime Softening
Plant Address	305 Coolidge Ave, Lehigh, FL 33936
Average Flow Data: October 1996 – September 1997	
Average Daily Raw Water Pumpage	1.40 MGD
Average Treated Water Produced	1.20 MGD
Unaccounted For Losses	8.60%

Interconnections: There are no interconnections.

Future: N/A

Discussion: N/A

Source: Florida Water Services, SFWMD, and FDEP Permits

Table D-40. Lehigh Potable Water Supply Wells (Wellfield 13 on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (ft)	Year Drilled
1	292448 E	826739 N	Active	Sandstone	65	50	6	150	N/A	1955
2	291046 E	825234 N	Active	Sandstone	69	52	6	150	N/A	1962
3	289213 E	825043 N	Active	Sandstone	68	58	8	200	N/A	1970
4	290225 E	827102 N	Active	Sandstone	85	50	8	150	N/A	1970
5	290943 E	826578 N	Active	Sandstone	66	54	8	150	N/A	1962
6	289426 E	826282 N	Active	Sandstone	62	52	8	100	N/A	1970
7	292688 E	824835 N	Active	Sandstone	85	57	8	200	N/A	1970
8	290591 E	824057 N	Active	Sandstone	80	62	8	250	N/A	1970
9	289309 E	823634 N	Active	Sandstone	80	63	8	200	N/A	1970
10	291115 E	823841 N	Active	Sandstone	80	60	8	350	N/A	1989
C1	294036 E	817509 N	Proposed	N/A	220	190	10	200	N/A	N/A
C2	291265 E	814930 N	Proposed	N/A	220	190	10	200	N/A	N/A
C3	289785 E	812113 N	Proposed	N/A	220	190	10	200	N/A	N/A
C4	288543 E	810536 N	Proposed	N/A	220	190	10	200	N/A	N/A
C5	286776 E	807766 N	Proposed	N/A	220	190	10	200	N/A	N/A
C6	285200 E	805139 N	Proposed	N/A	220	190	10	200	N/A	N/A
C7	284006 E	802512 N	Proposed	N/A	220	190	10	200	N/A	N/A
C8	282047 E	800421 N	Proposed	N/A	220	190	10	200	N/A	N/A

Lee County Waterway

SFWMD Permit Information 36-00152-W		
Permit Issue Date: 1/13/1996		Permit Expiration: 6/13/2001
Annual Allocation		392 MGY
Calculated Daily Allocation		1.07 MGD
Maximum Daily Allocation		1.51 MGD
Gallons Per Capita Per Day		97 GPCD
Maximum Day To Average Day Ratio		1.41
Withdrawal Source	Surficial, Lower and Mid-Hawthorn	
Source Limitations	None	
Plant Information FDEP PWS Id:		5360303
FDEP Rated Capacity		1.50 MGD
Type of Treatment Method	Lime Softening	
Plant Address	Waterway Estates Water Treatment Plant, 427 St. Claire Ave., Fort Myers, FL 33903	
Average Flow Data: October 1996 – September 1997		
Average Daily Raw Water Pumpage		0.87 MGD
Average Treated Water Produced		0.92 MGD
Unaccounted For Losses		Unreported

Interconnections: There are two interconnects with Lee County and one with Cape Coral. Both of the Lee County interconnects are on Pondella Road: a 6 inch pipe at Hancock Creek and a 4 inch pipe at the U.S. 41 Bridge. The Cape Coral interconnect is a 10 inch at Hancock Bridge Parkway and 24th Avenue.

Future: N/A

Discussion: Formerly owned by Florida Cities Water Company. It was sold to Lee County in April, 1999.

Source: Florida Cities Water Company, SFWMD, and FDEP Permits

Table D-41. Lee County Waterway Potable Water Supply Wells (Wellfield 14A on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (NGVD)	Year Drilled
N-1	200546 E	842805 N	Active	Water Table	48	30	8	40	-30	1957
N-2	200486 E	842936 N	Active	Water Table	57	42	8	75	-32	1957
N-3	200253 E	842693 N	Active	Mid-Hawthorn	130	130	6	30	-116	1966
N-4	199989 E	843066 N	Active	Mid-Hawthorn	48	14	8	50	-20	1966
N-6	199702 E	843155 N	Active	Mid-Hawthorn	205	124	8	45	-105	1971
N-8	199408 E	842060 N	Active	Mid-Hawthorn	43	13	8	40	-20	1976
N-9	200112 E	841821 N	Active	Mid-Hawthorn	230	125	8	50	-125	1971
N-10	200196 E	843211 N	Active	Mid-Hawthorn	235	134	8	30	-116	1972
N-11	198847 E	843552 N	Active	Mid-Hawthorn	230	133	10	85	-116	1983

Table D-42. Lee County Waterway Potable Water Supply Wells (Wellfield 14B on map).

Well Number	Planar Coordinates		Status	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (NGVD)	Year Drilled
NC-1	191844 E	854119 N	Active	Mid-Hawthorn	240	140	8	70	-130	1970
NC-2	192409 E	852169 N	Active	Mid-Hawthorn	240	140	8	85	-120	1975
NC-9	192343 E	852960 N	Active	Mid-Hawthorn	225	164	8	110	-116	1975

WASTEWATER TREATMENT FACILITIES

Wastewater treatment facilities are not permitted by the SFWMD but are of interest as the reclaimed water can be utilized for irrigation, which lowers the demands upon other water resources. This section includes only large wastewater treatment facilities, with a permitted average daily flow of 0.50 million gallons or greater.

Twenty-two large facilities are located within the LWC Planning Area (**Figure D-4**). Most of these are located in areas where reuse demand is possible. The total capacity of the twenty-two large facilities in 1997 permitted by FDEP is 98 MGD. The average daily flow was 65.0 MGD of which 46.0 MGD was reused. An overall summary of the large wastewater treatment facilities located within the LWC Planning Area is presented in **Table D-43**. A more detailed description of each facility follows the summary table. For each facility the following information is presented:

- Address of the facility
- SFWMD and FDEP basic permit information, including FDEP permitted average daily flow
- Average flow data for a one-year period starting October 1996 and ending in September 1997[1]
- The users of reclaimed water
- Known future plans
- Unique features of the facilities operating practice
- Sources of information (FDEP permits were reviewed for all facilities, SFWMD permits were reviewed when a wastewater treatment facility was discussed in a withdrawal permit)

1. This data year was selected because it matches the latest SFWMD reuse report. Not all data were successfully collected for each of the twelve months. The values presented are averages and when data was missing averages were made with the best available data.

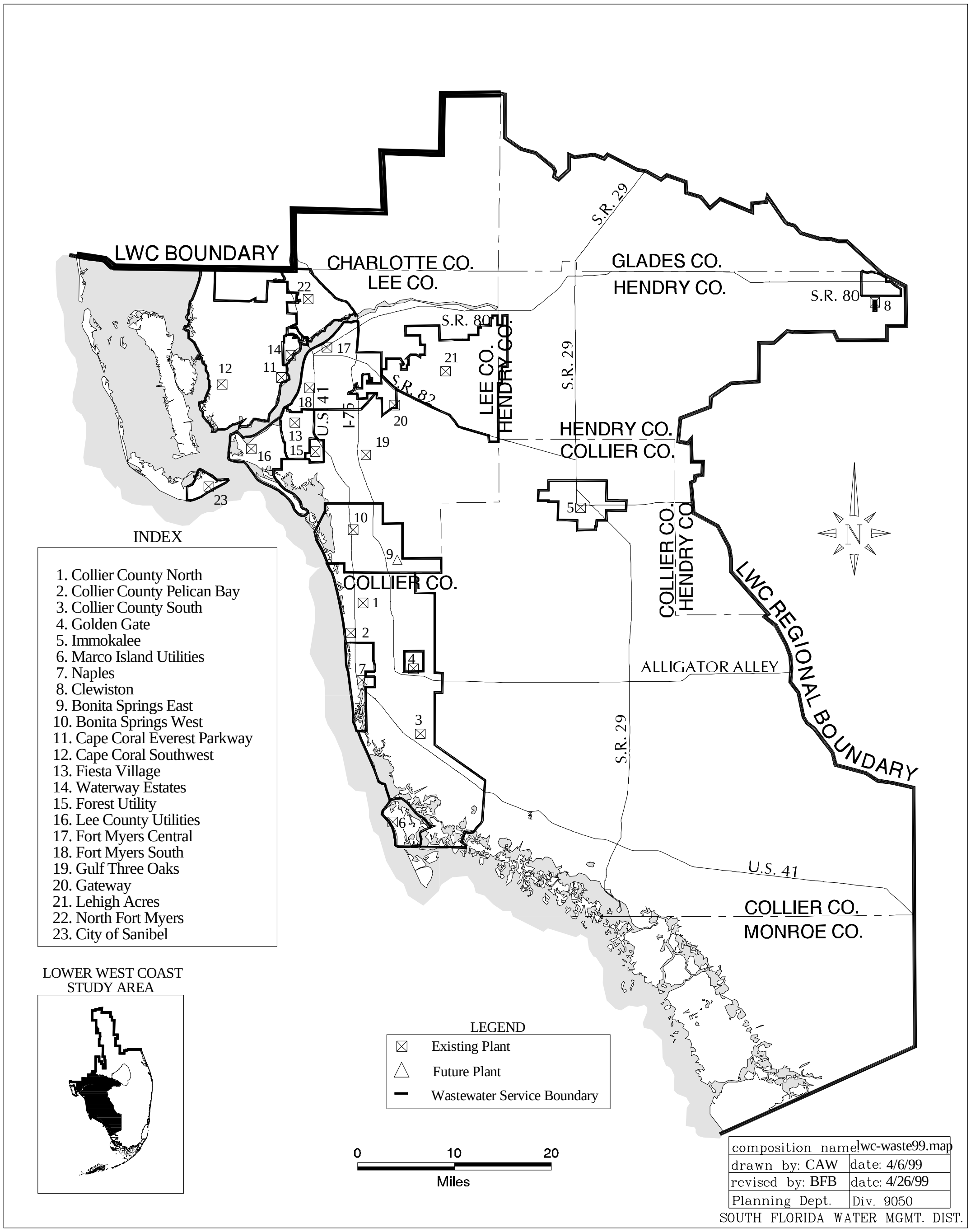


Figure D-4. Large Wastewater Treatment Facilities Located within the Lower West Coast Planning Area.

Table D-43. Summary of the Regional Wastewater Treatment Facilities Located within the Lower West Coast Planning Area.

Wastewater Treatment Facility	FDEP Rated Capacity (MGD)	Average Facility Flow (MGD)	Disposal Method: Deep Well Injection (MGD)	Disposal Method: Surface Water Discharge (MGD)	Disposal Method: Reuse (MGD)	Effluent Chloride Concentration (mg/L)
Collier County						
Collier County North	8.50	5.46	1.71		3.75	172
Collier County Pelican Bay	1.00				3.75[a]	161
Collier County South	8.00	5.96	2.57		3.39	109
Golden Gate	0.95	0.62			0.62	unreported
Immokalee	2.50	1.70			1.70	unreported
Marco Island Utilities	3.50	1.42	0.90		0.52	374
Naples	10.00	6.07		2.19	3.88	367
County Subtotal	34.45	21.23	5.21	2.19	17.61	
Hendry County						
Clewiston	1.50	1.20	N/A	N/A	1.20	unreported
Lee County						
Bonita Springs East and West	4.25	1.74	N/A	N/A	1.74	200
Cape Coral Everest Parkway	8.50	6.80	N/A	N/A	6.80	262
Cape Coral Southwest	6.60	2.70			2.70	232
Fiesta Villages	5.00	2.47		1.78	0.69	179
Waterway Estates	1.25	0.91	N/A	0.91	0.00	139
Forest Utility	0.50	0.25	N/A	N/A	0.25	unreported
Lee County (Fort Myers Beach)	6.00	2.78	N/A	N/A	2.78	200
Fort Myers Central	11.00	6.76	N/A	6.16	0.60	162
Fort Myers South	12.00	6.48	N/A	6.48	0.00	143
Gateway	0.50	0.20	N/A	N/A	0.20	105
Gulf Three Oaks	0.75	0.40	N/A	N/A	0.55[b]	105
Lehigh Acres	2.10	1.53	N/A	N/A	1.53	136
North Fort Myers	2.00	0.95	0.21	N/A	0.74	unreported
City of Sanibel	1.60	8.30			8.30	unreported
County Subtotal	62.05	42.27	0.27	15.36	26.88	
Lower West Coast Total	98.00	64.70	5.48	17.55	45.69	

a. Receives supplemental water from Collier County North.
b. Includes concentrate from Corkscrew Membrane Facility.

Collier County North

FDEP Permit Information	FLA0141399-0010DW1P
Permit Issue Date: 11/25/1996	Permit Expiration Date: 11/25/2001
Plant Address	State Road 846 and Coastline Railroad, Naples, FL
FDEP Permitted Average Daily Flow	
FDEP Rated Capacity	8.50 MGD
Disposal Capacities	
Deep Well Injection	15.75 MGD
Surface Water Discharge	none since 1995
Reuse	4.50 MGD
Average Flow Data: October 1996 – September 1997	
Actual Plant Flow	5.46 MGD
Disposal Flow	
Deep Well Injection	1.71 MGD
Surface Water Discharge	MGD
Reuse	3.75 MGD
Effluent/Reclaimed Chloride Concentration	172 mg/L

Reclaimed Water Users: Reclaimed water users and their usage are: Autumn Woods, 0.04 MGD; Audubon, 0.8 MGD; Bay Colony, 0.4 MGD; Beach Walk, 0.11 MGD; Imperial, 0.7 MGD; Pelican Bay Golf Course, 0.5 MGD; Pelican Marsh District, 0.6 MGD; Pelican Marsh Golf Course, 0.6 MGD; Palm River, 0.7 MGD; Vineyards, 3.0 MGD; and unspecified amounts are used by Bermuda Greens, Calusa Bay, Charleston Square, and Collier's Reserve.

Future: FDEP permit modifications have been applied for. The application asks for an increase of 5 MGD capacity and an anticipated increase in reuse of 4.35 MGD. The proposed new reuse customers are Vineyard School Park, Quail Creek and Village, Quail West, Longshore Lakes, Grey Oaks, Stonebridge, Barron Collier High School, Wyndemere, Kensington, Village Walk, DiVosta (Vanderbilt Beach Rd.), Regency Village, Carlton Lakes, Parklands, and Collier County Schools.

Discussion: N/A

Source: SFWMD and FDEP Permits and Collier County Utilities

Collier County Pelican Bay

FDEP Permit Information	FLA014133
Permit Issue Date: 2/19/1996	Permit Expiration Date: 2/19/2000
Plant Address	6200 Watergate Way, Naples FL, 33963
FDEP Permitted Average Daily Flow	
FDEP Rated Capacity	1.00 MGD
Disposal Capacities	
Deep Well Injection	N/A
Surface Water Discharge	N/A
Reuse	5.20 MGD
Average Flow Data: October 1996 – September 1997	
Actual Plant Flow	MGD
Disposal Flow	
Deep Well Injection	N/A
Surface Water Discharge	N/A
Reuse	3.75 MGD
Effluent/Reclaimed Chloride Concentration	161 mg/L

Reclaimed Water Users: Users include: Pelican Bay Community Golf Course, commercial and residential areas.

Future: N/A

Discussion: The demand for reclaimed water is greater than facility capacity. This demand is supplemented from the Collier County's North facility and ground water. This plant operates as needed.

Source: Collier County Utilities, and SFWMD and FDEP Permits

Collier County South

FDEP Permit Information	FLA014135
Permit Issue Date: 8/15/1996	Permit Expiration Date: 8/15/2001
Plant Address	5600 Warren St., Naples, FL
FDEP Permitted Average Daily Flow	
FDEP Rated Capacity	8.00 MGD
Disposal Capacities	
Deep Well Injection	15 MGD
Surface Water Discharge	18 MGD
Reuse	3.69 MGD
Average Flow Data: October 1996 – September 1997	
Actual Plant Flow	5.96 MGD
Disposal Flow	
Deep Well Injection	2.57 MGD
Surface Water Discharge	N/A
Reuse	3.39 MGD
Effluent/Reclaimed Chloride Concentration	109 mg/L

Reclaimed Water Users: Reclaimed water users and their usage are: Countryside, 0.55 MGD; Foxfire, 0.97 MGD; Glades, 1.9 MGD; Lakewood, 0.41 MGD; Lely Commercial Development, 3.0 MGD; Riviera, 0.66 MGD; Royal Palm, 1 MGD; Windstar, 1 MGD; an unspecified amount is used by Hibiscus; and percolation ponds.

Future: A 4.1 MGD increase in reuse is anticipated. This increase will accommodate both new customers and increased usage by current customers. The proposed new customers are Ironwood, Lely Resort, Eagle Creek, Shamrock, Embassy Woods, Fiddler's Creek, Royal Wood, Whispering Pines, Mario, Lakewood, Sierra Meadows, Collier Development of Regional Impact (DRI), area schools, area parks, and Median-Davis Boulevard.

Discussion: N/A

Source: Collier County Utilities, and SFWMD and FDEP Permits

Golden Gate

FDEP Permit Information	DC11-235566 Construction Permit
Permit Issue Date: 1/27/1994	Permit Expiration Date: 1/27/1999
Plant Address	4931 32nd Ave. SW, Golden Gate, FL
FDEP Permitted Average Daily Flow	
FDEP Rated Capacity	0.95 MGD
Disposal Capacities	
Deep Well Injection	N/A
Surface Water Discharge	N/A
Reuse	1.25 MGD
Average Flow Data: October 1996 – September 1997	
Actual Plant Flow	0.62 MGD
Disposal Flow	
Deep Well Injection	N/A
Surface Water Discharge	N/A
Reuse	0.62 MGD
Effluent/Reclaimed Chloride Concentration	unreported

Reclaimed Water Users: Reclaimed water is used for percolation ponds.

Future: N/A

Discussion: N/A

Source: Florida Cities Water Company, and SFWMD and FDEP Permits

Immokalee

FDEP Permit Information	FLA014132-266976
Permit Issue Date: 12/22/1995	Permit Expiration Date: 12/22/2000
Plant Address	1020 Sanitation Rd., Immokalee, FL
FDEP Permitted Average Daily Flow	
FDEP Rated Capacity	2.50 MGD
Disposal Capacities	
Deep Well Injection	N/A
Surface Water Discharge	N/A
Reuse	1.70 MGD
Average Flow Data: October 1996 – September 1997	
Actual Plant Flow	1.70 MGD
Disposal Flow	
Deep Well Injection	N/A
Surface Water Discharge	N/A
Reuse	1.70 MGD
Effluent/Reclaimed Chloride Concentration	unreported

Reclaimed Water Users: Reclaimed water is used for restricted spray irrigation.

Future: N/A

Discussion: Reuse is restricted to spray irrigation sites.

Source: SFWMD and FDEP Permits

Marco Island Utilities

FDEP Permit Information	D011-22157
Permit Issue Date: 6/28/1993	Permit Expiration Date: 6/28/1998
Plant Address	100 Winward Dr., Marco Island, FL
FDEP Permitted Average Daily Flow	
FDEP Rated Capacity	3.50 MGD
Disposal Capacities	
Deep Well Injection	5.76 MGD
Surface Water Discharge	N/A
Reuse	3.50 MGD
Average Flow Data: October 1996 – September 1997	
Actual Plant Flow	1.42 MGD
Disposal Flow	
Deep Well Injection	0.93 MGD
Surface Water Discharge	N/A
Reuse	0.52 MGD
Effluent/Reclaimed Chloride Concentration	374 mg/L

Reclaimed Water Users: Marco Island Golf Course uses 0.9 MGD of reclaimed water and Marco Shores Golf Course uses 0.5 MGD. Recharge via percolation ponds uses 5.7 MGD of reclaimed water.

Future: Plans are to increase the use of reclaimed water for landscape irrigation on Marco Island.

Discussion: N/A

Source: Florida Water Services, and SFWMD and FDEP Permits

Naples

FDEP Permit Information	FL0026271
Permit Issue Date: 2/1/1996	Permit Expiration Date: 9/30/1998
Plant Address	1400 3rd St. N., Naples, FL 33940
FDEP Permitted Average Daily Flow	
FDEP Rated Capacity	10.00 MGD
Disposal Capacities	
Deep Well Injection	N/A
Surface Water Discharge	2.42 MGD
Reuse	5.58 MGD
Average Flow Data: October 1996 – September 1997	
Actual Plant Flow	6.07 MGD
Disposal Flow	
Deep Well Injection	N/A
Surface Water Discharge	2.19 MGD
Reuse	3.88 MGD
Effluent/Reclaimed Chloride Concentration	367 mg/L

Reclaimed Water Users: The city of Naples reclaimed water usage includes: Royal Poinciana, Wilderness, Hole-in-the-Wall, Bear's Paw, Beach Club, Country Club of Naples, Quail Run, Moorings Country Club, High Point, Forest Lakes, Moorings Park, U.S. 41 Median, Faith Lutheran Church, Burning Tree Nursery, Water Tank Facility, Naplescape U.S. 41 and Goddlette, Naples High School, Fleishman Park (East Field), Lake Park Elementary School, In Town Club Condo, and Tank Filler Site and Warehouse.

Future: Wastewater treatment facility capacity will be expanded to 10 MGD. The reuse system will also be expanded.

Discussion: N/A

Source: City of Naples, Hole, Montes, and Associates Inc., and SFWMD and FDEP Permits

Clewiston

FDEP Permit Information	FL0040665
Permit Issue Date: 3/24/1998	Permit Expiration Date: 1/1/2000
Plant Address	Feed Lot Rd., Clewiston, FL
FDEP Permitted Average Daily Flow	
FDEP Rated Capacity	1.50 MGD
Disposal Capacities	
Deep Well Injection	N/A
Surface Water Discharge	N/A
Reuse	1.50 MGD
Average Flow Data: October 1996 – September 1997	
Actual Plant Flow	1.20 MGD
Disposal Flow	
Deep Well Injection	N/A
Surface Water Discharge	N/A
Reuse	1.20 MGD
Effluent/Reclaimed Chloride Concentration	unreported

Reclaimed Water Users: Reclaimed water is used for Restricted Public Access Irrigation. The sprayfields contain underdrains that discharge to a perimeter ditch; the perimeter ditch discharges to the Sugarland District canals and ultimately to the Caloosahatchee River.

Future: N/A

Discussion: N/A

Source: Clewsiton Utilities, and SFWMD and FDEP Permits

Bonita Springs

FDEP Permit Information	FLAO14443-277650
Permit Issue Date: 2/5/1996	Permit Expiration Date: 2/5/2001
Plant Address	25051 Tamiami Trail, Bonita Springs, FL
FDEP Permitted Average Daily Flow	
FDEP Rated Capacity	4.25 MGD
Disposal Capacities	
Deep Well Injection	N/A
Surface Water Discharge	N/A
Reuse	4.50 MGD
Average Flow Data: October 1996 – September 1997	
Actual Plant Flow	1.74 MGD
Disposal Flow	
Deep Well Injection	N/A
Surface Water Discharge	N/A
Reuse	1.74 MGD
Effluent/Reclaimed Chloride Concentration	200 mg/L

Reclaimed Water Users: One hundred percent is reused by Bonita Bay properties for residential and golf course irrigation.

Future: Ultimate capacities are 6 MGD for the west facility and 12 MGD at the new east facility.

Discussion: N/A

Source: Bonita Springs Utilities, and SFWMD and FDEP Permits

Cape Coral Everest Parkway

FDEP Permit Information	FL0030007
Permit Issue Date: 3/21/1997	Permit Expiration Date: 3/21/2002
Plant Address	1800 Everest Parkway, Cape Coral, FL
FDEP Permitted Average Daily Flow	
FDEP Rated Capacity	8.50 MGD
Disposal Capacities	
Deep Well Injection	N/A
Surface Water Discharge	15.10 MGD
Reuse	8.50 MGD
Average Flow Data: October 1996 – September 1997	
Actual Plant Flow	6.80 MGD
Disposal Flow	
Deep Well Injection	N/A
Surface Water Discharge	N/A
Reuse	6.80 MGD
Effluent/Reclaimed Chloride Concentration	262 mg/L

Reclaimed Water Users: Reclaimed water is used for irrigation of residential lots and is supplemented with water from a secondary canal system.

Future: Construction permit for Cape Coral Everest Parkway, DC36-229715 will allow total capacity to expand to 14.6 MGD in year 2008.

Discussion: Cape Coral operates a dual water system providing reclaimed water for irrigation to residents. The treated effluent from both wastewater plants and canals is directed to the irrigation system. The canal system serves as a storage facility for storm water and can be drawn upon to provide irrigation water when needed. During periods of low demand, treated effluent may be surface discharged to the Caloosahatchee River.

Source: Cape Coral, and SFWMD and FDEP Permits

Cape Coral Southwest

FDEP Permit Information	FL0030007
Permit Issue Date: 3/21/1997	Permit Expiration Date: 3/21/2002
Plant Address	3300 SW 20th Ave., Cape Coral, FL
FDEP Permitted Average Daily Flow	
FDEP Rated Capacity	6.60 MGD
Disposal Capacities	
Deep Well Injection	N/A
Surface Water Discharge	N/A
Reuse	2.70 MGD
Average Flow Data: October 1996 – September 1997	
Actual Plant Flow	2.70 MGD
Disposal Flow	
Deep Well Injection	N/A
Surface Water Discharge	N/A
Reuse	2.70 MGD
Effluent/Reclaimed Chloride Concentration	232 mg/L

Reclaimed Water Users: Reuse provides a secondary irrigation system for the residents.

Future: This facility is to expand to 13.20 MGD in the year 2013.

Discussion: Cape Coral operates a dual water system providing reclaimed water for irrigation to residents. The reclaimed water from both wastewater facilities and canals is directed to the irrigation system, and supplemented with surface water from local canals. The canal system serves as a storage facility for storm water and can be used to provide irrigation water when needed. During periods of low demand, treated effluent may be surface discharged to the Caloosahatchee River.

Source: Cape Coral, and SFWMD and FDEP Permits

Fiesta Villages

FDEP Permit Information	FL0039829-001
Permit Issue Date: 3/30/1998	Permit Expiration Date: 3/29/2003
Plant Address	1366 San Souci Dr., Fort Myers, FL, 33919
FDEP Permitted Average Daily Flow	
FDEP Rated Capacity	5.00 MGD
Disposal Capacities	
Deep Well Injection	N/A
Surface Water Discharge	5.00 MGD
Reuse	1.48 MGD
Average Flow Data: October 1996 – September 1997	
Actual Plant Flow	2.47 MGD
Disposal Flow	
Deep Well Injection	N/A
Surface Water Discharge	1.78 MGD
Reuse	0.69 MGD
Effluent/Reclaimed Chloride Concentration	179 mg/L

Reclaimed Water Users: Reclaimed water users and their usage are: Cypress Lakes, 0.22 MGD; Myerlee, 0.1 MGD; Landings/DOT, 0.31 MGD; Plant Irrigation, 0.01 MGD; Myerlee Circle, 0.03 MGD; Cypress Manor, 0.02 MGD; and Rutenberg 0.02 MGD.

Future: An overall 1.8 MGD increase in reuse is anticipated to the following potential customers: Cypress Lakes middle and high schools, Village of Seven Lakes, Edison Community College, Myerlee Gardens, Mariner Building, University of South Florida, Caloosa Yacht and Raquet Club, Golf View Country Club, and Parker Lakes Development. Lee County plans to build reclaimed water interconnects between the Fiesta Villages Plant and both the Fort Myers Beach Plant and the South Fort Myers Plant.

Discussion: Reclaimed water is no longer received from Fort Myers since the development of their deep injection well facility. Excess reclaimed water from Fiesta Villages is discharged to the Caloosahatchee River.

Source: Florida Cities Water Company and SFWMD and FDEP

Waterway Estates

FDEP Permit Information	DO36-228850
Permit Issue Date: 8/25/1993	Permit Expiration Date: 8/25/1998
Plant Address	1667 Inlet Dr. N., Fort Myers, FL
FDEP Permitted Average Daily Flow	
FDEP Rated Capacity	1.25 MGD
Disposal Capacities	
Deep Well Injection	N/A
Surface Water Discharge	1.25 MGD
Reuse	0.00 MGD
Average Flow Data: October 1996 – September 1997	
Actual Plant Flow	0.91 MGD
Disposal Flow	
Deep Well Injection	N/A
Surface Water Discharge	0.94 MGD
Reuse	0.00 MGD
Effluent/Reclaimed Chloride Concentration	139 mg/L

Reclaimed Water Users: N/A

Future: Lee County plans to build a larger interconnect along Pondella Road replacing the 6-inch pipe at Hancock Bridge Parkway.

Discussion: Permitted to discharge to the Caloosahatchee River.

Source: Florida Cities Water Company, and SFWMD and FDEP Permits

Forest Utility

FDEP Permit Information	FLA014478-262211
Permit Issue Date: 8/1/1995	Permit Expiration Date: 8/1/2000
Plant Address	Deer Run Southwest at Forest subdivision in Fort Myers.
FDEP Permitted Average Daily Flow	
FDEP Rated Capacity	0.50 MGD
Disposal Capacities	
Deep Well Injection	N/A
Surface Water Discharge	N/A
Reuse	0.50 MGD
Average Flow Data: October 1996 – September 1997	
Actual Plant Flow	0.25 MGD
Disposal Flow	
Deep Well Injection	N/A
Surface Water Discharge	N/A
Reuse	0.25 MGD
Effluent/Reclaimed Chloride Concentration	unreported

Reclaimed Water Users: One 280 acre golf course (Forest Country Club) uses 0.25 MGD with a capacity to use 0.5 MGD.

Future: N/A

Discussion: N/A

Source: Forest Utility, and SFWMD and FDEP Permits

Lee County- Fort Myers Beach

FDEP Permit Information	FL014215-001-DWIP
Permit Issue Date: 12/17/1998	Permit Expiration Date: 12/16/2003
Plant Address	17155 Pine Ridge Rd., Fort Myers, FL
FDEP Permitted Average Daily Flow	
FDEP Rated Capacity	6.00 MGD
Disposal Capacities	
Deep Well Injection	1.86 MGD
Surface Water Discharge	N/A
Reuse	4.95 MGD
Average Flow Data: October 1996 – September 1997	
Actual Plant Flow	2.78 MGD
Disposal Flow	
Deep Well Injection	0.00 MGD
Surface Water Discharge	N/A
Reuse	2.78 MGD
Effluent/Reclaimed Chloride Concentration	200 mg/L

Reclaimed Water Users: Reclaimed water is used for green space and golf course irrigation (1.9 MGD) and percolation ponds (.7 MGD). Current sites are Gulf Harbor, Kelly Greens, Bayside Estates, Shell Point, Health Park, Sanibel Factory, County Kelly Road, McGregor Park, Iona Mission, Caltapa Cove, Davis Court, Shell Oil, Sun Bank, and Lexington Country Club.

Future: The Lee County Fort Myers Beach Reuse Plan lists thirty-four potential new sites. These include Port of Iona/Harbor Isles, Pattinger's Nursery, Lee County property south of Kelly Road, Waterous Corporation, Peppertree Points, Cypress Cove (Health Park), Heath Park undeveloped land, and Sandpiper Cove. This new development is anticipated to increase demand to 1.24 MGD.

Discussion: The diversion of reclaimed water to the Fiesta Villages Plant is not utilized due to the availability of a newly constructed deep injection well at the Fort Myers Beach Wastewater Treatment Plant.

Source: Lee County Utilities, and SFWMD and FDEP Permits

Fort Myers Central

FDEP Permit Information	FL0021261
Permit Issue Date: 12/28/1993	Permit Expiration Date: 12/28/1998
Plant Address	1501 Raliegh St., Fort Myers, FL
FDEP Permitted Average Daily Flow	
FDEP Rated Capacity	11.00 MGD
Disposal Capacities	
Deep Well Injection	N/A
Surface Water Discharge	11.00 MGD
Reuse	2.00 MGD
Average Flow Data: October 1996 – September 1997	
Actual Plant Flow	6.76 MGD
Disposal Flow	
Deep Well Injection	N/A
Surface Water Discharge	6.16 MGD
Reuse	0.60 MGD
Effluent/Reclaimed Chloride Concentration	162 mg/L

Reclaimed Water Users: Reclaimed water users (green space irrigation and cooling water) and their usage are: Lee County Waste-to-Energy Facility, 1.0 MGD; Red Sox Minor League Practice Facility, 0.07 MGD; City of Fort Myers Nursery, 0.035 MGD; and City of Fort Myers Water Treatment Facility, 0.028 MGD.

Future: N/A

Discussion: In the permitting process

Source: City of Fort Myers, and SFWMD and FDEP Permits

Fort Myers South

FDEP Permit Information	FL0021270
Permit Issue Date: 1/11/1994	Permit Expiration Date: 1/11/1999
Plant Address	1618 South Drive (Bowling Green Boulevard), Fort Myers, FL
FDEP Permitted Average Daily Flow	
FDEP Rated Capacity	12.00 MGD
Disposal Capacities	
Deep Well Injection	N/A
Surface Water Discharge	12.00 MGD
Reuse	N/A
Average Flow Data: October 1996 – September 1997	
Actual Plant Flow	6.48 MGD
Disposal Flow	
Deep Well Injection	N/A
Surface Water Discharge	6.48 MGD
Reuse	N/A
Effluent/Reclaimed Chloride Concentration	143 mg/L

Reclaimed Water Users: N/A

Future: Lee County plans to build a reclaimed water interconnect to the Fiesta Villages Plant.

Discussion: Effluent is discharged to the Caloosahatchee River.

Source: City of Fort Myers, and SFWMD and FDEP Permits

Gulf Three Oaks

FDEP Permit Information	FLA014519
Permit Issue Date: 9/10/1996	Permit Expiration Date: 9/10/2001
Plant Address	18521 Three Oaks Parkway, Three Oaks, FL
FDEP Permitted Average Daily Flow	
FDEP Rated Capacity	0.75 MGD
Disposal Capacities	
Deep Well Injection	N/A
Surface Water Discharge	N/A
Reuse	1.15 MGD
Average Flow Data: October 1996 – September 1997	
Actual Plant Flow	0.40 MGD
Disposal Flow	
Deep Well Injection	N/A
Surface Water Discharge	N/A
Reuse	0.55 MGD
Effluent/Reclaimed Chloride Concentration	105 mg/L

Reclaimed Water Users: Golf course reclaimed water users and their usage are: Pelican Sound 0.50 MGD, Villages at Country Creek 0.15 MGD, The Vines 0.50 MGD, and San Carlos 0.69 MGD.

Future: A new reuse site, River Ridge, is approved for 0.5 MGD and FDEP is reviewing a request for permit modification which will allow Pelican Sound reuse to increase to 1.16 MGD.

Discussion: Three Oaks receives the membrane concentrate from the Gulf Corkscrew Water Treatment Facility.

Source: Gulf Environmental Services, Inc. and SFWMD and FDEP Permits

Gateway

FDEP Permit Information	FLA014542
Permit Issue Date: 5/22/1997	Permit Expiration Date: 5/22/2002
Plant Address	13240 Commerce Lakes Dr., Fort Myers, FL
FDEP Permitted Average Daily Flow	
FDEP Rated Capacity	0.50 MGD
Disposal Capacities	
Deep Well Injection	N/A
Surface Water Discharge	N/A
Reuse	0.50 MGD
Average Flow Data: October 1996 – September 1997	
Actual Plant Flow	0.23 MGD
Disposal Flow	
Deep Well Injection	N/A
Surface Water Discharge	N/A
Reuse	0.20 MGD
Effluent/Reclaimed Chloride Concentration	105 mg/L

Reclaimed Water Users: Reclaimed water is used for residential irrigation. 1,200 residents are using a dual water system.

Future: It is anticipated that capacity will be increased to 5 MGD. Reuse infrastructure continues to grow as development occurs within service boundary.

Discussion: The Gateway golf course is not irrigated with reclaimed water because of availability. It is irrigated with surface water.

Source: SFWMD and FDEP Permits and Gateway Services District

Lehigh Acres

FDEP Permit Information	DO36-211930
Permit Issue Date: 7/30/1992	Permit Expiration Date: 7/30/1997
Plant Address	500 Construction Lane, Lehigh Acres, FL
FDEP Permitted Average Daily Flow	
FDEP Rated Capacity	2.10 MGD
Disposal Capacities	
Deep Well Injection	N/A
Surface Water Discharge	N/A
Reuse	2.10 MGD
Average Flow Data: October 1996 – September 1997	
Actual Plant Flow	1.53 MGD
Disposal Flow	
Deep Well Injection	N/A
Surface Water Discharge	N/A
Reuse	1.53 MGD
Effluent/Reclaimed Chloride Concentration	136 mg/L

Reclaimed Water Users: Reclaimed water is used for golf course irrigation and percolation ponds. The golf course uses 0.62 MGD of reclaimed water and the infiltration basins use 1.48 MGD of reclaimed water.

Future: N/A

Discussion: N/A

Source: SFWMD and FDEP Permits

North Fort Myers

FDEP Permit Information	FLA014548-268241
Permit Issue Date: 10/3/1995	Permit Expiration Date: 10/3/2000
Plant Address	1700 Tucker Lane, North Fort Myers, FL
FDEP Permitted Average Daily Flow	
FDEP Rated Capacity	2.00 MGD
Disposal Capacities	
Deep Well Injection	4.00 MGD
Surface Water Discharge	N/A
Reuse	1.70 MGD
Average Flow Data: October 1996 – September 1997	
Actual Plant Flow	0.95 MGD
Disposal Flow	
Deep Well Injection	0.27 MGD
Surface Water Discharge	N/A
Reuse	0.74 MGD
Effluent/Reclaimed Chloride Concentration	unreported

Reclaimed Water Users: Reclaimed water is used for golf course irrigation. River Bend uses 0.4 MGD of reclaimed water, Six Lakes uses 0.1 MGD and Sable Spring uses 1.20 MGD.

Future: A deep injection well is used for disposal of excess reclaimed water. The facility is in permitting to increase to 3.50 MGD rated capacity.

Discussion: N/A

Source: North Fort Myers Utilities, and SFWMD and FDEP Permits

City of Sanibel

FDEP Permit Information	FLA 014430
Permit Issue Date: 7/25/1996	Permit Expiration Date: 7/25/2001
Plant Address	930 Donax St., Sanibel, FL
FDEP Permitted Average Daily Flow	
FDEP Rated Capacity	1.60 MGD
Disposal Capacities	
Deep Well Injection	N/A
Surface Water Discharge	N/A
Reuse	1.60 MGD
Average Flow Data: October 1996 – September 1997	
Actual Plant Flow	0.83 MGD
Disposal Flow	
Deep Well Injection	N/A
Surface Water Discharge	N/A
Reuse	0.83 MGD
Effluent/Reclaimed Chloride Concentration	unreported

Reclaimed Water Users: Reclaimed water is used for percolation ponds and golf course irrigation. Users include the Beachview and Dunes Golf Club golf courses.

Future: Plant is expanding to increase capacity to 2.50 MGD. Development of dual water distribution system and deep well injection is being considered in cooperation with Island Water Association.

Discussion: N/A

Source: City of Sanibel, Hartman & Associates, Inc., and SFWMD and FDEP Permits

Appendix E
WETLANDS AND ENVIRONMENTALLY SENSITIVE AREAS

FACTORS AFFECTING WETLANDS AND ENVIRONMENTALLY SENSITIVE AREAS

Factors which influence wetland systems and environmentally sensitive lands include hydrology, fire, geology and soils, climate, and ecological succession. This section presents an overview of each of these factors.

Hydrology

Hydrology is the single most important determinant for the establishment and maintenance of specific types of wetlands and wetland processes (Mitsch and Gosselink, 1986). Hydraulic inflows and outflows, such as precipitation, surface runoff, ground water inputs, and in some cases, tides and river flooding, provide the energy to transport nutrients and other organic material to and from wetlands. Water depth, hydroperiod, flow patterns, stage, duration, frequency of flooding, and water quality all influence the biochemistry of wetlands and ultimately, the species composition and type of wetland community that develops. The hydrology of a wetland acts both as a limit and a stimulus for determining the numbers, types (species), and growth rates of flora and fauna that can live within a specific wetland. For example, the growth rates of pine trees appear to be affected by water table depths. Slash pine growth rates in flatwoods generally increase in proportion to the depth to the water table, indicating the inhibitory effect of excessive moisture (Duncan and Terry, 1983). At the other extreme, tree growth can be limited by a lack of available moisture during the dry season (Haines and Gooding, 1983). Hydrology also strongly affects aquatic primary production, organic accumulation, and the cycling of nutrients (Mitsch and Gosselink, 1986).

Precipitation

The Lower West Coast (LWC) Planning Area experiences wide variations in annual rainfall, resulting in flooding and extended drought periods. During heavy rainfall years, there is overland flow and discharge to the ocean. During extended drought years, however, the natural system is stressed by saltwater intrusion, increased frequency of fires, loss of organic soils, and invasion of wetlands by exotics. The region averages about 52 inches of rainfall annually, with approximately two-thirds falling during the summer months (Duever et al., 1986). During the dry season (November-April), precipitation is governed largely by large-scale winter weather fronts which pass through the region roughly every seven days (Bradley, 1972). Rainfall from these fronts exhibit a uniform distribution pattern as compared to precipitation derived from the highly variable, convective-type thunderstorms characteristic of the wet season (May-October).

Evapotranspiration

Evapotranspiration (ET) is the combined process of evaporation from land and water surfaces, and transpiration from plants. ET rates vary as a function of solar radiation, air and water temperature, relative humidity, wind velocity and duration, and the type and density of vegetation (Duever et al., 1986). In South Florida, ET ranges from 70 to 95 percent of annual rainfall. During the dry season and drought years, ET exceeds rainfall inputs (Klein et al., 1975). Temperature is often regarded as the most important factor controlling ET. Minimum ET rates occur during the winter months of December and January, with highest values experienced during the spring months of April and May. Typical ET values for South Florida range from 40 to 45 inches a year, up to a maximum of 60 inches a year (Parker et al., 1955). As a result, ET plays a very important role in the development of any hydrologic model that might be developed for a particular wetland system and is usually the most difficult parameter to estimate.

Hydroperiod

Hydroperiod refers to the annual period of water level inundation, specifically the length of time (duration) that a wetland contains water above ground level. **Figure E-1** presents examples of typical hydroperiods experienced by three different South Florida plant communities. Duever et al. (1986) reports that hydroperiod is the dominant factor controlling both the existence, plant community composition and succession of South Florida wetland systems. Hydroperiod is often expressed in terms of the range of the number of days that a wetland is normally inundated. For example, in the Big Cypress Preserve, Duever et al. (1986) reports that freshwater marshes are usually found on sites having a hydroperiod of 225 to 275 days per year, as compared to a pond system which is inundated year round. Each wetland type is thought to have a hydrologic signature that describes the rise and fall of water levels from year to year (Mitsch and Gooselink, 1986). Duever et al. (1986) found that work conducted at Corkscrew Swamp “has clearly shown that the distribution of undisturbed upland, marsh, swamp and shallow aquatic habitats are largely a function of a site's hydroperiod.” In contrast, O'Brien and Motts (1980) state that from a hydrological point of view, the most significant feature of a wetland is the level of the ground water table. They point out that the depth to the ground water table is more significant than the hydroperiod or time the wetland is flooded.

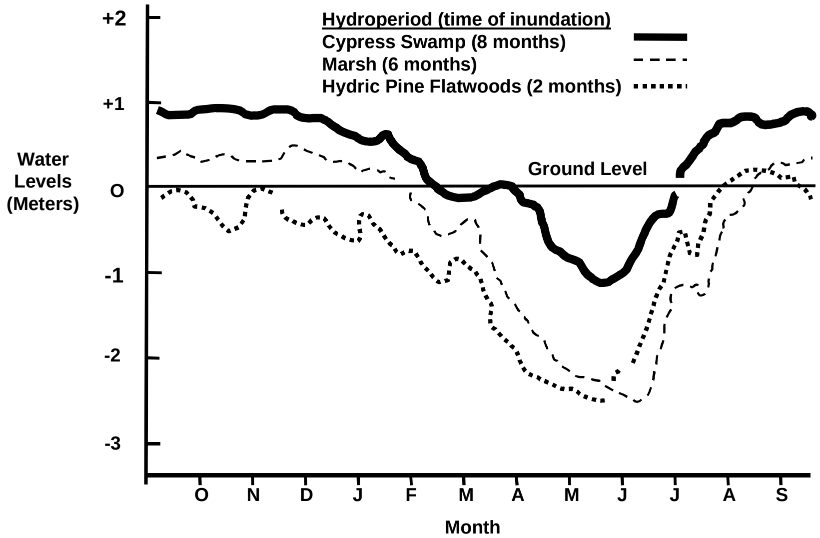


Figure E-1. Hydrographs and Hydroperiod Ranges for Three Different South Florida Vegetation Types (Duever et al., 1986).

Water Level Depth and Timing

In South Florida's freshwater wetlands, wading bird nesting success is highly dependent on present and past water level conditions, which influence the amount and availability of wading bird prey items, such as crayfish and small forage fish (Kushlan, 1976, 1978, 1979, 1980, 1986; Powell, 1987; Frederick and Collopy, 1988). Ecological studies of Southwest Florida wetlands have found a direct relationship between numbers of wading bird breeding attempts and the amount of rainfall preceding the breeding season (Ogden et al., 1980, 1987). Kahl (1964) found that the timing and initiation of wood stork breeding attempts was predictable from the measurement of marsh surface water levels. Kushlan et al. (1975) found that wading bird nesting success was directly related to the rapid winter/spring recession of water levels (drying rate) of South Florida wetlands. Therefore, maintenance of appropriate water depths and timing of wetland water level fluctuations is a critical factor in determining wading bird nesting success.

Topography

In general, wetlands in temperate and tropical regions tend to develop in areas of low topographic relief and high rainfall inputs. Topography also controls the shape and size of watersheds, and affects the timing and quantity of runoff. Topography is also an important factor in controlling the vertical and horizontal extent of seasonal water level fluctuations within a wetland. In the Big Cypress Swamp, Duever et al. (1986) found that wetlands dominate much of South Florida because: (1) the flat topography reduces runoff to a minimum, (2) high rainfall during the warm part of the year compensates for high ET losses, and (3) low ET rates during the cool part of the year approximates rainfall inputs. At the site-specific level, wetlands are determined by the depth and duration of inundation, which in turn are influenced by site microtopography (differences in water depth of only a few centimeters), soil type, and vegetation cover (Duever et al., 1986).

Vegetation Type

Vegetation type can affect the hydrologic cycle of a wetland, primarily through ET. Vegetation also influences water movement and water quality. Plant leaves, leaf litter and attached periphyton (algae) communities tend to impede water flow which: (1) increases the period of inundation, (2) reduces surface water runoff and erosion, (3) allows more time for aquifer recharge, and (4) assimilates nutrients and chemical exchanges between the soil vegetation and water (Duever et al., 1986).

Tropical Storms and Hurricanes

Hurricanes, tropical cyclones which generate winds in excess of 75 miles per hour, are recurrent events in South Florida and are important physical processes which affect the regional ecology (Craighead and Gilbert, 1962). Southwest Florida has been identified by the National Weather Service as one of the most hurricane-vulnerable areas of the United States. Hurricanes normally cause the greatest amount of damage when wind velocities average greater than 111 miles per hour. Storms of this magnitude have passed within 100 miles of Fort Myers on the average of once every five-and-one-half years from 1900 to 1985 (SWFRPC, 1990).

Coastal flooding from tropical storms or tropical depressions occur commonly within the LWC Planning Area, causing flooding in low-lying areas, along barrier islands, and near river and bay systems (SWFRPC, 1990). Although these storms are destructive to life and property, they appear to be an important component of the region's natural hydrological cycle, often following several drought years to replenish surface and ground water sources. These storms also appear to be an important source of fresh water and nutrient inputs into Florida Bay (Meeder and Meeder, 1989).

Fire

Fire is also an important factor controlling the species composition, distribution and succession of wetland communities in the LWC Planning Area. Within the constraints of wetland hydrology, fires occur with variable frequency and severity affecting plant succession.

Theoretically, hardwood hammocks represent the climax plant community for South Florida (Alexander and Crook, 1973; Wharton et al., 1977; Duever, 1984). Hammocks develop when fire is absent or infrequent, and organic soils are allowed to build up over time to support the succession of hardwoods (**Figure E-2**). However, fire is a common component of the South Florida landscape. In the Everglades, fires occur on the average every seven years. Few areas escape fire; thus hammocks are relatively uncommon and occur only on elevated sites where fire is infrequent. Most sites high enough to support hammocks are occupied by pine flatwoods, which are tolerant of periodic fire (Duever, 1984).

Wetlands are subject to fires during the dry season. Marshes that dry out and burn with enough frequency do not allow the establishment of woody plants such as wax myrtle and cypress forests. Cypress dominated wetlands occur on wetter organic soils that burn less frequently. Before man settled the region, the majority of fires were caused by lightning strikes during the wet season. As more people moved to the region, fires became suppressed with controlled burns occurring during the winter dry season. These fires are typically more severe and extensive, since they occur during the dry season when wetland soils are dry.

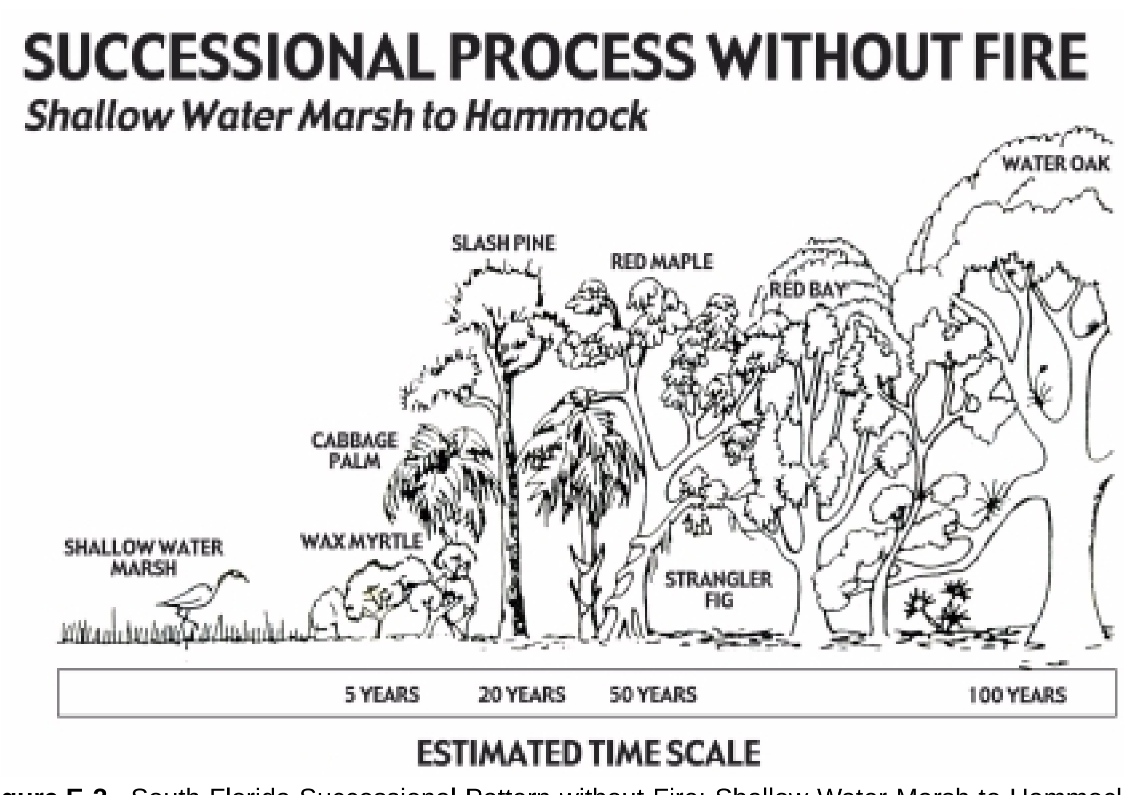


Figure E-2. South Florida Successional Pattern without Fire: Shallow Water Marsh to Hammock (Wharton et al., 1977).

Geology and Soils

The primary geological feature that controls regional hydrology is the permeability of the underlying rock. Limestone with deposits of quartz sand, clay and shell comprise the underlying aquifer. A more detailed description of the region's geology and underlying aquifer system is found in Chapter 3 of the Support Document.

Two primary factors which affect the hydrogeology of wetlands are the porosity and permeability of its underlying soils (Duever, 1988). A highly porous soil can hold or store large amounts of water, while a highly permeable soil allows water to flow to the underlying aquifer. The high capillary action of peat or clay soils enable wetlands to store large quantities of water, somewhat similar to how a sponge takes up water.

Some wetlands contain perched water tables. A perched water table exists where a saturated soil layer is found above a water table and is separated from it by an unsaturated zone (Freeze and Cherry, 1979). This can occur where a relatively impermeable clay or organic soil layer is present near the ground level and restricts the downward movement of water. Perched water tables come in various sizes and can influence surface water levels over large areas or have only local, temporary effects (Duever, 1988). A common misconception is that wetlands can only occur on sites containing a perched water table. Although this may be the case in some areas, Duever's (1988) experience in Southwest Florida indicates that wetland water levels coincide with the regional water table. Situations which at first appeared to be indicative of a perched water table turned out to represent unusual or transient hydrologic conditions.

Climate

In addition to hydrology and fire, climate also plays an important role in controlling plant community succession. The areal extent, species composition, and existence of wetlands are all affected by long-term climatic changes. In addition to normal cyclic drought and flood conditions, long-term cycles have the ability to produce gradual, but nevertheless, major shifts in the normal annual range of hydrologic conditions. As climatic cycles become wetter, wetlands tend to cover larger areas of the landscape. Wetland communities also tend to become more diverse as a result of the presence of greater ranges of hydroperiods on different topographically contolled sites. A wetter climate may also increase the rate of peat accretion in wetlands, thus encouraging the development of edaphic plant communities. Long-term drier conditions may produce the opposite effects. A wetter or dryer climate may also affect the frequency of fire, shifting plant community succession. A major difficulty in managing wetlands is the inability to distinguish between shifts in hydrologic conditions that result from man's activities and those that result from the periodic reoccurrence of natural events or long-term shifts in climate (Duever, 1984).

Succession

Overdrainage of wetlands and reduction of hydroperiod length directly influences the direction of plant community succession within a wetland. McPhearson (1973) reported that “differences of only a few inches in depth or changes in period of inundation will determine, in time, what plant communities are present [in the Everglades].” Numerous investigators have documented changes in the species composition of South Florida plant communities resulting from altered water level conditions (Davis, 1943; Loveless, 1959; Kolipinski and Higer, 1969; Dineen, 1972, 1974; Alexander and Crook, 1973, 1988; Schortemeyer, 1980; Worth, 1983). Duever et al. (1976) used fire frequency and hydroperiod data to establish a basis for the occurrence of plant community succession in Corkscrew Swamp. This relationship is presented in **Figure E-3**. The successional relationships of South Florida wetland and upland plant communities have also been discussed by Alexander and Crook (1973), Craighead (1971), Davis, (1943), Wharton et al. (1977), and Duever, et al. (1986). These data are useful for making a general assessment of the direction that succession may take as a result of increasing or decreasing hydroperiod in a Southwest Florida wetland.

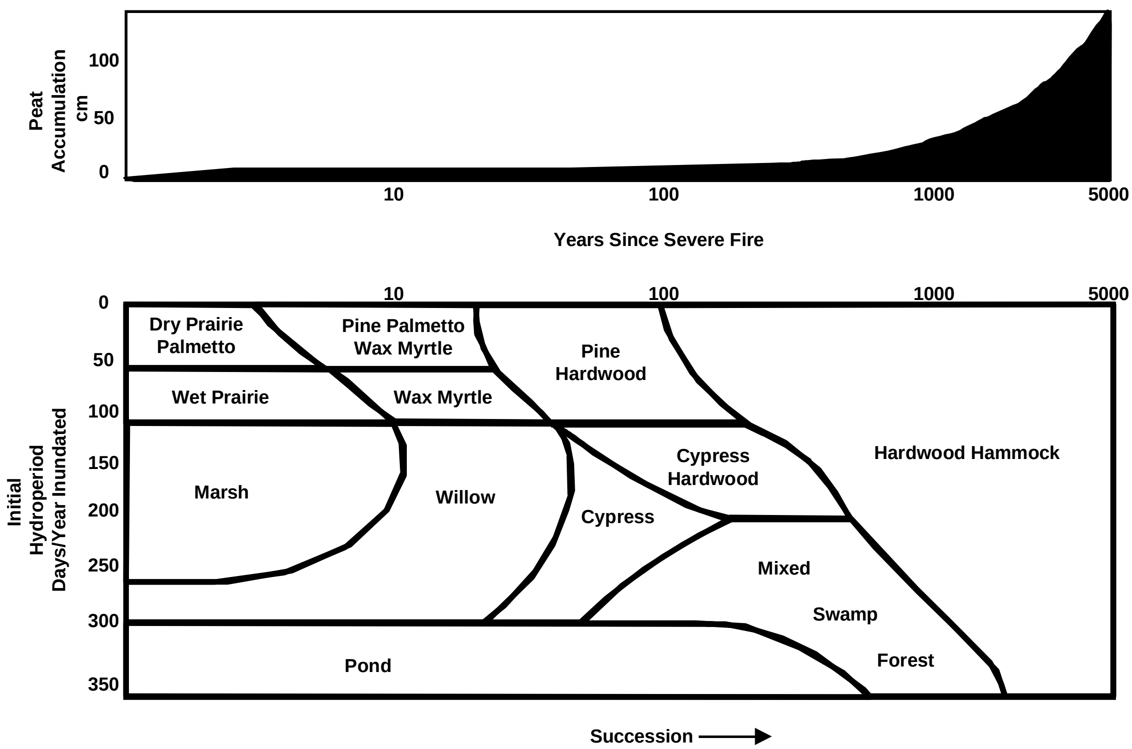


Figure E-3. Successional Patterns and Rates within South Florida Inland Plant Communities (Duever et. al., 1984).

REGIONAL ENVIRONMENTAL ISSUES

Loss of Wetlands

According to the U.S. Fish and Wildlife Service (1990), Florida has lost over 9.3 million acres of wetlands between 1780 and 1985, a 46 percent loss. During the 1970s and 1980s, despite strict environmental regulations, Florida lost, on average, over 26,000 acres of wetlands annually, which is the equivalent of losing 70 acres of wetlands each day. Almost all of these losses are the result of conversion of wetland to agriculture, urban and other built-up areas (Frayer and Hefner, 1991).

In Southwest Florida, large-scale loss of wetlands occurred during the 1960s and 1970s. Urban and agricultural development has affected both the quantity and quality of remaining wetlands. In Lee County, continued urban growth has altered the county's natural systems over the past 50 years. In the northwest portion of the Lee County, the peninsula now occupied by the city of Cape Coral, originally consisted of sloughs, marshlands, and seasonal ponds. Nearly all of the original habitat has been lost to development. Lehigh Acres, another large-scale residential development located in the eastern part of the county, has resulted in the ditching and draining of thousands of acres of the original wetland/upland mosaic. Other parts of the county have also been converted to cropland and improved pasture.

In Collier County, a single large development, Golden Gate Estates, attempted to drain 110,000 acres of pristine forested and emergent wetlands. This project dug 183 miles of canals, constructed 813 miles of roads, and sold over 50,000 individual lots to buyers worldwide (Frayer and Hefner, 1991). Construction of two primary canal systems, the Golden Gate Canal and the Faka Union Canals, disrupted natural drainage patterns and subsequently lowered ground water levels to control flooding and make land suitable for development (Klein et al., 1970; Carter et al., 1973; McPherson et al., 1976). Along the coast of Collier County, south of Naples, a large resort community was built on Marco Island. Construction of this community converted approximately 5,300 acres of mangroves and uplands to finger canal subdivisions. Collier County has also experienced a large amount of growth along its northern coastal area. This growth has the greatest impact on the estuarine communities affected by the alteration of both the quantity and quality of the freshwater runoff they receive. Construction of Alligator Alley (State Road 84), Tamiami Trail (U.S. 41), I-75 and State Road 29 have all impacted historical surface water flow patterns throughout the LWC Planning Area. Heavy use of these roads is a threat to several species of endangered wildlife, including the Florida panther.

The Corkscrew Regional Ecosystem Watershed (CREW) lands represent more than 50,000 acres of environmentally sensitive wetlands and uplands located in Collier and Lee counties. The CREW lands contain five major wetland systems: (1) Flint Pen Strand, (2) Corkscrew Marsh, (3) Corkscrew Swamp Sanctuary, (4) Bird Rookery Swamp and, (5) Camp Keis Strand. This area probably represents the largest remaining hydrologically intact wetland ecosystem in South Florida and provides important wildlife habitat to a number of rare, threatened, and endangered species.

Potential impacts to CREW include: (a) the possibility of lowered ground water tables and impacts to wetlands as a result of county and municipal wellfield development within the watershed, and (b) lowered water table elevations, degraded water quality, and associated wetland impacts caused by the expansion of the citrus and vegetable industries. If properly managed, these lands have the potential to provide a number of benefits to the region. Preliminary data suggests that CREW may offer some degree of water supply for Lee and Collier counties, along with the potential for providing drainage, flood storage and water quality improvements for surface waters discharged to downstream estuaries. The District is currently conducting a hydrologic evaluation of the CREW watershed.

Relocation of Citrus to Southwest Florida

In the early 1980s, a series of devastating freezes caused serious damage to Central Florida's citrus industry. As a result, many citrus growers have recently migrated to Southwest Florida, seeking to reduce the risk of freeze damage to their crop. This has resulted in a major shift in the geographical distribution of citrus within Florida. Most of this new citrus development is occurring within Hendry County, western Glades, eastern Lee and Charlotte, and northern Collier counties. In fact, Hendry County now ranks as Florida's number one citrus county based on the number of trees in the ground and third in total citrus acreage.

Impacts on Wetlands

Citrus development requires specific drainage of the land in order to maintain appropriate soil moisture in the root zone. Much of the east-central portion of the LWC Planning Area is currently cattle rangeland (improved and unimproved pasture and native rangeland). The drainage requirements for rangeland, however, are significantly different from those required to operate a citrus grove. Pasture and rangeland are typically drained by shallow ditches placed at wide intervals because native grasses can survive long periods of flooding. In contrast, citrus groves are very sensitive to saturated water table conditions and require rapid drainage. As a result, the typical citrus operation requires a rather elaborate and responsive drainage/irrigation system, which includes high capacity wells, pumps, reservoirs, ditches, levees, and dikes. Impacts caused by the drawdown of the water table beneath adjacent wetlands, as with all uses, is a concern. However, impacts to wetlands are minimized through the permitting process.

Impacts on Uplands

Based on the magnitude and scale of citrus development within this area, there is a potential that this development could replace some of the remaining upland communities such as flatwoods and xeric scrub habitats that are native to the region. Conversion of large areas of uplands to citrus within Hendry, Lee and Collier counties may significantly affect the regional ecosystem and its remaining wildlife habitat, which borders two federally protected areas (i.e., the Big Cypress National Preserve, Everglades National Park, and the Florida Panther National Wildlife Refuge). Some of this development is occurring in areas occupied by threatened or endangered species such as the Florida panther, black bear, red-cockaded woodpecker, gopher tortoise, gopher frog, or Florida scrub jay. As illustrated in **Figure E-4**, this citrus development is occurring in a portion of the Florida panther's range. Listed species are also considered in the CUP program.

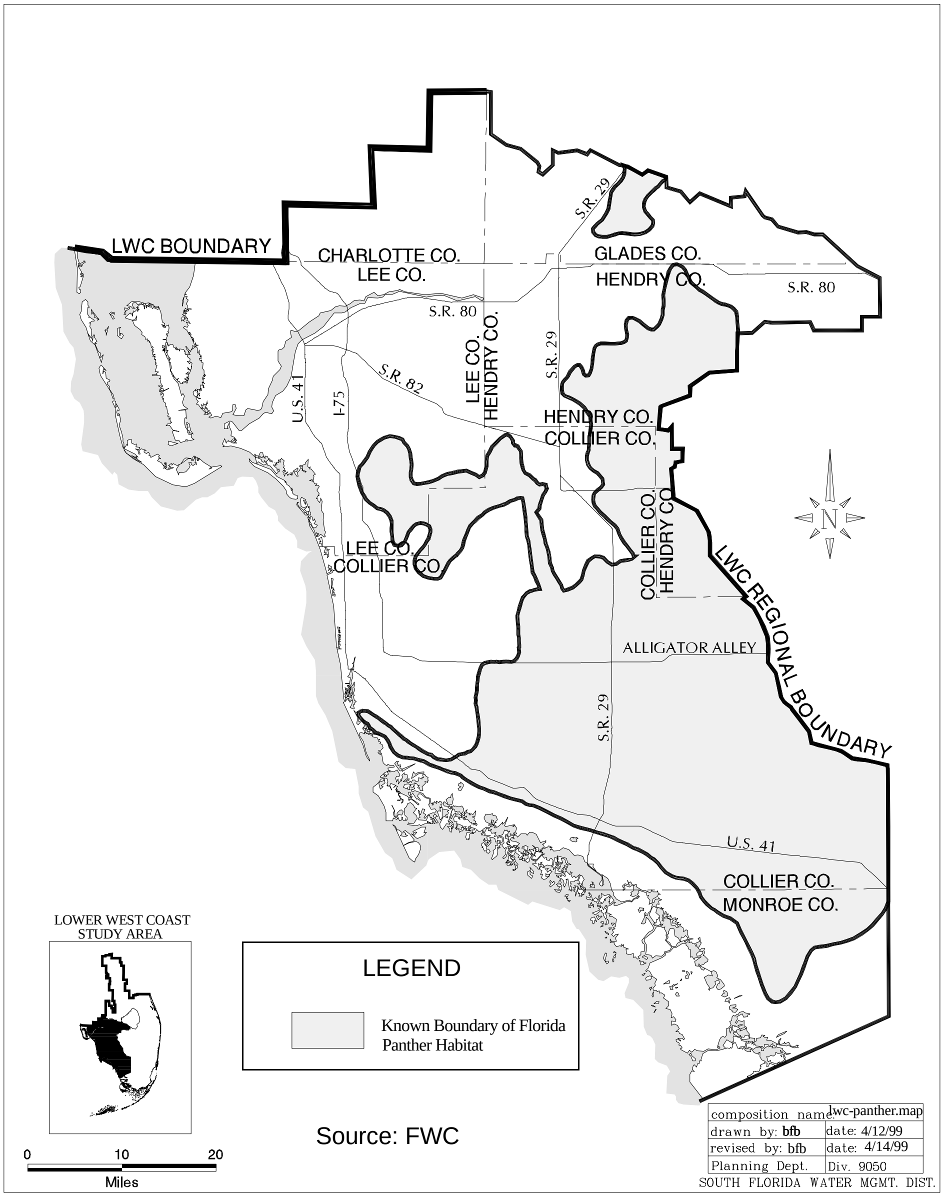


Figure E-4. Florida Panther Habitat in Southwest Florida.

Large-scale citrus development has the potential to effect the natural hydrology of the area, although impacts will be minimized through the permitting process. In addition, fertilizers and pesticides are used in citrus grove operations. If transported offsite in drainage waters, these fertilizers and pesticides have the potential to become contaminants in downstream receiving waters. Current surface water management regulations require water quality and quantity considerations as part of the approval process for development. In addition, current CUP regulations require low volume, high efficiency irrigation techniques. These requirements provide advantages over older methods.

Impacts of Ground Water Drawdowns on Wetlands

Expansion of existing county and municipal wellfields in central Collier, southeastern Lee and Hendry counties, and the associated effects of lowering regional ground water tables, due to water use and drainage, is a concern for existing wetland systems in the LWC Planning Area. However, these concerns are minimized through the permitting process.

Studies are being conducted to better describe potential impacts of wellfield drawdowns (public water supply and agriculture) on wetland systems in the LWC Planning Area, specifically the depth which the water table can be lowered before an impact can be detected within a wetland. A majority of available information has been derived from municipal wellfield drawdown studies.

The effects of municipal wellfield drawdowns on wetlands have been well documented by the Southwest Florida Water Management District (Rochow, 1982, 1983, 1984, 1985; Rochow and Dooris, 1982; Dooris et al., 1990; Watson et al., 1990; Rochow and Rhinesmith, 1991). Over a 15-year period, the SWFWMD has produced more than a dozen technical reports from their wellfield monitoring program concerning the effects of ground water withdrawals on wetland ecosystems. In general, these data indicate that long-term wellfield drawdowns greater than one foot result in "unacceptable ecological change" to wetland communities. These changes (from Dooris et al., 1990) include the following:

- Invasion or establishment of terrestrial plant species creating a "disturbed" appearance and potentially allowing for invasion by exotics
- In severe cases, lowered water table elevations have caused cypress tree mortality and loss of canopy cover
- Increased susceptibility to damage by fire and increased numbers of destructive fires causing changes to community structure
- Loss of organic soils and increased soil subsidence
- Loss of wildlife habitat and wildlife resources

Hydrological and biological monitoring of the Starkey Wellfield has shown that a 0.6 foot water table drawdown corresponded to a noticeable replacement of wetland plant species with those more adapted to upland sites (Rochow, 1989).

In the LWC Planning Area, relatively little work has been directed towards determining the effects of wellfield drawdowns on wetland ecology. The majority of available information has focused upon the ecological impacts of lowered water tables caused by drainage canals. In a study of the Big Cypress Swamp, Carter et al. (1973) described the impacts to cypress wetlands from drainage. Burns (1984) studied the effect of declining water levels within a Fakahatchee Strand cypress community. Results showed that lowering of the water table by an average of 50 cm (1.6 ft.) significantly decreased biomass and net production of the cypress strand. Within this same strand system, Carter et al. (1973) and Burns (1984) found a ten-fold decrease in primary productivity, extensive thinning of the cypress forest canopy, and a reduction in the rate of forest litter decomposition, leading to buildup of fuel for destructive wildfires. Related observations in the Big Cypress Swamp indicate that extensive dewatering of certain areas of the swamp over the past three decades has led to widespread invasion of cypress communities by slash pine, red maple and red bay. In areas that were previously lumbered and burned, willow is the dominant canopy species for decades to come (Duever et al., 1984). In Southeast Florida, recent data published by Hofstetter and Sonenshein (1990) showed vegetative changes that occurred from 1978 through 1986 in an Everglades wetland (Northwest Wellfield, Miami-Dade County). Results of the study show that wellfield drawdowns shorten hydroperiod, decease herbaceous marsh vegetation in favor of woody vegetation and allow for invasion by melaleuca.

Loss of Aquatic Productivity

Wetlands are known as one of nature's most productive ecosystems. For the greater portion of the year, wetlands are flooded and therefore function essentially as an aquatic system. Typically in Southwest Florida, 75 to 85 percent of the annual precipitation occurs during the months of June through October. Since Southwest Florida wetlands depend upon rainfall as their major source of inflow water, water levels within wetlands systems closely follow seasonal rainfall patterns. Maximum water levels occur near the end of the wet season (October - November) while water levels generally decline during the dry season, reaching lowest levels during April and May. The majority of animals which inhabit Southwest Florida are adapted to this annual cycle. The reproductive success of several key species is closely tied to the rate of water level recession and the concentration of food resources that occurs during the dry season (Ogden et al., 1987; Robertson and Kushlan, 1974).

The presence of surface water within a wetland is essential for maintaining wetland aquatic productivity, i.e., the growth and reproduction of aquatic organisms such as insects, small forage fish, amphibians, crayfish, freshwater shrimp, snails, and other invertebrates that form the basis of the food chain for higher trophic level organisms such as amphibians, reptiles, wading birds and raptors which utilize these wetlands (Kahl, 1964; Kushlan, 1976, 1978; Frederick and Collopy, 1988). Overdrainage of wetlands by ground water withdrawals or surface drainage directly impacts this annual cycle by reducing wetland size, as well as the amount, number and kinds of microorganisms produced by wetlands. Therefore, large-scale drainage of wetlands has a great potential to impact the regional food supplies, breeding and nesting areas for many species of wildlife.

Decrease in Wetland Size

The most obvious impact of reducing water levels is a decrease in size of the wetland. This is especially true of shallow, low gradient wetlands which may be completely eliminated. Decrease in wetland size reduces the available wildlife habitat and the area of vegetation capable of nutrient assimilation. Decrease in wetland size also reduces the water surface area, and corresponding ET and evaporation rates, which can have an influence on the rain cycle and regional climatic conditions.

Degradation of Fish and Wildlife Habitat

A decrease in wetland size reduces the available wildlife habitat. The accompanying changes in vegetative composition and diversity, and loss of aquatic productivity impacts the breeding and nesting areas for many species of wildlife.

Invasion by Exotic Plants

Invasion by exotic plants such as melaleuca and Brazilian pepper is encouraged by changes in the depth and/or duration of wetland water levels. Melaleuca adapts well to alternating flood and drought conditions, and can form thick, monotypic stands that have very little wildlife value. Melaleuca also exhibits a high rate of ET and is very tolerant of fires, sprouting readily from the root stock after burning. The threat from this aggressive and difficult to control species argues strongly against allowing any further decreases in water levels or hydroperiods in the wetlands.

Alteration of Historical Surface Water Flows

Changes in water levels can also affect surface water flow patterns within and between wetlands. Reductions of the amount of surface water flow from wetlands can also have a negative effect on the salinity balance in estuarine habitats. This can be detrimental to the productivity of seagrass beds, oyster bars, and other valuable coastal environments.

Soil Subsidence and Increase in Fire Potential

With the impact on wetland water budgets that occurs from wellfield drawdowns comes an increase in the frequency and severity of wildfires. Fires are part of the natural process that recycles nutrients from accumulated plant material back into the soil. Fires are prevalent in the dry season, especially during drought years. Normally, the soil remains wet almost to the surface, protecting the roots of wetland vegetation from damage. When the water table is depressed to unnaturally low levels, the muck soils that underlay many of South Florida's wetlands dry out and become flammable. Resulting muck fires kill natural wetland vegetation, which is replaced by less desirable, weedy species. Even in the absence of fire, overly drained muck oxidizes and degrades, which can lead to vegetation changes and degradation of wetland function.

Saltwater Intrusion

Wetlands in coastal areas may experience vegetative changes in response to salinity changes. For example, cypress, maple, and other freshwater species can be killed by increased salinity resulting from decreased inflows of fresh water. A potential solution to this problem would be to establish minimum flows, which could lead to constraints on water supply development upstream.

Other Impacts

There are numerous other activities which affect wetlands that are outside the scope of this report, but may contribute to the cumulative impact on wetland systems (Larson, 1976; Carter et al., 1973; University of Florida, Center for Government Responsibility, 1982; Rochow, 1989; CH2M Hill, 1988): These activities include the following:

- Outright filling (conversion to residential, commercial, industrial, or agricultural uses)
- Drainage for pasture
- Rock mining
- Peat mining
- Chemical or biological pollution
- Impounding
- Dumping
- Recreational misuse and overuse
- Noise pollution

Impacts of Ground Water Drawdowns on Uplands

Little is currently known about the hydrologic requirements of upland communities. However, it is known that the water table levels beneath an upland play an important role in defining the vegetative structure and composition of an upland community. Impacts to uplands from water table withdrawals are similar to those encountered by wetlands, such as increased frequency of fire caused by reduced moisture conditions resulting from lower than normal water table elevations. Most natural environments in South Florida depend on appropriate fire regimes to maintain their ecological integrity. Those upland communities that are on the highest and lowest water tables may prove to be the most sensitive to water table level change. Monitoring of upland parameters is needed to provide a better understanding of wetlands.

Impacts of Ground Water Drawdowns on Estuarine and Marine Habitats

Although estuarine and marine habitats are not specifically addressed in the water supply model developed for the LWC Water Supply Plan, these sensitive environments need to be considered whenever management scenarios have the potential to affect freshwater releases to tidewater. The degree of salinity as well as volume, distribution, circulation, and temporal patterns of freshwater discharge all contribute to the character of these systems. In many ways, salinity is a master ecological variable that controls important aspects of community structure and food web organization in coastal systems (Myers and Ewel, 1990). Salinity patterns affect productivity, reproduction cycles, population distribution, community composition, predator-prey interactions, and food web structure in the inshore marine habitat. Disruption of the food web resulting from a salinity imbalance would also have a detrimental impact on commercial and recreational fishing industries. Other aspects of water quality, such as turbidity, dissolved oxygen content, nutrient loads, and toxic constituents also affect functions of these areas (Environmental Coalition of Broward County, 1987; U.S. Department of Agriculture, 1989; Myers and Ewel, 1990).

Impacts on Wading Birds

The interior freshwater marshes of South Florida are important habitats because of their importance as feeding and nesting areas for a number of endangered or threatened species (wood stork, sandhill crane), or species of special concern (little blue heron, snowy egret, Louisiana heron, least bittern, limpkin). The future of these species is ultimately linked with maintaining healthy, viable wetland systems (Ogden, 1978).

Wading bird species commonly feed upon small fish (1 to 6 inches long) in waters typically 2 to 30 inches deep. Although wood storks and white ibis display different feeding techniques, both species are tactile foragers, meaning they feed by touching prey with their bill and swiftly snapping it shut to catch food. This specialized feeding technique requires a greater concentration of fish than needed by other wading birds, which feed primarily by sight. Therefore, wood stork and white ibis foraging success is affected in situations where total numbers of available fish are reduced as a result of wetland drainage or altered hydroperiods, as compared to wading bird species which feed primarily by sight.

Populations of wading birds have experienced large declines in South Florida. Factors which have led to decreased population levels include loss of habitat, alteration of historical water levels and hydroperiod, increased fire frequency, and overhunting. In some cases, species which inhabit wetland areas have been adversely affected by water management actions which were intended to provide for their protection.

Robertson and Kushlan (1974) estimated the total population of wading birds to be as high as 2.5 million in 1870, declining to less than 500,000 in 1910 as a result of plume hunting. Restrictive hunting legislation enabled populations to increase to an estimated 1.2 million by 1935. Since that time, total populations have declined to levels about 10 percent of the levels recorded during the 1930s (Collopy and Frederick, 1986). Ogden (1978) states that the rapid decline in wading bird populations over the last three to four decades is the result of repeated nesting failures caused by inadequate food production. This can be attributed to marshland destruction and altered hydroperiods. Lowered water levels cause shortened reproductive periods for fish and aquatic invertebrates, and increase the frequency of destructive fires. Unusually high water levels during the nesting season cause food resources to be dispersed and unavailable during the critical nesting season.

The status of the endangered wood stork is of particular concern because it nests within the LWC Planning Area (Corkscrew Swamp). Historical populations of wood storks have sharply declined in South Florida. This decline is estimated to be about 80 percent between 1960 and 1980 (Ogden et al., 1987). Population levels averaged about 2000 pairs until 1960, although much variation occurred (Robertson and Kushlan, 1974; Ogden et al. 1987). Numbers continued to decline during the 1970s and 1980s after construction of water management structures which delivered water to Everglades National Park (Ogden et al., 1987). Ogden et al. (1987) has argued that the decline of wading bird populations within Everglades National Park was the result of alteration of the timing and distribution of surface water discharged into the Everglades since the 1960s. The authors indicate that the new water delivery schedule regime resulted in delayed and incomplete dry season drawdowns, which delayed wood stork nesting to the point where the nesting period extended into the wet season, and the adults could no longer obtain a sufficient concentrated food supply to support their young. Water management actions which allowed flood releases to the Everglades reversed the annual cycle of declining water levels and dispersed prey concentrations. Loss of peripheral wetlands, due to urban and agricultural development, is also thought to be the a major factor for nesting failures of many wading bird species.

Impacts on Rare, Threatened, or Endangered Species

Loss of habitat and habitat fragmentation are the major causes of the decline in a number of listed rare, threatened, or endangered (RTE) wildlife species in South Florida. Reduction in population is due largely to conversion of natural habitats to agricultural and urban uses. Some species, such as the Florida panther and black bear, require large expanses of land to successfully survive as a breeding population. Other species are restricted to one particular type of habitat, such as the Florida scrub jay (pine/oak scrub) or red-cockaded woodpecker (mature pine flatwoods). Listed RTE species within the LWC Planning Area depend on both wetland and upland communities for survival. For example, the Florida panther inhabits uplands, but it frequents wetlands. The reverse is true for other species, such as the wood stork.

Agricultural and urban development have gradually fragmented and reduced the quality and size of existing wildlife habitat. Continued fragmentation of upland and wetland ecosystems has the potential to cause problems for the survivorship of many species. **Table E-1** presents a list of the rare, threatened, and endangered species and species of special concern that are found within the LWC Planning Area. The following is a summary of selected species listed in the table.

Florida Panther (*Felis concolor coryi*)

A federally listed endangered species, the Florida panther has been given a high priority status to be saved through the Florida Panther Recovery plan (U.S. Fish and

Table E-1. Selected, Threatened, Endangered, and Species of Special Concern within the Lower West Coast Planning Area.

Species	FWC	USFWS
Amphibians and Reptiles		
American alligator *Alligator mississipiensis*	SSC	T(S/A)
Eastern indigo snake *Drymarchon coralis couperi*	T	T
Gopher frog *Rana aerolata*	SSC	UR2
Gopher tortoise *Gopher polyphemus*	SSC	UR2
Florida pine snake *Pituophis melanoleucus mugitus*	SSC	UR2
Birds		
Audubon's crested caracara *Polyborus planus audubonii*	T	T
Bald eagle *Haliaeetus leucocephalus*	T	E
Burrowing owl *Athene cunicularia*	SSC	
Florida sandhill crane *Grus canadensis pratensis*	T	
Florida scrub jay *Aphelocoma coerulescens*	T	T
Limpkin *Aramus guarauna*	SSC	
Little blue heron *Egretta caerulea*	SSC	
Osprey *Pandion haliaetus*	SSC (Monroe Co.)	
Red- cockaded woodpecker *Picoides borealis*	T	E
Roseate spoonbill *Ajaia ajaja*	SSC	
Snowy egret *Egretta thula*	SSC	
Southeastern American kestrel *Falco sparverius paulus*	T	UR2
Tricolored heron *Egretta tricolor*	SSC	
Wood stork *Mycteria americana*	E	E
Mammals		
Big Cypress fox squirrel *Sciurus niger avicennia*	T	UR2
Everglades mink *Mustela vison evergladensis*	T	UR2

Table E-1. (Continued) Selected, Threatened, Endangered, and Species of Special Concern within the Lower West Coast Planning Area.

Species	FWC	USFWS
Florida black bear *Ursus americana floridanus*	T	UR2
Florida mouse *Podomys floridanus*	SSC	UR2
Florida panther *Felis concolor coryi*	E	E
Round-tailed muskrat *Neofiber alleni*		UR2
West Indian manatee *Trichechus manatus*	E	E

E = Endangered.

T = Threatened.

SSC = Species of Special Concern.

UR2 = Under review for listing, but substantial evidence of biological vulnerability and/or threat is lacking.

T(S/A) = Threatened due to similarity of appearance.

Source: SWFRPC, 1990

Wildlife Service, 1987). The panther requires a large territorial range, which is rapidly disappearing due to the expansion of agricultural and urban developments. This continued "loss and fragmentation of native landscapes in Southwest Florida will reduce the ability of panthers to function normally and will exacerbate problems associated with low numbers" (Maehr, 1990). Maehr also observed that while wetlands are an important habitat to panthers, they appear to prefer native upland forest habitats in Southwest Florida. The survival of the panther is closely correlated to the preservation of large tracts of contiguous and suitable habitats. Additional habitat losses may be incurred by changes in the hydrology of wetlands and uplands due to drawdown effects from wellfield operations.

Red-Cockaded Woodpecker (*Picoides borealis*)

Also a federally listed endangered species, the red-cockaded woodpecker was once common in the region within mature pine forest habitat. However, logging for timber and clearing for agriculture has significantly reduced this habitat, affecting the woodpecker population size and range. This woodpecker is the only woodpecker species to excavate a nesting cavity in a mature living pine tree, and therefore requires a mature stand of pines for successful nesting. In addition, the woodpecker lives in groups, referred to as clans, that may be as large as nine individuals. Their territories vary in size up to 250 acres, with areas of utilization up to 1,000 acres. Soils which support mature pine forests are subject to conversion to agriculture and urban development. Hydrological changes from wellfield development may cause the further loss of pine forest habitat by increased fire frequency.

Florida Scrub Jay (*Aphelocoma coerulescens*)

The Florida scrub jay is a threatened species that lives within a very restricted habitat range, permanently residing in upland scrub communities. These scrub communities exist on historic sand dunes, and are vanishing due to urban developments and conversion to citrus groves. The protection of this habitat is critical for species survival.

Gopher Tortoise (*Gopherus polyphemus*)

A species of special concern, the gopher tortoise lives in a variety of habitats. The major cause for decline of tortoise populations has been the conversion of native habitat to agriculture and urban development. In the process of clearing the land, the tortoise is often killed by suffocation due to burial within their burrow. Highway mortality also significantly contributes the decline of this species in Lee County (Lee County, 1989). Gopher tortoise burrows are also utilized by over 80 different wildlife species, such as the Eastern indigo snake (threatened species) and the gopher frog (species of special concern).

REFERENCES CITED

Alexander, T.R. and A.G. Crook. 1973. Recent and long-term vegetation changes and patterns in South Florida. In: *South Florida Ecological Study*. Coral Gables: University of Miami Press.

Alexander, T.R. and A.G. Crook. 1984. Recent vegetational changes in South Florida. In: Gleason, P.J. (Ed.), *Environments of South Florida: Present and Past II*. Miami Geological Society, Coral Gables, FL. pp 61-72.

Behr, R.M. 1989. *Report presented by the Florida Department of Citrus, to the Gulf Coast Growers Association*, LaBelle, FL. n. pag.

Bradley, J.T. 1972. Climate of Florida. In: *Climate of the States*. No. 60-8. Environmental Data Service, Silver Springs, MD. 5 pp.

Burns, L.A. 1984. Productivity, and water relations in the Fakahatchee Strand of South Florida. In: Ewel, K.C. and H.T. Odum (Eds.), *Cypress Swamps*. Center for Wetlands, University of Florida, Gainesville. pp. 318- 333.

Carter, M.R., L.A. Burns, T.R. Cavinder, K.R. Dugger, P.L. Fore, D.B. Hicks, H.F. Revels, and T.M. Schmidt. 1973. *Ecosystems analysis of the Big Cypress Swamp and estuaries*. Ecological Report Number DI-SFEP-74-51. U.S. Environmental Protection Agency, Athens, GA. 375 pp.

CH2M Hill. 1988. Hydroecology of wetlands on the Ringling-MacArthur Reserve. Technical Report No. 2, Vol. 1. Prepared for Sarasota County, FL. vari. pag.

Craighead, F.C. 1971. *The Trees of South Florida*. Volume 1. The natural environments and their succession. Coral Gables: University of Miami Press.

Craighead, F.C. and V.D. Gilbert. 1962. The effects of Hurricane Donna on the vegetation of southern Florida. *J. Fla. Acad. Sci.*, 25:1-28.

Davis, J.H. 1943. *The Natural Features of Southern Florida, Especially the Vegetation, and the Everglades*. Bulletin No. 25. Florida Geological Survey, Tallahassee, FL. 311 pp.

Dineen, J.W. 1974. *Examination of Water Management Alternatives in Conservation Area 2A. In Depth Report* 2(3): 1-11. South Florida Water Management District, West Palm Beach, FL.

Dineen, J.W. 1972. *Life in the Tenacious Everglades. In Depth Report* 1(5): 1-10. Central and Southern Flood Control District, West Palm Beach, FL.

Dooris, P.M., G.M. Dooris, T.F. Rochow, and M. Lopez. 1990. The effects on wetland vegetation and habitat value caused by altered hydroperiods resulting from groundwater withdrawals in central Florida. Env. Sec. Tech. Report, 1990-1. Southwest Florida Water Management District, Brooksville, FL. 18 pp.

Duever, M.J. 1984. Environmental factors controlling plant communities of the Big Cypress Swamp. In: Gleason, P.J. (Ed.), *Environments of South Florida: Present and Past. II*. Miami Geological Society, Miami, FL. pp. 127-137.

Duever, M.J. 1988. Hydrologic processes for models of freshwater wetlands. In: Mitsch, William, J.M. Jorgensen and S.E. Jorgensen (Eds.), *Wetlands Modeling*. Amsterdam: Elsevier: pp. 9-39.

Duever, M.J., J. E. Carlson, J.F. Meeder, L.C. Duever, L.H. Gunderson, L.A. Riopelle, T.R. Alexander, R.L. Meyers and D. Spangler. 1986. *The Big Cypress National Preserve*. New York: National Audubon Society. 444 pp.

Duever, M.J., J.E. Carlson, L.A. Riopelle, L H. Gunderson and L.C. Duever. 1976. Ecosystems analysis at Corkscrew Swamp. In: Odum, H.T., K.C. Ewel, J.W. Ordway and M.K. Johnston (Eds.), *Cypress Wetlands for Water Management, Recycling and Conservation*. 3rd Annual Report to National Science Foundation and Rockefeller Foundation, Center for Wetlands, University of Florida, Gainesville, FL. pp. 707-737.627-725.

Duncan, D.V. and T.A. Terry. 1983. Water management. In: Stone, E.L. (Ed.), *The Managed Slash Pine Ecosystem*. Proc. Symp., School For. Res. Conserv., Univ. of Florida, Gainesville, FL. pp. 91-111.

Environmental Coalition of Broward County. 1987. *Natural Areas Survey- Broward County Florida*, 1986-87. 13 pp.

Florida Gulf Citrus News. 1990. Gulf area grows, gains ground. *Florida Gulf Citrus News*, Fourth Quarter.

Frayer, W.E. and J.M. Hefner. 1991. *Florida's Wetlands: Status and Trends, 1970s to 1980s*. U.S. Fish and Wildlife Service, Southeast Region. 22 pp.

Frederick, P.C. and M.W. Collopy. 1988. *Reproductive Ecology of Wading Birds in Relation to Water Conditions in the Florida Everglades*. Technical Report Number 30.

Florida Cooperative Fish and Wildlife Research Unit, University of Florida, Gainesville, FL. 259 pp.

Freeze, R.A. and J.A. Cherry. 1979. *Groundwater*. Englewood Cliffs, NJ: Prentice-Hall.

Haines, L.W. and J. Gooding. 1983. Slash pine versus other species. In: Stone, E.L. (Ed.), *The Managed Slash Pine Ecosystem*. Proc. Symp., School For. Res. Conserv., University of Florida, Gainesville, FL. pp. 112-130.

Hofstetter, R.H. and R.S. Sonenshein. 1990. V*egetation Changes in a Wetland in the Vicinity of a Wellfield, Miami-Dade County, Florida*. U.S. Geological Survey Water Resource Investigation Report 89-4155. U.S. Geological Survey. 16 pp.

Kahl, M.P. 1964. Food ecology of the wood stork (*Mycteria americana*). *Ecol. Monogr.*, 34:97-117.

Klein, H., J.T. Armbruster, B.F. McPherson and H.J. Freiberger. 1975. *Water and the South Florida Environment*. U.S. Geological Survey Water Resources Investigation Report 24-75. U.S. Geological Survey, Tallahassee, FL. 165 pp.

Klein H., W.J. Schneider, B.F. McPherson and T.J. Buchanan. 1970. *Some Hydrological and Biological Aspects of the Big Cypress Swamp Drainage Area, Southern Florida*. U.S. Geological Survey Open-File Report 70-003. U.S. Geological Survey, Tallahassee, FL. 94 pp.

Kolipinski, M.C. and A.L. Higer. 1969. *Some Aspects of the Effects of the Quantity and Quality of Water on Biological Communities in Everglades National Park*. U.S. Geological Survey Open-File Report 69-007. U.S. Geological Survey, Tallahassee, FL. 97 pp.

Kushlan, J.A. 1976. Wading bird predation in a seasonally fluctuating pond. *The Auk*, 93: 464-476.

Kushlan, J.A. 1978. Feeding ecology of wading birds. In: Sprunt Jr., A., J.C. Ogden, and S.A. Winkler, (Ed.), *Wading Birds*. Report number 7. National Audubon Society Research, New York. pp. 149-196.

Kushlan, J.A. 1979. Feeding ecology and prey selection in the White Ibis. *Condor*, 81:376-389.

Kushlan, J.A. 1979. Prey choice by tactile-foraging wading birds. In: *Proceedings of the Colonial Waterbird Group*, 3:133-142.

Kushlan, J.A. 1980. Population fluctuations of Everglades fishes. *Copeia*, (4): 870-874.

Kushlan, J.A. 1986. Responses of wading birds to seasonally fluctuating water levels: Strategies and their limits. *Colonial Waterbirds*, 9:155-162.

Kushlan, J.A., J.C. Ogden and A.L. Higer. 1975. *Relation of Water Level and Fish Availability to Wood Stork Reproduction in the Southern Everglades, Florida*. National Park Service, South Florida Research Center, Homestead, FL. 56 pp.

Land, D. 1988. Presentation made before the general assembly of the Florida State Horticultural Society, Miami, FL.

Larson, J.S. 1976. *Models for Assessment of Freshwater Wetlands*. Publication Number 32. Water Resources Research Center, University of Massachusetts at Amherst. 91 pp.

Lee County. 1989. *The Lee Plan, Section B, Support Documentation, Part 1*. Planning Division, Fort Myers, FL. vari. pag.

Maehr, D.S. 1990. *Florida Panther Movements, Social Organization, and Habitat Utilization*. Final report. Bureau of Wildlife Research, Florida Game and Fresh Water Fish Commission. Gainesville, FL. vari. pag.

McPherson, B.F., G.Y. Hendrix, H. Klein, and H.M. Tyrus. 1976. *The Environment of South Florida, A Summary Report*. U.S. Geological Survey Professional Paper 1011. U.S. Geological Survey. 81 pp.

Meeder, J.F. and L.B. Meeder. 1989 (abstract). Hurricanes in Florida Bay: a dominant physical process. Bulletin of Marine Science 44(1) 518. Presented at Symposium on Florida Bay, a Subtropical Lagoon, U. S. National Park Service/Everglades National Park and University of Miami/Rosenstiel School of Marine and Atmospheric Science.

Mitsch, W.J. and J.G. Gosselink. 1986. *Wetlands*. New York: Van Nostran Reinhold Company.

Myers, R.L. and J.J. Ewel. 1990. *Ecosystems of Florida*. Gainesville: University Presses of Florida.

O'Brien, A.L. and W.S. Ward. 1980. Hydrogeological evaluation of wetlands for land use planning. *Water Resource Bulletin, American Water Resources Assess*., 16(5):785-789.

Ogden, J.C. 1978. Freshwater marshlands and wading birds in South Florida. In: H.W. Kale III (Ed.), *Birds, Vol. 2: Rare and Endangered Biota of Florida*. Gainesville: University Presses of Florida. 121 pp.

Ogden, J.C., H.W. Kale, II and S.A. Nesbitt. 1980. The influence of annual variation in rainfall and water levels on nesting by Florida populations of wading birds. *Transactions of Linnaean Society of New York*, 9:115-126.

Ogden, J.C., W.F. Loftus and W.B. Robertson, Jr. 1987. Wood storks, wading birds and freshwater fishes. Statement paper. U.S. Army Corps of Engineers, General Design Memorandum on modified water deliveries to Everglades National Park, South Florida Research Center, Everglades National Park, Homestead, FL.

Parker, G., G.E. Gorginsen, and S.K. Love. 1955. *Water Resources of Southeastern Florida*. U.S.Geological Survey Water-Supply Paper 1255. U.S. Geological Survey, Washington, D.C. 965 pp.

Powell, G.V.N. 1987. Habitat use by wading birds in a subtropical estuary: Implications of hydrography. *The Auk*, 104(4):740-749.

Robertson, W.B. Jr. and J.A. Kushlan. 1974. The southern Florida avifauna. In: P.J. Gleason (Ed.), *Environments of South Florida: Present and Past, II*. Miami Geological Society, Coral Gables, FL. pp. 219-257.

Rochow, T.F. 1982. *Biological Assessment of the Jay B. Starkey Wilderness Park- 1982 Update*. Technical Report 1982-9. Environmental Section, Southwest Florida Water Management District, Brooksville, FL. 58 pp.

Rochow, T.F. 1983. 1983 *Photographic Survey of the Jay B. Starkey Wilderness Park*. Technical Memorandum 4/27/83. Environmental Section, Southwest Florida Water Management District, Brooksville, FL.

Rochow, T.F. 1984. *Photographic Survey of the Jay B. Starkey Wilderness Park*. Technical Memorandum 4/27/84. Environmental Section, Southwest Florida Water Management District, Brooksville, FL.

Rochow, T.F. 1985. *Biological Assessment of the Jay B. Starkey Wilderness Park- 1982 Update*. Technical Report 1985-4. Environmental Section, Southwest Florida Water Management District, Brooksville, FL. 105 pp.

Rochow, T.F. 1989. Part II rule revision: water table levels necessary to maintain wetland vegetation in cypress domes and marshes. Memorandum to D.L. Moore. Environmental Section, Southwest Florida Water Management District, Brookesville, FL.

Rochow, T.F. and P.M. Dooris. 1982. *Photographic Survey of the Jay B. Starkey Wilderness Park.* Technical Memorandum 4/27/82. Environmental Section, Southwest Florida Water Management District, Brooksville, FL.

Rochow, T.F. and P. Rhinesmith. 1991. *Comparative Analysis of Biological Conditions in Five Cypress Dome Wetlands at the Starkey and Eldridge-Wilde Wellfields in Southwest Florida*. Tech. Report 1991-1. Environmental Section, Southwest Florida Water Management District, Brookesville, FL. 67 pp.

Schortemeyer, J.L. 1980. *An Evaluation of Water Management Practices for Optimum Wildlife Benefits in Conservation Area 3A*. Florida Game & Fresh Water Fish Commission, Ft. Lauderdale, FL. 74 pp.

Southwest Florida Regional Planning Council. 1990. *Southwest Florida: A Description of the Region-- Part One of the Regional Comprehensive Plan*. SWFRPC, N. Ft. Myers, FL. vari. pag.

University of Florida. 1991. *Evaluation of the Regional Short and Long-Term Effects of New Citrus Development on Fish and Wildlife*. Preliminary draft report to the South Florida Water Management District. Institute of Food and Agricultural Sciences and the Florida Cooperative Fish and Wildlife Research Unit, University of Florida, Gainesville, FL. vari. pag.

University of Florida. 1982. *Wetland Loss in South Florida and the Implementation of Section 404 of the Clean Water Act*. A report to the Office of Technology Assessment, Oceans and Environment Program, U.S. Congress. Center for Government Responsibility, University of Florida College of Law, Gainesville, FL. 124 pp.

U.S. Department of Agriculture. 1989. *Twenty-six Ecological Communities of Florida*. Soil Conservation Service, USDA. Reprinted by Florida Chapter Soil and Water Conservation Society. vari. pag.

U.S. Fish and Wildlife Service. 1987. *Florida Panther* (*Felis concolor coryi*) *Recovery Plan*. Florida Panther Interagency Committee, USFWS, Atlanta, GA. 75 pp.

Watson, J. 1990. Hydrogeologic Investigations of Cypress Domes Wetlands in Wellfields Area North of Tampa, Florida. In: *Proc. Focus Eastern Conference*, pp. 163-176, National Water Well Assoc., Dublin, OH.

Wharton, C.H., H.T. Odum, K. Ewel, M. Duever, A. Lugo, R. Boyt, J. Bartholomew, E. DeBellevue, S. Brown, M. Brown, and L. Duever. 1977. *Forested Wetlands of Florida: Their Management and Use*. Center for Wetlands, University of Florida, Gainesville. 348 pp.

Worth, D. 1983. *Preliminary Environmental Response to Marsh Dewatering and Reduction in Water Regulation Schedule in Water Conservation Area-2A, September 1983*. Technical Publication 83-06. South Florida Water Management District, West Palm Beach, FL. 63 pp.

STRATEGIC LAND ACQUISITION/CONSERVATION/ PRESERVATION PLAN FOR SOUTHWEST FLORIDA (DRAFT)

*Note: This unmodified **DRAFT** document was forwarded to the SFWMD by David Burr, Planning Director, Southwest Florida Regional Planning Council (SWFRPC), February 1999.*

I. Background

The passage of the Environmentally Endangered Lands program in 1972 was Florida's first statewide acquisition program. This program was implemented due to the recognition that our natural resources were vital to our economy and quality of life, or sustainability. This recognition is demonstrated in "The Green Plan: A Basic Understanding of Florida's Resource Limitations as a Foundation for Land Use Planning" prepared by the Division of State Planning, Bureau of Comprehensive Planning, 1975. To gauge the "state of the region" near that time, Map 1 (*not available in this document*) is extracted from the SWFRPC "Land Use: Inventory and Issues, The Initial Element of the Land Use Policy Plan", June 1977, Open Space Land Map. This map depicts the major proposed public and private preserves at the time based on the "Green Plan" and additional regional planning. (Note that the Big Cypress and Fakahatchee Strand acquisition began after 1972 and that the Lykes Brothers Fisheating Creek was a voluntary private wildlife management area. Lykes has since removed this designation.

Since that time there have been a number of public and private initiatives, including the Federal purchase of Big Cypress, the Environmentally Endangered Lands (EEL) program (which related to the Florida Green Plan), the Conservation and Recreational land Program (CARL), and P-2000. These programs are inventoried and described later in this plan. Map 2 (*not available for this document*) depicts the current preserved or planned open space through the various programs.

As can be seen on the various maps we have made significant progress in preserving and conserving our strategic natural resources. What remains in the puzzle are the more remote natural resources that will receive future development pressure, smaller and more isolated rare and unique communities, and the links and connections between our existing preserves that form corridors and Greenways. In other words, our major regionally significant natural resources have been identified for acquisition, preservation or conservation within public and private acquisition programs and have been set aside within developments. Future work should include the connections of the dots and the filling of any gaps in the strategic system.

Also being recognized is that publicly sponsored acquisition programs can not alone provide for the sustainability of our natural resources, and that other tools are necessary. These tools include conservation easements, purchase of development rights, regulation and private initiatives. These tools and other tools are also presented in this plan.

At the April 15,1998 Southwest Florida Issues Group (Governor's Commission for a Sustainable South Florida Subcommittee) meeting, a series of presentations were provided by public and private conservation agencies and organizations regarding their land acquisition activities. Virtually every speaker responded in the affirmative to the question “Does Southwest Florida need a Strategic Acquisition Program/Plan?” The responses varied, but there was significant support even for the simple task of an annual convocation.

Consequently, continuing discussions are proposed for these agencies and organizations and guidance given to the topic of strategic acquisition of environmentally sensitive, and other targeted properties, with some evaluation of a minimum effort to the furthest extent of practicable effort. Any discussion should take into account the following:

- The basic structure of a strategy;
- The measurable outcomes that would be expected;
- The compatible and contradictory missions between the entities (recreation, hunting/fishing, flood control, forestry activities, etc.);
- Coordinated efforts in land (and water) resource identification for conservation;
- Fiscal flexibility and constraints;
- The variation in intensity of land management needed in the different acquisition programs;
- The extent to which strategically important parcels are still being lost for acquisition; and
- Broadening the fiscal value for which land are appraised.

Another expected outcome for this Convocation is a strong regional presence that will be coordinated to increase efficiency in natural resource protection and provide a plan of action that can quickly respond to the availability of funding and/or other initiatives.

Note: Identification of "Proposed Public Acquisition/Conservation/Preservation Lands" within this Plan is solely for planning purposes and not for regulatory purposes. Better, site specific data (if available) for any feature or resource shown on these lists or maps should be used to identify whether any natural resource of regional significance is in fact present on that site for purposes of preparation of local comprehensive plans and for consideration of site specific land use requests.

II. Goals, Objectives and Actions (To Be an Amendment to the Southwest Florida Regional Planning Council's Strategic Regional Policy Plan)

GOAL: **BY 2020, SOUTHWEST FLORIDA WILL HAVE ALL LANDS ACQUIRED OR CONTAINED WITHIN A LAND CONSERVATION PROGRAM, WHICH INCLUDES A LONG TERM MANAGEMENT COMPONENT, TO INSURE SUSTAINABILITY OF OUR NATURAL RESOURCES AND QUALITY OF LIFE**

OBJECTIVE: **TO IDENTIFY AND INCLUDE WITHIN A LAND CONSERVATION OR ACQUISITION PROGRAM, THOSE LANDS IDENTIFIED AS BEING NECESSARY FOR THE SUSTAINABILITY OF SOUTHWEST FLORIDA, UTILIZING ALL LAND PRESERVATION TOOLS AVAILABLE.**

ACTIONS:

- To help eliminate possible duplication or competition on a tract of land between entities, provide a clearinghouse and inventory of lands included in all land acquisition programs in a central location so various entities can see if any other entities were involved in a specific location. A future Web Site would be a useful tool and provide easy access.
- Support continued acquisition of lands targeted for conservation and recreation by Public Land Acquisition Programs including CARL, SOR, Florida Communities Trust, Lee County CLSAC, CREW, WRDA and other efforts in the Region.
- Support continued acquisition of lands targeted for conservation and recreation by Private Environmental Land Trust Programs in the Region.
- Facilitate and assist in the coordination of all land acquisition programs in the Southwest Florida Region by sponsoring periodic meetings of all public and private initiatives.
- Create a map depicting land that has been set aside for conservation purposes within approved developments (existing conservation easements).
- Create a map depicting regionally significant lands that private landowners agree will be voluntarily managed to maintain their environmental value, yet still provide them with economic benefits, without the need for public

acquisition consideration (such lands would be candidates for future conservation easements).

- Working with the various entities and utilizing the following Criteria and Guidelines, create a gaps planning map of land needed for recreation, hunting/fishing, flood control, forestry activities, etc.; to provide support for future populations and to protect existing ecosystems. Potential gaps may include lands which are not included in any current acquisition/conservation /preservation program, have not already been set aside as conservation areas within approved development or lands which may be within private ownership and may be potentially proposed for future agricultural or urban intensification, which would preclude their environmental value.
- Workings with the various acquisitions programs identified in this Plan and working with Local Governments and private landowners, develop a strategy to protect gaps lands identified in the above action, using the Tools outlined in this plan.
- Assist in the preparation of applications of existing programs for funding of land acquisitions for gaps lands shown on the above-mentioned planning map.
- Investigate the potential of forming a new Programs, Land Trusts, or encourage existing Land Trusts, to focus on land acquisition, and on other land conservation techniques within portions of Southwest Florida not currently within a program and depicted on the above mentioned gaps map.
- Because we do not have all the money necessary to acquire all lands needed, and because some methods may remove lands from needed ad valorem tax status, other methods rather than just fee simple acquisition are needed.
- Encourage citizen organizations within the Region to refocus on land conservation strategies as a proactive method in addressing environmental protection issues.
- Working with the various entities, refine existing Management Strategies to insure that the lands acquired are maintained in the natural condition that led to their preservation status.
- Incorporation of the plan into the Strategic Regional Policy Plan of the Southwest Florida Regional Planning Council.

III. Acquisition-Preservation-Conservation Criteria

A. Wetlands

Areas that are considered as wetlands. These include configurations of diverse ecosystems that are periodically inundated with fresh water; those areas where the water level is at, near, or above the land surface for at least 30 days of an average (rainfall) year. Examples include: Hydric Hammocks, Hydric Pine Flatwoods, Freshwater marshes, Wet Prairies, Floodplain Forests and Swamps, Cypress Sloughs, Strands and Domes, Wetlands adjacent to Lake Okeechobee and Wetlands that have value to assist in stormwater management and public water supply.

B. Unique Uplands and Other Natural Communities

Areas that represent the best remaining examples of each of the Region’s unique Uplands and Natural Communities and their subtypes, with priority given to those communities or subtypes which have been designated by the Florida Natural Areas Inventory as Critically Imperiled, Imperiled, or Rare Natural Communities.

C. Fish and Wildlife

Areas that are critical to the survival of wildlife listed as endangered, threatened or species of special concern. Examples include: areas that serve as colonial bird nest sites, that are necessary to maintain the Region's native animal species diversity, that are used as large mammal corridors linking critical habitats, and areas that are documented as breeding or nesting sites for listed species.

D. Vascular Plants

Areas that contain habitat for rare, endangered, and threatened plant species, with priority given to those sites that are critical to their survival, or are not critical but contain important assemblages of rare or endangered species.

E. Freshwater Supplies

Areas that serve as protective buffers along Outstanding Florida Water rivers and lakes, protective buffers surrounding potable water wellfields. Areas that serve as protective buffers to Lake Okeechobee and that have been identified for acquisition as part of the Save Our Rivers, C.A.R.L., and P-2000 acquisition programs.

F. Coastal Resources

Areas that contain undeveloped portions of, or entire undeveloped Barrier Islands. Upland and wetland buffers to protect the Region's significant commercial and recreational saltwater fisheries, particularly those fisheries that are designated State Aquatic Preserves, National Estuarine or Marine Sanctuaries, Areas of Critical State

Concern, Outstanding Florida Waters, National Estuary Program, or Class II Shellfish Harvesting Areas.

G. Archaeological and Historic Resources

Lands that contain archaeological and historical sites that best typify the various cultural periods and regions of the state, the classes of cultural activity, the various styles of architecture, and the unique works of individuals.

H. Outdoors Recreational Resources

Areas that help meet needs identified in the Strategic Regional Policy Plan, and in Florida's Statewide Comprehensive Outdoor Recreation Plan. Areas that enhance the representational balance of natural and historic resources within the Region's Park system, or lands that contain prime examples of the state's natural and historical resources. Areas that serve as fish and wildlife oriented outdoor recreation areas. Areas that could assist in meeting Local Government Comprehensive Plan recreational level of service and concurrency requirements.

I. Forest Resources

Lands that maintain representation of the various forest or timber types of the Region; maintain Florida's forests to perpetuate their environmental, economic, aesthetic, and recreational values; give special consideration to manageable forests that have income producing potential to defray management costs; and give special consideration to upland forests that help meet the resource-based recreational needs of Florida's growing populations.

J. Geologic Features

Lands that contain prime examples of unique geological exposures, formations, and outcrops.

K. Other General Guidelines

Areas with resources of statewide or regional importance. Endangered and vulnerable lands and waters that are in immediate danger of loss to some other land use. Lands and waters with ecologically intact systems that have minimal disturbances, and can be feasibly managed to conserve the resource for which the lands to be acquired. Lands and waters that add inholdings, and other areas, that would enhance management or protection of existing state lands that have important resources. Lands and waters that have significant resource values, and satisfy specific regional concerns, with special consideration given to those projects that are accessible to urban areas. Areas that should be targeted due to repeated flooding, that are vulnerable to hurricane loss and that could require extensive disaster relief funds after a catastrophic event. Areas that provide connectivity to existing preserves, and provide wildlife and public greenway corridors.

IV. Regional Guidelines For Setting Land Acquisition, Conservation, Preservation Priorities

Existing and Proposed Public and Private Acquisition Programs contain lands that form important “Core Areas” for wildlife, water resource protection purposes, recreation, historic/archeological and other natural resource protection. In many cases, however, these lands are not interconnected, and in time will become more isolated from adjacent preserves unless a strategy for maintaining these connections is implemented. The following general guidelines are suggested:

1. Focus on the continued acquisition of lands within identified P 2000 (CARL, SOR, etc.) projects.
2. Fill in any Gaps in the P 2000 Projects and “Core Areas”.
3. Focus on lands directly adjacent to P 2000 Projects and “Core Areas”.
4. First consider lands that are not currently approved for urban development, citrus or mining.
5. Consider lands that are currently approved for urban, agriculture, or mining, if they are strategically located adjacent to “Core Areas”, contain lands with outstanding natural resources that should be preserved, or contain lands that provide important connections to the “Core Areas” and adjacent conservation areas.

V. Florida Statewide Land Acquisition Plan (FLSAP): Land Acquisition Guidelines

1. Prefer projects with resources of statewide or regional importance.
2. Prefer the more endangered and vulnerable projects, which are in immediate danger of loss to some other use.
3. Prefer projects with ecologically intact systems that have minimal disturbances and can be feasibly managed to conserve the resources for which they are to be acquired.
4. Give special consideration to inholdings, additions and other lands that would enhance management, protection, or restoration of existing public lands with important natural or cultural resources.
5. Prefer projects with significant resource values that satisfy specific regional concerns, giving special consideration to projects that are accessible to urban areas.

6. Prefer projects that have sufficient size and resource diversity to support multiple-use management and resource-based outdoor recreation.
7. Give special consideration to habitat corridors or landscape linkages that serve a demonstrated Conservation or recreation purpose.
8. Give special consideration to large projects that exhibit wilderness characteristics.
9. Give special consideration to projects with acquisition or management assistance from other governmental or nonprofit entities if these projects also help to achieve other FSLAP objectives.

VI. Estero Bay Agency on Bay Management Gaps Map

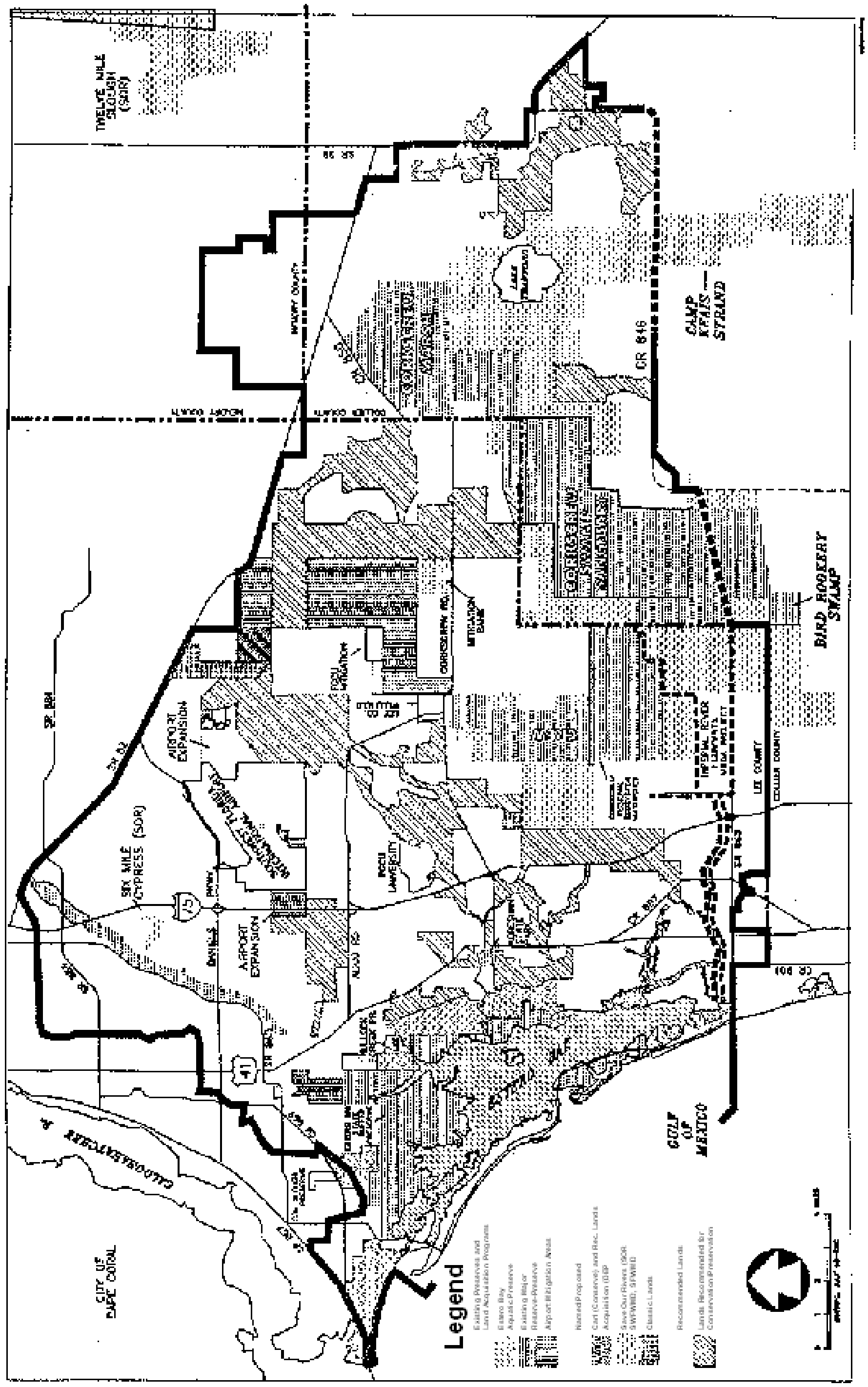
The Estero Bay Agency on Bay Management (ABM) has prepared a proposed Land Conservation GAPS Map for the Estero Bay Basin (*following page*). A subcommittee of the ABM using the above criteria prepared the map. It is proposed that the SWRFPC work with similar groups to prepare a gaps map for the entire region.

VII. Tools For Preservation\Acquisition\Conservation

A. Fee-simple

1. <u>Outright Sale</u> - The owner of a piece of property transfers the title of the land, with all rights commonly associated with property, to another party. This is the most common way for government agencies to purchase land. This is-also called Negotiated free market acquisition and outright purchase. For example, Preservation 2000.

   The advantages are; clearly will not have residential or other such development; no restrictions on type of management; and, potentially available for public recreation. The disadvantages include: high initial cost since purchasing entire property, including its potential value if it were to be developed; removes property from tax role; and, may not be funds for proper management.
2. <u>Sale-Leaseback</u> - A piece of land is sold, then the buyer leases it to the original owner. For example, the purchase of lands around airfield, which is then, leased back for agricultural activities. The advantage is clear control over use of property since



ADOPTED JULY 13, 1998 BY THE ESTERO BAY AGENCY ON BAY MANAGEMENT

ESTERO BAY WATERSHED

LAND CONSERVATION/PRESERVATION STRATEGY MAP other uses are restricted by terms of lease. The disadvantage is must still fund, upfront, the fair market value for entire parcel.

3. Sale-Sale Back - A piece of land is sold then sold back to the original owner or another buyer with restrictions.

4. Eminent Domain And Condemnation – The advantage is that this process ensures that the identified piece is actually bought. The disadvantage is that the process is non-voluntary and often results in legal actions that add to the overall cost of land acquisition.

5. Donations Of Land

   - Immediate donation.
   - Donation by bequest. Property transfers at death of owner. The advantages include reduction in income taxes for - immediate donation and donation with reserved life -estate; reduction in estate taxes for donation by bequest.
   - Life Estate. An estate whose duration is limited to the life of the party holding it, or some other person. Upon the death of the life tenant, the property (real or personal) will go to the holder of the remainder interest or to the grantor by reversion. This type of estate does not amount to ownership but denotes a claim or interest in the property, limited by a term of life.

6. Term Estate - An estate for years whereby a person has an interest in lands and tenements and a possession thereof, by virtue of such interest, for some fixed and determinate period of time; as in the case where lands are leased for a term of a certain number of years, agreed upon between the lessor and lessee. This type of estate is generally for a fixed and definite period of time; implying a period of time with some definite termination date.

7. Trade Agreements - Tax-deductible gifts of property that have low ecological value are sold in order to purchase more desirable natural areas. For example, corporations donate obsolete factory sites and land left over from development projects to The Nature Conservancy.

8. Land Exchanges With State Surplus Land - Private land is exchanged for state-owned land. The DEP Bureau of Land Management Services reviews proposals for swapping of private land (in areas targeted for acquisition) for lands declared surplus by the State.

9. "Like-Kind" Or "Third 'Party" Exchange - The owner of land who receives payment-for a conservation easement or fee-simple sale gives the money to a third party intermediary (usually

an attorney) who then purchases property of the owner's choosing for business, trade, or investment purposes. This is governed by Section 1031 of the Internal Revenue Code. The advantage is that the capital gains taxes are deferred until the acquired property is sold (rather than paying on the cash received).

B. Subsidies and Incentives

1. Voluntary Registration -This recognizes parties that manage their lands for natural resource purposes. Example programs are:

   - The National Institute for Urban Wildlife has a Urban Wildlife Sanctuary Program to certify and recognize lands that are managed for wildlife.
   - The Florida Department of Agriculture and Consumer Services presents annual awards to those who promote environmentally sensitive agricultural practices.
   - The Soil and Water Conservation District (in Dekalb County, IL) awards a certificate and a sign to honor farmers who are working to protect the resources.
   - The National Wildlife Federation recognizes people who consider wildlife when landscaping through their Backyard Wildlife Habitat Program.

   The advantage is that this makes landowner personally feel good about their efforts and, through community support, encourages other landowners to do the same.

2. Marketplace Incentives - Recognize and promote products that have been grown or produced in a manner that is not destructive to the environment. For example, the Florida Department of Agriculture certifies produce that has been grown organically.

3. Ecotourism - Use tourist potential for properties managed for natural resources. For example, the Babcock Wilderness Adventures offer tours on a ranch in Punta Gorda.

4. Payments and Credits

   - Cost-share programs for improvements. Provides public funding to improve the quality of the land. Examples are: NRCS funds changes in production to protect water quality through the Agricultural Water Quality Incentive Program; NRCS funds crop management to reduce application of pesticides and nitrogen through the Special Practice 53 Program; DEP funds projects for water quality through the

Nonpoint Source Management Program; and, U.S. Forest Service funds management of small forested parcels through the Forest Stewardship Program.

- One-time payments to implement conservation practices. For specific actions. Examples are: NRCS pays to stop growing crops on land subject to excessive erosion or contributes to water quality problems through the Conservation Reserve Program; NRCS pays to restore or preserve wetlands on their property through the Wetlands Reserve Program; and, DEP funds for the cost of removing fuel tanks under the Abandoned Tank Restoration Program.
- Compensation for damage by wildlife. Offered to owners who agree allow wildlife to roam on their property. For example, the Defenders of the Wildlife compensate farmers for verified livestock losses to wolves.
- Low-interest loans to continue agriculture use of land. Loans for family farms and low-income farmers to continue agricultural use of lands. Also loans to farmers who cannot secure enough funding to acquire agricultural land. The Consolidated Farm Services Agency administers the Federal programs. There are no state programs in Florida.
- Property Tax relief. Tax land at the current use (as farmland), not at the potential value if developed. Under Florida Statute 193.461 provides for a Florida Agricultural Use Assessment for lands in commercial agriculture.

Advantages are that the landowner immediately receives a "return" on the efforts to preserve natural resources. The disadvantage is that the programs are not perpetual.

5. <u>Technical Assistance</u> - Provides state-of-the-art research and other information to improve land management. For example, the American Farmland Trust has an Agricultural Economic Development Program in Palm Beach County to provide assistance in developing new products and job opportunities.
6. <u>American Farmland Trust</u> - The American Farmland Trust (AFT) is a private, nonprofit organization dedicated to conserving agricultural resources. AFT's mission is to stop the loss of productive farmland and promote farming practices that lead to a healthy environment. Its approach is a farmer-friendly mix of public education, on-farm demonstration projects and public policy development at the national, state and local levels. Since its establishment in 1980, AFT's professional staff has provided leadership and technical assistance on many issues related to agricultural resources conservation.

7. Florida Stewardship Foundation - The Florida Stewardship Foundation is working to:

   - Create a forum that will bring private landowners ... who own the vast majority of the state's land area ... are custodians of the largest repository of natural resources ... and hold majority interest in the remaining stock of Florida's future land uses ... together with government and environmental and natural resource conservation interests;
   - Create a statewide coalition of agriculture, forestry, government and conservation interests to pursue a new environmental ethic that will recognize private property rights, be inclusive of all interests and rely on "common sense" solutions and incentives to promote private stewardship of natural resources; and
   - Act as an intermediary and mediator between government agencies, conservation interests and private landowners in negotiating and consummating less-than-fee transactions and economic incentive programs that tie good stewardship decisions to good business decisions, encourage better cooperation between government agencies and private landowners, and promote private stewardship of natural resources.

C. Land Use and Regulatory

1. Conservation Easements - The owner transfers to another party one or several of the group of "rights" that go with land ownership to another. The owner retains the "rights" not transferred. The "rights" granted may be any of those that go with the land. For example, the owner may give up the right to construct a dock on a waterfront lot (one of the rights of riparian access). In some cases, there is a "right" to develop the property. Often this right is defined in local zoning/planning regulations and can be transferred. Organized programs can encourage such transfers as follows:

   - Transferable Development Rights (TDR) Program - The owner of a property may transfer development rights-from an area that the government wants to restrict development to another area. Development rights could be in the form of allowable number of residential units (density per acre). An easement is placed on the property to reflect the reduction in development rights. The owner may sell the development rights to another.
   - Purchasing Development Rights (APR) Program - Where the landowner will continue existing use of the land but

agrees not to change its use by development. An easement is placed on the property to reflect the reduction in development rights.

(i) Can be to maintain undeveloped use. For example, the Green Swamp Land Authority will pay landowners the difference between full market value and undeveloped value.

(ii) Can be to maintain agricultural use (also called Purchase of Agricultural Easements PACE). For example, Palm Beach County is considering starting a program within its Agricultural Reserve.

When donated, the landowner may deduct the value of the easement from taxes, but the IRS will look for assurance -that a conservation contribution will result in a substantial benefit to the public. The advantage is that this is less expensive than outright purchase. The disadvantages are: it is difficult to clearly defining the restrictions imposed by the easement; and, there is no clear method to place a value (purchase price) on the "right" thereby transferred.

2. Zoning - Through land use planning, properties are designated for types of use and density. The zoning plan can be refined in additional ways, as follows.

   - Performance Zoning. This sets up standards for site design rather than providing a detailed map. Some Florida counties have requirements for buffers from roads and criteria for providing a certain percentage of "open area" in the site plan.

   - Special Treatment Overlay. These are special interest restrictions that may cross other land-use boundaries. Some Florida counties have "special treatment" or "conservation" overlays for particular wetlands which impose requirements for additional approvals or constraints on development.

   The advantage is that these constraints are part of the overall comprehensive plan for the community and there is a formal process for public involvement.

3. Critical Areas Criteria - A watershed or similar area is identified and a group meets to develop criteria for development or other actions to support the needs of the area. One type of example is the National Estuary Program. Another is the ongoing EIS on growth in Southwest Florida. The advantage is that a coordinated vision of a region's needs is developed and links are formed for cooperation. The disadvantage is that compliance with the criteria is generally voluntary.

4. Land Management Plans - The landowner develops a plan for their property, with technical assistance from the government agency. Examples are as follows.

   - Habitat Conservation Plan. Landowners modifying habitat of federally listed species prepare a plan with assistance of FWS. An advantage is that the FWS may permit an "incidental take,, if a plan is implemented. Texas Parks and Wildlife Department is proposing a Cooperative Conservation Plan concept where several adjoining landowners would develop a single plan.
   - Whole Farm Plan. Purpose is to be a comprehensive plan covering all natural resources, including soil and water, to protect the landowner from piecemeal regulatory burdens. The FG&FWFC provides assistance in Southwest Florida, called All Farm Plans primarily focused on those with habitat for the Florida panther. The Suwannee River Water Management District intends to provide assistance and coordinate the different plans through a Forestry and Agriculture Resource Management Program.
   - Food Security Act Compliance Plan. Landowners who receive cost-sharing funding through the USDA are required to develop and implement these plans.

   An advantage is that the plan will be the result of a comprehensive look at an agricultural operation, including a balancing of the needs for the operation against natural resources. The disadvantage is that its success is generally based on the level of voluntary -effort by the landowner and the amount of technical assistance that is available from the government agency.

5. Regulatory Reform - These are changes in the process that result in coordinated and quicker regulatory review (and thereby reduce the costs to the landowner in obtaining permits) in exchange for increased protection of natural resources. The advantage is less money is spent in the "process" and so it can be spend directly on the natural resource. The disadvantage is that this requires a high level of cooperation and trust between the landowner and agencies and between agencies.

6. Advanced Identification of Disposal Areas (ADIDs) - Identifies wetlands of higher value that would or would not be suitable for development. Advantage is that it informs the landowner or potential landowner of agency concerns. Disadvantage is that it is focused on wetlands, not the entire ecosystem.

7. Special Area Management Plans (SAMPs) - Identifies areas of importance and develops plans and criteria for review of regulatory permits. Advantage is that it is a mechanism to involve the views of the landowners outside of the tension of a permit review process. Disadvantage is that it is a non-binding document.

8. Florida Statute Chapter 380 - This chapter includes several processes for natural resource planning:

   - Resource Planning and Management Committees. The Governor appoints a group that, in 12 months, will either adopt a proposed voluntary resource planning and management program for a particular area under study or recommend that such a plan not be adopted. The purpose is to organize an effort to resolve existing and prevent future problems, which may endanger resources in the area. One committee was created for the Charlotte Harbor region, which resulted in a Plan adopted by the Governor and Cabinet in 1981. The Kissimmee River had a similar committee established.

   - Areas of Critical State Concern. The State by rule designates a geographic area. The rule includes a detailed boundary of the area, principles guiding development, a statement of purpose for the designation, a checklist of actions which, when implemented, will result in removal of the designation, and a list of issues or programs to assure ongoing implementation. Areas currently designated include the Big Cypress, Green Swamp, Florida Bay, and Apalachicola Bay.

   - Developments of Regional Impact (DRIs). Projects that will have regional impact to resources, natural as well as transportation, utility, and other infrastructure, undergo a comprehensive review process by the Regional Planning Councils.

   - Special Agreements. (Section 380.032(3)). The DCA can enter into agreements with any landowner, developer, or government agency as may be necessary to effect the purposes of Section 380.

   The advantage is that this formal process involving the State. The process is not restricted to a single resource but can look at an area comprehensively. The process also provides for review of issues that extend beyond jurisdictional boundaries. The disadvantage is the perception that this creates yet another level of government review for projects.

9. Local Government Comprehensive Plans - Each local government is required to prepare a plan that addresses use of land and the infrastructure and other needs of the community. The plans are reviewed by DCA for compliance with 9J-5 FAC. The Local Government submits a status report every five years called an Evaluation and Appraisal Report (EAR). The advantage is that this mechanism provides for a comprehensive view of the conflicts between growth and resources and provides for an extensive public participation process. Most Plans discourage development of wetlands by assigning low densities to these lands. Other Plans utilize different methods to control impacts such as:

   - Monroe County has a Rate of Growth Ordinance (ROGO) that assigns a quota of allowable new residential units by geographic area. An application for a building permit is scored based on the natural resources to be impacted, availability of utilities, etc.. The score is used to rank the permit applications, the higher ranking applications will receive a permit until the quota is used up.
   - Monroe County has a County Land Acquisition Authority that: purchases property for which building permits have been denied due to concerns for natural resource; purchases lands that have high potential for development (presence of roads, etc.) but with potential for restoration or protection of natural resources; and, to seek large blocks of funds for purchase of environmentally sensitive tracts of lands.
   - As part of the U.S. 1 widening for the Florida Keys, there is discussion of funding an Environmental Carrying Capacity Study that would look at how much development can be supported without detriment to the natural resources. The ROGO discussed above is currently based only on hurricane evacuation times. This study would identify other limiting factors.

10. Surface Water Improvement and Management (SWIM) - A study of a particular watershed to determine the needs for the preservation and restoration of the receiving waterbody. Advantage is that these are generally very thorough and technically based. The disadvantage is that the emphasis is only on one aspect of the ecosystem.

11. Permit Issuance/Denial - The Corps, DEP, WMDS, and Counties can deny a permit if it is contrary to the public interest or if it does not comply with the 404(b)(1) Guidelines or other criteria. Advantage is that it is a comprehensive look at a project's impact and generally results in a balance between the need of

the development and the natural resource. Disadvantage is that information and commitments outside of the applicant's property and control are not available, except through poorly defined cumulative and secondary impact analysis/restrictions.

D. Financing

1. Mitigation Banking - A geographic area is identified and a restoration and management plan is developed for the natural resources. This is the "bank". Projects that impact natural resources in the region are permitted to give money to the "bank" in lieu of funding restoration work within the project site. The restoration within the "bank" is given some units of measurement (typically, acres). As the restoration takes place, the bank generates "credits". The developer of the project to be permitted purchases these credits in lieu of on-site restoration. The advantage is that restoration takes place in a contiguous area rather than spread over several different properties. Also, since there is a finite amount of money available for restoration, this places that money in the most regionally important locations. The disadvantage is that it is very difficult to calculate the ecological value of the "credits". The Institute for Water Resources, in a report, also notes that an entrepreneur could establish a bank for the purpose of earning a profit from the sale of these "credits", a process they term Private Credit Market. Florida Wetlandsbank, Inc., is doing this in Broward County.

2. Private Initiatives - Private groups solicit funds for land acquisition and restoration projects. Examples are the Trust for Public Lands and the CREW Trust. The advantage is that they tend to increase knowledge of the need through advertising and corporate/community contacts.' They also provide a conduit for corporate and private donations.

3. Tax Funding of Acquisition - Specific tax is imposed dedicated to the purchase of lands. The P2000 program is supported by a document stamp tax. Monroe County currently spends money for natural resource protection from the proceeds of the Tourist Impact Tax (F.S. 125.0108). Other Counties have established programs such as the Lee County Conservation 2020 program. Additionally, other Counties have dedicated tax revenues toward land acquisition such as the Carlton Reserve in Sarasota County and the contribution towards the purchase of the Fairway Woodlands DRI project in Charlotte County.

4. Toll Road - Directing revenues to fund non-transportation restoration efforts. Tolls currently can go to the direct cost of maintaining the roads, compensatory mitigation for direct impacts to

natural resources, and, under the Intermodal Surface Transportation Efficiency Act (ISTEA), can include landscaping and mitigation of such impacts as noise on surrounding neighborhoods. There is a pending bill in Congress to authorize tolls from Alligator Alley to be placed in the Everglades Restoration Fund.

VIII. Existing Acquisition Programs within Southwest Florida

Map 2 is the Regionally Significant Natural Resources Map prepared for the Strategic Regional Policy Plan for the Southwest Florida Region. It locates the various lands identified in this section.

A. Federal Programs

1. *National Parks.* Yellowstone, which was created in 1872 in the administration of President Grant, was the first national park in the US (and in the world). The National Park Service Act (1916) created the world's first National Park system. Florida has three National Parks: Biscayne, Everglades and Dry Tortugas.
2. *National Wildlife Refuges*. The first national wildlife refuge was at Pelican Island in the Indian River on the Florida Atlantic Coast. President Theodore Roosevelt, visiting the site in 1903, was impressed by the abundance of brown pelicans. Upon learning that the island was Federal government property, he declared it a wildlife refuge by executive order. There are five National Wildlife Refuges in Southwest Florida. The J. N. "Ding" Darling NWR on Sanibel Island (6,000 acres), created in 1954 and named after a crusading newspaper cartoonist from Iowa who agitated for the protection of wildlife, is one of the most-visited of the national refuges, drawing approximately 250,000 visitors every year to see wildlife in a well-protected, but highly visible, setting. The Matlacha Pass (500 acres), Pine Island (500 acres) and Caloosahatchee (one small island) NWRs in Lee County and the Island Bay (23 acres) Charlotte County—are managed by the Ding Darling staff. The 24,000-acre Florida Panther NWR in Collier County, which is a component of the Big Cypress, and the 19,000-acre Ten Thousand Islands NWR, also in Collier, have their own management
3. *Pittman-Robertson Act.* The Federal Aid in Wildlife Restoration Act of 1937, better known as the Pittman-Robertson Act, has forged a long-lasting partnership between the Federal government and the states to protect wildlife resources. The Federal government reimburses up to 75 percent of the costs associated with a wildlife restoration project, drawing its revenues from an

11 percent excise on the sale of sporting arms. In the first 53 years of the program's existence, Pittman-Robertson funds purchased more than 5 million acres of land nationwide. The Babcock-Webb Wildlife Management Area in Charlotte County is a Pittman-Robertson project.

4. *Dingell-Johnson Act*. Adopted in 1950, this act of Congress imposed an excise on fishing equipment and motorboat fuels to support the restoration of sport fish habitat.

5. *Land and Water Conservation Fund.* This Great Society program, promoting open space and parkland development, was adopted in 1965. LWCF matches Federal dollars with local funds to build and enhance parks and natural areas. Several parks in Southwest Florida have been developed with LWCF assistance. One example is John Pennington Park, a patch of riverfront open space in Charlotte County.

6. *Everglades National Park*. Authorized by Congress in 1934, and dedicated by President Truman, who motored from Key West to Everglades City in 1947, this park has grown to more than 1,500,000 acres, drawing approximately 1,000,000 visitors annually. This was the first national park, which was not carved from existing Federal lands. Since that time, a few other parks have been acquired from private purchases (e.g. Great Smoky Mountains, Shenandoah) or from state donations (Big Bend NP in Texas), but most of the national parks were Federal public land to begin with.

7. *Big Cypress National Preserve*. This 728,000-acre preserve is by far the largest public holding of land in Southwest Florida. It protects vast tracts of wetlands, including cypress strands and domes, and provides free-range habitat for the critically endangered Florida Panther. State and national attention was first focused on the Big Cypress in the late 1960s when the Miami-Dade Jetport was almost built on a 38-square mile tract of the Big Cypress in Eastern Collier. (The Nixon administration scrapped Federal government support for the project in 1970, but not until one complete runway was finished.) The Big Cypress National Preserve is not a national park like the Everglades—it is managed for multiple uses, including hunting and the extraction of oil and gas. In the quarter-century since the original purchases were made other Federal and state programs have taken place and are underway within the basin, including the Fakahatchee Strand, South Golden Gate, the Okaloacoochee Strand and the adjacent National Refuges mentioned above.

B. State Programs

1. *Five percent excise on bathing suits*. Adopted in 1964, this was Florida's first program, which linked land acquisition with a revenue source.
2. *Environmentally Endangered Lands (EEL).* A $240 million program which was approved by Florida voters in a 1972 referendum. $200 million were dedicated to environmental lands and $40 million to recreational lands. Among the first EEL acquisitions were Cayo Costa Island in Lee County and the Charlotte Harbor State Preserve in Charlotte and Lee Counties. The principal revenue source was a tax on phosphate extractions. In the late 1970s, following a minor scandal concerning appraisal practices, the Florida Legislature replaced EEL with a new program.
3. *Conservation & Recreation Lands.* Established in 1979 as the successor to the EEL program, CARL—with its notoriously rigorous standards of property appraisal and valuation—has become the workhorse of state-funded environmental land acquisition programs in Florida. Since 1990, it has also been the centerpiece of Preservation 2000. These tend to be large-tract, high dollar purchases, and they are frequently linked to other acquisition projects. So far, CARL and EEL combined have acquired more than one million acres of land statewide at a staggering $1.5 *billion* dollars. No other state program in recent decades has rivaled the effectiveness of this program.
4. *Save Our Rivers, Save Our Coasts, and Save Our Everglades.* These three programs, with total authorized funding of $800 million, were created in 1982 and 1983 during the administration of Governor Graham. Save Our Coasts has been used to improve beach access in Southwest Florida; Save Our Everglades has been a major source of funding for the acquisition of South Golden Gate; Save Our Rivers funds have been used to acquire several tracts in the Region.
5. *Preservation 2000.* Created in 1990 by a Democratic legislature and signed by Bob Martinez on May 28, 1991, this umbrella program combined CARL with the three "Save Our" programs and the newly created Florida Communities Trust to form a ten year, $3 *billion* package of land acquisition. The funding source is a documentary stamp tax on the sale and transfer of land. After eight years of operation, P-2000 is nearing the end of its cycle. Funds are allocated to various land acquisitions programs as follows:

Program	Percent
Conservation and Recreation Lands Program	50.0%
Water Management Lands Program (Save Our Rivers, Surface Water Improvement and Management)	30.0%
Florida Communities Trust Program	10.0%
Division of Recreation and Parks for inholdings and additions	2.9%
Game and Freshwater Fish Commission for inholdings and additions	2.9%
Division of Forestry for inholdings and additions	2.9%
Department of Environmental Protection for recreational trails programs	1.3%

Note: Amounts may change for legislative set-asides for other purposes.

6. *Florida Communities Trust.* This program was created in 1990 as a part of the P-2000 package. FCT is similar to CARL, but it encourages the use of local matching funds, and has something of a recreational orientation. Its methods of land appraisal and valuation are not as exacting as those of CARL.

C. State Acquisitions in Southwest Florida

1. *Cayo Costa/North Captiva (Lee).* Cayo Costa and North Captiva are among the largest of the barrier islands, which form the outer limits of Charlotte Harbor. This was one of EEL's first acquisitions in the early 1970s, and it has been on the CARL list since 1980. So far, the State of Florida has acquired 1,692 acres of land at a cost of $20,400,000. An additional 240 acres, with an estimated tax valuation of $3,800,000 remain. Cayo Costa is now a state park, albeit one which is accessible only by private boat and offers few amenities. The few who do visit are treated to a view of the barrier island beaches as they existed years ago.
2. *Charlotte Harbor (Lee/Charlotte).* This is another EEL project. The first round of acquisition took place in 1977 and 1978 when General Development Corporation sold 16,000 acres of wetlands to the state for $5.1 million. Charlotte Harbor has been on the CARL list since 1986. This project consists of several large

tracts of wetlands which were once scheduled for development by General Development Corporation (south of present-day Port Charlotte); Punta Gorda Isles (south of the city of Punta Gorda); and Rotonda Corporation (on the Cape Haze peninsula). It includes the 900-acre parcel on which the popular Charlotte Harbor Environmental Center (CHEC) is located.

3. *Fakahatchee Strand aka Remuda Ranch (Collier).* Remuda Ranch was the brainchild of Milt Mendelsohn, protégé of the Rosen Brothers, developers of Cape Coral. In February 1966, the Rosens purchased 68,267 acres of land. Installment buyers in turn bought lots (typically 1.25 acres at $1,250 each) for which they received membership in a resort club which offered outdoor recreation—camping, hunting, skeet shooting, tennis and the like. Lot buyers were not promised (in writing, at least) the right to build a single family dwelling unit or anything else, which is fortunate considering that most of the site was underwater most of the year. The Fakahatchee is, in the words of the Florida Department of Environmental Protection (DEP), "probably the best example of strand swamp found in the United States." It is a vital hydrologic link between the Everglades system and the Ten Thousand Islands which contains, among other features, the largest assortment of native orchids in North America. In 1972, faced with pressure from the Federal Trade Commission, GAC—the Rosens' successor—halted sales at Remuda Ranch. Since then, approximately 66,000 acres have been acquired through EEL and CARL funds or through litigation. The purchase area includes some parcels, which were not included in the Remuda Ranch project. An additional 8,500 acres remain to be acquired one lot at a time. The Fakahatchee is a state preserve, and does not allow some of the uses that are permitted in the Federal Big Cypress, including hunting and off-road vehicles.

4. *South Golden Gate aka Picayune State Forest (Collier).* The Rosen Brothers billed this project, which is located generally west of Remuda Ranch, as "the world's largest subdivision." The Rosens purchased 112,000 acres (or 175 square miles, larger than the combined area of the cities of Pittsburgh, Washington, and Minneapolis), which they subdivided into a host of large lots—five acres was typical. In a scheme, which ran contrary to all of the standard assumptions of good planning, purchasers were encouraged to become small-time developers by subdividing their lots and selling them to other buyers. This low-lying link between the Fakahatchee and the Ten Thousands is now the subject of vigorous acquisition efforts, jointly funded by the State and Federal governments. In June 1997, Vice President Al Gore, in a visit to Everglades National Park, announced

that the Federal government would provide a $25 million match to the $25 million already committed by the Save Our Everglades to purchase 31,000 acres, divided into 12,000 lots.

5. *Charlotte Flatwoods (Charlotte/Lee).* The CARL list refers to this 18,700-acre site as the Charlotte *Harbor* Flatwoods; it is also called the "Yucca Pens," harking back to its past use as cattle range. This project, which began as a joint initiative of the Charlotte County Planning Department, the Florida Game and Freshwater Fish Commission, and the (now defunct) Lee County Department of Environmental Sciences, has been on the CARL list since 1992. Slash pine dominate the site which links the Webb-Babcock area with the coastal wetlands, including the southern tip of the Charlotte Harbor Buffer Preserve. It contains habitat for Florida panther, black bear, red-cockaded woodpecker, and the beautiful pawpaw, an endangered plant. When completed, this acquisition will provide corridors for wildlife, and will form a "sprawl stopper" on the Gulf Coast, assuring an open space break between Fort Myers/Cape Coral to the south and Punta Gorda/Port Charlotte to the north. So far, more than 4,000 acres have been acquired at a cost of $10,265,940.

6. *Estero Bay Aquatic Preserve and Buffer Reserve (Lee).* Millions of tourists have seen Estero Bay, even if they see it only from the bridge as they travel to and from Estero Island (Fort Myers Beach). One of Florida's most productive estuaries, this project has been on the CARL list since 1985. The Nature Conservancy donated the first component, a 316-acre parcel, in 1986. Since then, nearly 6,500 acres have been acquired at a cost of $7,700,000. More than 9,000 acres remain to be purchased. The Estero Bay Aquatic Preserve is about 10,000 acres and the Buffer Reserve is about 6,500 acres.

7. *Oscar Scherer Addition (Sarasota).* Another CARL acquisition, this 922-acre addition to Oscar Scherer State Recreation Area was purchased in 1991 at a cost of $11,800,000. The well-drained site includes about 400 acres of scrub land, which is prime habitat for the threatened Florida and commensal species. A five-mile nature trail gives the public an opportunity to experience the gregarious jays.

8. *Pineland Site (Lee).* Sixteen miles from its northernmost to southernmost point, Pine Island is the largest island along the Gulf Coast. Centuries ago, Pineland was the center of the thriving Calusa culture. The Pineland site, which is adjacent to a portion of the Charlotte Harbor Aquatic Preserve, contains midden mounds, a burial mound, and an ancient man-made canal, all of which are the objects of intensive archaeological study by

the Florida Museum of Natural History, under the direction of Professor William Marquardt. This is a 250-acre project. A 56-acre parcel, the "Randall tract", has already been donated to the University of Florida Foundation, which pledges that all proceeds of the sale of the property will be given to the Randall Research Endowment Fund for the management of the tract. The Pineland Site Complex has been on the CARL list since 1996. So far, only one purchase (of less than one acre) has taken place.

9. *Myakka Estuary (Sarasota and Charlotte).* This project has been on the CARL list since 1994. In 1995, the Southwest Florida Water Management District acquired more than 9,000 acres in the southwestern portion of the city of North Port, at a cost of $6,700,000 from Atlantic Gulf Corporation (AGC), the successor of the bankrupt General Development Corporation, which originally subdivided and marketed North Port. More than 4,500 acres remain to be acquired.

10. *Okaloacoochee Slough (Hendry/Collier).* The 29,000-acre Okaloacoochee Slough is the major headwater to the Fakahatchee and to the Big Cypress. This largely undisturbed tract contains more than 11,000 acres of mostly undisturbed wetlands. The Save Our Everglades program was the principal funding source for this acquisition.

11. *Rookery Bay National Estuarine Research Reserve (Collier).* This project includes Cannon, Johnson, and Keewaydin Islands. A CARL project since 1980, the State of Florida has so far acquired more than 10,000 acres at a price in excess of $33,000,000. It is now on the CARL "substantially complete" list. According to Judy Haner of the Florida Department of Environmental Protection, Rookery Bay has had the status of a national estuarine research reserve—one of 22 nationwide—since 1978. The site was established as a partnership between the Audubon Society and the Conservancy of Collier County, as it was then known. This partnership was responsible for the purchase of the first 6,000 acres. The Florida Department of Environmental Protection and jointly administers Rookery Bay with the National Oceanographic and Atmospheric Administration (NOAA).

12. *Belle Meade* (Collier). This 19,000-acre project was third on the 1997 CARL list. Lying to the west of South Golden Gate Estates, and north of Collier-Seminole State Park, Belle Meade is the primary watershed for Henderson Creek, the main tributary to Rookery Bay *(q.v).* The properties within the acquisition zone are typically small lots (most are 40 acres or less) in the possession of approximately 800 landowners. The land is

zoned for agricultural use, and there is a scattering of single family residences, plant nurseries, and groves. Although the acquisition area has experienced some encroachment from exotic plant species, especially melaleuca, there are few roads and other drainage alterations, in stark contrast to South Golden Gate Estates. Acquisition has moved quickly—more than 9,000 acres have been purchased under the CARL program at a cost in excess of $12,000,000. In December, the Governor and Cabinet are expected to authorize the purchase of an additional 2,670 acres.

13. *FDEP Recreation and Parks* District 4 Florida Park Service ranges from Citrus County down to Collier County. This district has 30 units under their purview, the one of the largest being the Fakahatchee Strand.

D. Local Initiatives

1. *Lee County.* A 2000-acre strand swamp, which parallels the course of the Caloosahatchee River, the Six Mile Cypress Slough is really 9.2 miles in length. Acquisition was very much a grass-roots effort. In the mid-1970s, after the Slough failed to make the EEL list, the cause of the Six Mile Cypress was enthusiastically adopted by students in the Lee County Environmental Education program, under the direction of educator William Hammond. After a spirited campaign, voters approved a .2-mil, two-year tax for acquisition of the tract in November 1976. The acquisition effort moved slowly until the early 1980s, when $2 million of Save Our Rivers funds, administered by the South Florida Water Management District, were added. The acquisition area has since been expanded to 2,200 acres. One popular feature of the Slough is the mile-long boardwalk, which is used by about 20,000 visitors annually. The Conservation 2020 Program adopted by voters in 1996, this initiative could generate as much as $77 million over a five-year period. Many of the lands being considered are already on the CARL lists.

2. *Charlotte County.* Charlotte County has acquired a former DRI known as Fairway Woodlands of about 468 acres adjacent to the Charlotte Harbor Flatwoods CARL project, Cedar Point, an 88 acre peninsula next to Lemon Bay used for passive recreation and outdoor education and contains 4 eagles nests and Tippicanoe Scrub and Amberjack Slough. The County does have some conservation easements near Boca Grande and have given easements to the FGFWFC near the East Water Treatment plant. These tracts were identified by the Charlotte County advisory

group known as the Environmental Lands Acquisition Advisory Council.

3. *CREW (Lee/Collier).* Created in 1989, the Corkscrew Regional Ecosystem Watershed is a 60,000-acre project surrounding the Corkscrew Sanctuary. In the mid-1980s, after several years of low rainfall, Lee County was motivated to apply for funds from the Save Our Rivers program administered by the South Florida Water Management District (SFWMD) to acquire the 15,000-acre Flint Pen Strand. The Corkscrew Sanctuary filed a separate application for lands within Collier County. SFWMD, hoping to acquire watershed lands in both counties as a unified project, created the CREW Trust, composed of representatives of several public and private agencies, to coordinate land acquisition, management, and public use. According to CREW's Ellen Lindblad, approximately 21,000 acres have already been purchased from four major funding sources—SFWMD (which will be the ultimate manager of the project), Lee County, the Big Cypress National Preserve, and CARL. The Florida Game and Freshwater Fish Commission is now preparing a management plan for the area. Hunting *may* be permitted in the future, but four-wheeling will probably continue to be prohibited. A five-mile hiking trail was completed in 1994.

4. *Sarasota County.* Starting in 1993, a citizens advisory group, known as the Environmentally Sensitive Lands Advisory Committee, began a mapping process to identify environmentally sensitive lands that should remain undeveloped. This program prohibits property taking and directed that all dealing with landowners would be on a voluntary basis. The mapping process has been completed. On March 9, 1999 voters of Sarasota County will vote on a referendum to increase ad valorem property tax by not more than .25 mill for 20 years.

E. Private Initiatives

1. *Conservancy of Southwest Florida (Collier-based).* Founded in 1964 to spearhead the acquisition of lands in Rookery Bay, this 5,300-plus member not-for-profit organization has been helping with the acquisition of South Golden Gate since 1991. Among other projects, the Conservancy has assisted the State at Collier County tax deed sales since 1994. Education is a major emphasis of the Conservancy, which maintains two nature centers—in Naples and at the Rookery Bay National Estuarine Research Reserve.

2. *Calusa Nature Center and Planetarium (Lee).* The Nature Center started in 1965 as a Junior League Project and was opened to

the public in 1977. The city of Fort Myers owns the property, which receives between 80,000 and 100,000 visitors annually.

3. *Corkscrew Sanctuary/National Audubon Society (Collier).* The newly formed National Audubon Society hired Guy Bradley, a Floridian, as a wildlife ranger to protect birds from plume hunters. When he was murdered in 1905, wildlife protection suddenly became a national *cause celebre.* The Audubon Society has maintained a warden station at the site since 1913. In 1954, Audubon acquired the first part of its 10,000-acre sanctuary. Corkscrew draws approximately 100,000 visitors annually, many of whom pause to photograph the extraordinary wildlife which can be found along the boardwalk which cuts through the cypress swamp, a very visible habitat for alligators, wood stork, river otter, and a host of other species. Well-staffed and immaculately maintained, Corkscrew demonstrates that private, not-for-profit management of natural resources can be just as effective as management by a public agency.

4. *Sanibel-Captiva Conservation Foundation (Lee).* Created in 1967, the Foundation has grown to more than 2,500 members, according to Kevin Lollar of the Fort Myers *News-Press.* The Foundation has acquired 1,178 acres at a cost of $2.55 million, and has received 563 acres of donated land. The Nature Center, which includes a four mile nature trail, a native plant nursery, and a butterfly house, draws approximately 15,000 visitors annually.

5. *Calusa Land Trust.* Trust began in about 1976 to buy sensitive lands around the Pine Island area and currently have almost 600 members and own approximately 1,100 acres. Their holdings are in a GIS system. Lands have been donated or purchased fee simple. Currently we are working with FDEP and the Pine Island Water Association to provide management of lands. Volunteers do much of the work.

Others to be contacted:

GICIA	Misty Nabors
The Nature Conservancy	Bob Burns
Trust for Public Lands	Dale Allen
SW Fla Land Preservation Trust	Cher Compton
Myakka River Conservancy	Julie Morris
Buckingham Conservancy	Dick Workman
Lemon Bay Conservancy	Sydney Crampton
North Captiva Group	Gary Walker

IX. Strategic Regional Land Acquisition Contacts

Federal Agencies

USF&WS	Lou Hinds Andy Eller Kim Dryden
USACOE	Chip Clough, or Bob Barron

State Agencies

FDEP	Heather Stafford Bob Reppening Gary Lytton Ken Alverez
FGFWFC	Jim Beever

Regional Agencies

SFWMD	Chip Merriam, or Jacque Rippe
SWFWMD	Steve Minnis
CREW	Ellen Lindblad
East County Water Control Dist.	Peg Weatherford

Local Governments

Charlotte County	Bill Byle
Lee Co./ CLASSAC	John Cassani Lynda Riley John Wilson
City of Ft. Myers	John Kremski, or Bill Mankin
City of Cape Coral	Rick Sosnowski

City of Sanibel	Rob Loflin
Town of Fort Myers Beach	John Gucciardo
Collier County	Vince Cautero
City of Naples	Jon Staiger
Sarasota County	Gary Comp
Hendry County	Jim LaRue
Glades County	Jim Threewits

Organizations

Audubon	Ed Carlson
Calusa Land Trust	Peter Ordway
Sanibel-Captiva Cons. Found.	Eric Lindblad
Conservancy of SW Fla.	Mike Simonik
GICIA	Misty Nabors
The Nature Conservancy	Bob Burns
Trust for Public Lands	Dale Allen
SW Fla Land Preservation Trust	Cher Compton
Myakka River Conservancy	Julie Morris
National Wildlife Federation	Kris Thoemke
Buckingham Conservancy	Dick Workman
Lemon Bay Conservancy	Sydney Crampton
North Captiva Group	Gary Walker

X. References

Working Group of the Task Force for South Florida Ecosystem Restoration, Draft Report, Appendix L, Land Based Protection Strategy.

American Farmland Trust third draft of "Protecting Natural Resources and Florida Panther Habitat on-Private Lands".

National Institute for Urban Wildlife report "Wildlife Reserves and Corridors in the Urban Environment"

"Florida Statewide Land Acquisition Plan" (FSLAP), as approved by the Governor and Cabinet on July 1, 1986, and amended on June 28, 1991.

Bob Barron, U.S. Army Corps of Engineers, (904) 232-2203.

"Alternative Methods of Land Acquisition", Southwest Florida Water Management District, Less than Fee Acquisition Team

Appendix F
DEMAND ESTIMATES AND PROJECTIONS

In the Lower West Coast (LWC) Water Supply Plan, demand assessments for 1995 and projections for 2020 were made for the following water use categories:

- Public water supply
- Domestic self-supply (including small public supply systems)
- Commercial and industrial self-supply
- Recreational self-supply
- Thermoelectric power generation self-supply
- Agricultural self-supply

The first five categories are urban water uses and are discussed in the Urban Demand section of this appendix. The Agricultural Demand section contains the discussion of the agricultural self-supply water use category.

Water demand projections for the year 2020 included analyses under both 1-in-2 (average) rainfall conditions and 1-in-10 drought year conditions. Rainfall analysis is presented in Appendix B. Projections are based on current trends and circumstances and therefore imply an extension of current production, market, and legal circumstances.

The LWC Planning Area contains part or all of six counties. All of Lee County is within the LWC Planning Area boundaries, but only a portion of Collier, Hendry, Glades, Charlotte, and Monroe counties are within the boundaries. The portion of Collier County not within the LWC Planning Area is part of the Big Cypress National Preserve, and has no urban or agricultural water demand. All of the land in the LWC Planning Area portion of Monroe County is within the boundaries of either Big Cypress Basin National Preserve or Everglades National Park, and has no significant urban or agricultural demand. Much of the data used to estimate water demands is available only at the county level. For Hendry, Glades, and Charlotte counties, this data was adjusted so that the demands reported within this document are for the LWC Planning Area only. To distinguish between county level data and adjusted data, the portions of these counties within the LWC Planning Area will be referred to as the Hendry Area, the Glades Area, and the Charlotte Area.

URBAN DEMAND

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) as well as residents that supply their own water needs. Self-supplied residents may be either within utility boundaries or outside of utility boundaries (rural self-supplied).

The utility service areas used in this analysis were derived from the service areas detailed within District water use permits and utility plans. It was assumed that all projected population growth within areas being serviced by a utility would be connected to the PWS system. Current DSS demand within utility service areas was assumed to remain constant. The breakdown of populations within utility service areas into PWS supplied and DSS categories were modified in several instances based on utility input.

Population

The 1995 population within the LWC Planning Area is 590,939 and is projected to increase 68 percent to 992,805 in 2020 (U.S. Bureau of the Census, 1995; Bureau of Economic Business Research (BEBR), 1998).

1995 Population Assessments

U.S. Census data for 1995 were used as the basis for the 1995 permanent population and the distribution of that population. Block group level information from the 1995 estimated 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. The total units connected to a PWS system and total units self-supplied were obtained from the census data (U.S. Bureau of the Census, 1995).

Estimates of occupied units connected to PWS systems and occupied units that are self-supplied were calculated for each block group. It was assumed that the percentages of units occupied and the number of occupants per unit were the same for both PWS connected and DSS units. PWS and DSS block group populations were calculated by multiplying the number of occupied units by the number of persons per occupied unit for the respective block group (**Equation F-1**).

$$\textit{Block group population} = \textit{Occupied units} \times \textit{Persons per occupied unit} \qquad \textit{(F-1)}$$

The geographic areas represented by the census block groups and the utility service areas were input as polygon coverages into the District's Geographic Information System (GIS). Population density for those areas served by a PWS and those self-supplied were calculated for each block group generally assuming a uniform density within each. Satellite imagery was used to review decisions if necessary. The two coverages, census block group populations and utility service areas, were overlaid to create a polygon coverage with the attribute data from both coverages. PWS and DSS population assessments were then calculated for the new polygon coverage by multiplying the polygon area by the population density (**Equation F-2**). The permanent populations for each area were then totaled.

$$\textit{Permanent population for area} = \textit{Polygon area} \times \textit{Population density} \qquad \textit{(F-2)}$$

Any growth in population within a utility service area was assigned to that utility and the DSS population was assumed to remain the same. 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 Business Research (BEBR) (1998), were used as the basis for population projections for 2020. In Lee and Collier County, the geographic distribution of the 2020 population was determined using traffic analysis zones (TAZs). TAZs were not available for the Hendry, Glades, or Charlotte areas, so the geographic distribution of the 2020 population was based on the population distribution in the 1995 estimated census block data or was determined from information in the counties' comprehensive plans. Population density was calculated assuming a uniform density within each zone.

The geographic areas represented by the TAZs, cities, and the utility service areas were input as polygon coverages into the District's GIS. The coverages were overlaid to create a new polygon coverage with the attribute data from the original coverage. Population estimates were then recalculated for the new polygon coverage by multiplying the area of the polygon by the population density (**Equation F-2**). The populations for each 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 PWS utilities:

$$\textit{Per capita water use rates} = \textit{Raw water pumped}/\textit{Population served} \qquad \textit{(F-3)}$$

Population served by the utilities were determined using the population assessment methodology described above and refers to permanent resident population. The USGS and District pumpage reports provided raw water withdrawal data. This includes use by seasonal residents and tourists, commercial and industrial utility supply used, and the loses 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.

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.

Per capita rates for 1995 were used to develop the base 2020 utility demand projections. Adjustments that were made to these projections to normalize them for 1-in-2 (average) and 1-in-10 drought year rainfall conditions are described below.

Demand Projection Calculations

Water demand projections for the year 2020 included analyses under 1-in-2 (average) rainfall conditions and under 1-in-10 drought year conditions. A 1-in-2 rainfall year is defined as rainfall with a 50 percent probability of being exceeded over a twelve-month period. A 1-in-10 drought year condition is defined as below normal rainfall with a 90 percent probability of being exceeded over a 12-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 goals associated with identifying demands shall be based upon meeting demands during a 1-in-10 drought year event.

Drought conditions increase outdoor water use, mainly for irrigation, requiring adjustments to be applied to the water demand. The projections described in this appendix include the complete satisfaction of irrigation requirements. Irrigation requirements are equal to the difference between evapotranspiration and effective rainfall (**Equation F-4**):

$$\textit{Irrigation requirements} = \textit{Effective rainfall} - \textit{Evapotranspiration} \qquad \textit{(F-4)}$$

Effective rainfall is the rainfall that is stored in the plant root zone. Appendix B contains a discussion on the derivation of the 1-in-2 and 1-in-10 drought year rainfall values.

Changing rainfall levels and timing affect irrigation requirements, but agricultural and 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, same 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.

Unadjusted Base Demand

Unadjusted base demand is calculated by multiplying population by per capita water use rate:

$$\textit{Unadjusted base demand} = \textit{Projected population} \times \textit{Base year per capita rate} \qquad \textit{(F-5)}$$

The difference between the monthly demand for the base year and the unconstrained demand for a 1-in-2 (average) or a 1-in-10 year will directly depend on the changes in the outdoor use, specifically, changes in irrigation. If the base year is a 1-in-2 year, then there is no need to adjust the base year to a 1-in-2 year. However, if the base year is significantly wetter or drier than average, then unconstrained demands for outdoor use will need to be adjusted proportionally.

Indoor water use does not increase during a drought and, therefore, does not need to be adjusted. Therefore, the adjustments are applied to that portion of PWS and DSS demand that is used outdoors.

1-in-2 Year Adjustments

In order to calculate 1-in-2 (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 their utilities' total demand that is used outdoors during a 1-in-2 year. In cases where utilities did not respond, the District 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.

For any given utility, PWS demand for a 1-in-2 year is determined using the percent outdoor use and irrigation requirements for sod for both a base year and a 1-in-2 year. The irrigation requirements are calculated using the District's Modified Blaney-Criddle irrigation requirement model. Below is an example of the calculation of a 1-in-2 demand for a utility.

Marco Island in Collier County has an assessed outdoor usage of 65 percent of total demand. The irrigation requirements for sod for 1995 and a 1-in-2 year are presented in **Table F-1** as millions of gallons per year (MGY). Rainfall and evapotranspiration data from the Naples rainfall station and a crop type of sod (100 acres) were used.

Table F-1. PWS 1-in-2 Year Adjustment Example (Marco Island).

1-in-2 irrigation requirement	134.1 MGY
1995 (base year) irrigation requirement	108.0 MGY
1-in-2 factor	1.242
Percent outdoor use	65%
PWS 1-in-2 adjustment	1.16

The PWS adjustment for a 1-in-2 year is determined using **Equations F-6** and **F-7**:

1-in-2 factor = 1-in-2 year irrigation requirement / Base year (1995) irrigation requirement *(F-6)*

1-in-2 adjustment = [(1-in-2 factor - 1) x *percent outdoor use]*

The 1-in-2 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 1-in-2 year demands for DSS. 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 also made for each county's rural self-supplied residents.

1-in-10 Drought Year Adjustments

For any given utility, PWS demand for a 1-in-10 drought year is determined using percent outdoor use, the 1-in-2 irrigation requirements for sod, and a 1-in-10 drought year irrigation requirement calculated using the District's Modified Blaney-Criddle model. The same percent outdoor use is used in both the 1-in-2 and 1-in-10 calculations. Below is an example of the calculation of a 1-in-10 drought year demand for a utility.

Continuing to use Marco Island as an example, this utility has an assessed outdoor usage of 65 percent of total demand. Irrigation requirements for 100 acres of sod for both a 1-in-2 year and a 1-in-10 drought year are presented in **Table F-2**. The same rainfall station, Naples, was used as in the 1-in-2 calculations above.

Table F-2. PWS 1-in-10 Drought Year Adjustment Example (Marco Island).

1-in-10 irrigation requirement	152.4 MGY
1-in-2 irrigation requirement	134.1 MGY
1-in-10 factor	1.136
Percent outdoor use	65%
PWS 1-in-10 adjustment	1.09

The PWS adjustment for a 1-in-10 drought year is determined using **Equations F-7** and **F-8**:

$$\textit{1-in-10 factor} = \textit{1-in-10 irrigation requirement/1-in-2 irrigation requirement} \quad \text{(F-7)}$$

$$\textit{1-in-10 adjustment} = [(\textit{1-in-10 factor} - 1) \times \textit{percent outdoor use}] + 1 \quad \text{(F-8)}$$

Annual demands in a 1-in-10 drought year would be 9 percent higher than projections made for an average (1-in-2) year for the Marco Island PWS utility. No adjustments were made to 1-in-10 demands in consideration of conservation efforts to save water by users.

A similar methodology was then used to assess the 1-in-10 year demands for the DSS 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 also made for each county's rural self-supplied residents.

Summary

Table F-4 summarizes the adjustment data for each utility and rural self-supply within the LWC Planning Area. **Table F-3** describes columns “a” through “o” in **Table F-4**.

The District recognizes the PWS utilities responsibilities to withdraw greater than average day demands to provide specific needs to the public for health, safety, and welfare purposes. The average day demands are utilized for determining likely effects to the resource over the planning period.

PWS demands listed in **Table F-4** are in terms of an average annual daily demand for document purposes. It is recognized that demands vary from month to month and this temporal variation is reflected in monthly demand figures used in the analysis. This information is not related in anyway to allocatable withdraws through the CUP process.

Table F-3. Column Legend for Public Water Supplied and Domestic Self-Supplied Demand Adjustments Table (**Table F-4**).

Columns	**Heading**	Description
a	#	Index numbers that match up with the maps in Appendix D showing utility withdrawal facility locations (**Figures D-1**, **D-2**, and **D-3**).
b	Utility	Name of the public water supply utility for which 1995 assessments and 2020 projections are made.
c	Total population	Population that resides within the utility's active service boundaries.
d	PWS population	Population served by the PWS utility.
e	PWS base (MGD)	For 1995, base year demands are the pumpage reported by the USGS and/or District pumpage records. For 2020, projected demands are based on the projected population served (column d) multiplied by the gallons per capita day (GPCD) observed in 1995 (column f) e = d x f
f	GPCD (gallons per capita day)	Per capita rate (GPCD) is calculated by dividing pumpage reported by the USGS and/or District pumpage records (column e) by population served by the PWS utility (column d). f = e/d
g	Percent outdoor use	Estimated average percentage of total utility withdrawal that is used outdoors, primarily for landscape irrigation.
h	1-in-2 factor	1-in-2 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 1-in-2 (MGD)	PWS base year demands (column e) multiplied by the impact of the percent outdoor use (column g) expressed as a decimal on the 1-in-2 factor (column h). i = e x (((h-1) x g) + 1)
j	1-in-10 factor	1-in-10 drought year irrigation requirements of 100 acres of sod divided by the 1-in-2 year irrigation requirements for that same area/ crop as calculated by the District's modified Blaney-Criddle evapotranspiration model.
k	PWS 1-in-10 (MGD)	PWS 1-in-2 year demands (column i) multiplied by the impact of the percent outdoor use (column g) expressed as a decimal on the 1-in-10 factor (column j). k = i x (((j-1) x g) +1)
l	DSS population	Population not served by each PWS utility that resides within each utility's active service boundaries.
m	DSS base (MGD)	DSS population (column l) multiplied by the per capita rate (GPCD) observed in 1995 (column f). m = l x f
n	DSS 1-in-2 (MGD)	DSS base year demands (column m) multiplied by the impact of the percent outdoor use (column g) expressed as a decimal of the 1-in-2 factor (column h). n = m x (((h-1) x g) + 1)
o	DSS 1-in-10 (MGD)	DSS average MGD (column n) for each utility for 1995 and 2020 multiplied by the impact of the percent outdoor use (column g) expressed as a decimal and the 1-in-10 factor (column j). o = n x (((j-1) x g) + 1)

Table F-4. Public Water Supply and Domestic Self-Supply Demand Projections.[a]

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
	Utility	**Total Pop.**	**PWS Pop.**	**PWS Base (MGD)**	**GPCD**	**Percent Outdoor Use**	**1-in-2 Factor**	**PWS 1-in-2 (MGD)**	**1-in-10 Factor**	**PWS 1-in-10 (MGD)**	**DSS Pop.**	**DSS Base (MGD)**	**DSS 1-in-2 (MGD)**	**DSS 1-in-10 (MGD)**
Collier County														
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	Government Utility Authority	15,188	8,698	1.09	125	50%	1.242	1.22	1.136	1.31	6,490	0.81	0.91	2.97
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	Marco Island	10,603	10,529	5.5	522	65%	1.242	6.36	1.136	6.93	74	0.04	0.04	0.05
	Rural Self-Supplied	10,106			246	35%	1.242		1.136		10,106	2.49	2.70	2.82
1995 Totals		182,933	158,708	39.04				44.42		47.89	24,225	4.89	5.40	5.72
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	Government Utility Authority	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	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
2020 Totals		349,200	322,919	72.44				82.00		88.13	26,281	5.40	5.95	6.29
Lee County														
1995														
1	Lee County Olga	62,143	47,576	3.09	65	35%	1.187	3.29	1.179	3.5	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	6.4	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	Lee County 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	2.8	458	50%	1.187	3.06	1.179	3.34	2	0.00	0.00	0.00

Table F-4. (Continued) Public Water Supply and Domestic Self-Supply Demand Projections.[a]

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
	Utility	Total Pop.	PWS Pop.	PWS Base (MGD)	GPCD	Percent Outdoor Use	1-in-2 Factor	PWS 1-in-2 (MGD)	1-in-10 Factor	PWS 1-in-10 (MGD)	DSS Pop.	DSS Base (MGD)	DSS 1-in-2 (MGD)	DSS 1-in-10 (MGD)
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	Lehigh	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	Lee County Green Meadows	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
1995 Totals		375,238	317,451	40.20				42.91	1.179	45.68	57,787	5.70	6.02	6.35
							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	Lee County Waterway	8,215	7,945	1.04	130	35%	1.187	1.1	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	Lehigh	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	Lee County Green Meadows	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
2020 Totals		594,300	517,506	62.45				66.63		70.89	76,794	8.11	8.64	9.18
							Hendry Area							
							1995							
1	LaBelle	7,544	4,803	0.59	123	35%	1.111	0.61	1.166	0.65	2,741	0.34	0.35	0.37
2	Clewiston	14,446	13,814	3.25	235	35%	1.111	3.38	1.166	3.57	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

Table F-4. (Continued) Public Water Supply and Domestic Self-Supply Demand Projections.[a]

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
	Utility	**Total Pop.**	**PWS Pop.**	**PWS Base (MGD)**	**GPCD**	**Percent Outdoor Use**	**1-in-2 Factor**	**PWS 1-in-2 (MGD)**	**1-in-10 Factor**	**PWS 1-in-10 (MGD)**	**DSS Pop.**	**DSS Base (MGD)**	**DSS 1-in-2 (MGD)**	**DSS 1-in-10 (MGD)**
1995 Totals		27,714	18,617	3.84				3.99		4.22	9,097	1.67	1.73	1.83
2020														
1	LaBelle	10,888	8,147	1.00	123	35%	1.111	1.04	1.166	1.10	2,741	0.34	0.35	0.37
2	Clewiston	20,850	20,218	4.76	235	35%	1.111	4.94	1.166	5.23	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
2020 Totals		39,999	28,365	5.76				5.98		6.33	11,634	2.19	2.27	2.41
Glades Area														
1995														
1	City of Moore Haven	2,222	2,122	0.27	127	35%	1.182	0.29	1.163	0.3	100	0.01	0.01	0.01
	Rural Self-Supplied	2,187	0.00	0.00	127	35%	1.182	0.00	1.163	0.00	2,187	0.28	0.30	0.31
1995 Totals		4,409	2,122	0.27				0.29		0.30	2,287	0.29	0.31	0.33
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	0.00	0.00	127	35%	1.182	0.00	1.163	0.00	3,750	0.48	0.51	0.54
2020 Totals		7,560	3,710	0.47				0.50		0.53	3,850	0.49	0.52	0.55
Charlotte Area														
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
1995 Totals		645	0	0.00				0.00		0.00	645	0.08	0.08	0.09
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
2020 Totals		1,746	0	0.00				0.00		0.00	1,746	0.22	0.23	0.24

a. Table headings are described in detail in the previous table (**Table F-3**).

Urban demand is projected for Lee and Collier counties and the portions of Hendry and Glades counties located within the LWC (referred to as the Hendry and Glades areas.). The Charlotte Area is not included in the urban water demand analysis because the portion of the county within the LWC Planning Area has no PWS. Urban demands are concentrated in Lee and Collier counties, with these two counties accounting for approximately 96 percent of the LWC Planning Area urban population. About 16 percent of the 1995 population were self-supplied and this is projected to decrease to 12 percent in 2020 **(Table F-5)**.

Table F-5. Population in the Lower West Coast Planning Area 1995-2020.

County Area	1995 Population				2020 Population			
	Total	PWS	DSS	%PWS	Total	PWS	DSS	%PWS
Collier	182,933	158,708	24,225	87	349,200	322,919	26,281	92
Lee	375,238	317,451	57,787	85	594,300	517,506	76,794	87
Hendry	27,714	18,617	9,097	67	39,999	28,365	11,634	71
Glades	4,409	2,122	2,287	48	7,560	3,710	3,850	49
Charlotte	645	0	645	0	1,746	0	1,746	0
Total Planning Area	590,939	496,898	94,041	84	992,805	872,500	120,305	88

Commercial and Industrial Self-Supply

The types of employment available in an area depend on the commerce or industry located within the area. If the employment types can be anticipated to grow at the same rate and in the same direction as the population, than projected population can be used to determine the commercial and industrial self-supplied water demand. In the LWC Planning Area, the majority of the employees are found in the service and retail sales sectors. Water demand in these sectors will generally grow along with the population. Therefore, demand for this category of water use was projected to grow at the rate of each county's population growth. Commercial and industrial demands supplied by public utilities are included in the PWS demands.

The Lee and Collier counties are the only portions of the LWC Planning Area with reported commercial and industrial self-supplied demands (**Table F-6**). Estimates are provided both in terms of millions of gallons per year (MGY) and millions of gallons per day (MGD).

Table F-6. Commercial and Industrial Self-Supplied Demand.

County Area	Demand (MGY) 1995	Demand (MGY) 2020
Collier County	2,181	4,163
Lee County	1,974	3,126
Hendry Area	0	0
Glades Area	0	0
Charlotte Area	0	0
Total Planning Area	4,155	7,289

Recreation

The recreational demand category includes self-supplied irrigation demands for large landscaped and recreational areas not supplied by utilities as well as reuse supplied by wastewater treatment facilities. Recreational demands supplied by utilities are included in the PWS demands. Because of the data sources available, golf course demands by county are projected separately and added to the other landscape and recreation demands. Nongolf 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. This is generally consistent with the methodology of the District Water Supply Assessment (DWSA). New courses constructed since the publication of the DWSA were included in this plan.

Recreation demand for each county and county area is presented in **Table F-7**.

Table F-7. Total Recreation Demand.

County Area	1995 Demand (MGY)				2020 Demand (MGY)			
		Golf Course				Golf Course		
	Landscape	Self-Supplied	Reuse	Total	Landscape	Self-Supplied	Reuse	Total
Collier County	10,093	6,548	4,772	21,413	19,267	14,161	11,358	44,786
Lee County	7,012	4,999	3,359	15,370	11,105	10,686	5,257	27,048
Hendry Area	0	267	14	281	0	267	14	281
Glades Area	0	24	9	33	0	24	9	33
Charlotte Area	0	0	0	0	0	0	0	0
Total Planning Area	17,105	11,838	8,154	37,097	30,372	25,138	16,638	72,148

Golf Courses

In the 1994 LWC Water Supply Plan, historical irrigated golf course acreage data were gathered from the Official Florida Golf Guide (Florida Department of Commerce, 1990), Golf Guide to the South (Florida Golfweek, 1989), the Golf Course (Cornish and Whitten, 1988), District water use permits, and personal communication with several of the golf courses listed. The primary source used to update this data was the 1997 Golf Course Directory published by the National Golf Foundation.

The primary statistical used for forecasting golf course acreage, which is also used for forecasting many of the agricultural acreages below, is multiple regression analysis. Multiple regression analysis refers to a group of techniques for studying the straight-line relationships among two or more variables. Multiple regression estimates the ßi's in the equation:

$$Yj = \beta_0 + \beta_1 X_{1j} + \beta_2 X_{2j} + \ldots \beta_p X_{pj} + \varepsilon_{\cdot j} \qquad (F\text{-}9)$$

where:

The X's are the independent variables.

The Y is the dependent variable.

The subscript, j, represents the observation (row) number.

The ß's are the unknown regression coefficients. Their estimates are represented by b's. A ß represents the original unknown (population) parameter, while b is an estimate of this ß.

The j is the error of the jth row.

Although the regression problem may be solved by a number of techniques, the most-used method is least squares. In least squares regression analysis, the b's are selected so as to minimize the sum of the squares. This set of b's is not necessarily the set you want, since they may be distorted by outliers (points that are a long ways from the rest of the data). An alternative to least squares regression is robust regression, a form of weighted least squares estimation.

In multiple regression analysis, we are studying the relationship between one dependent (response) variable and p independent variables (called predictors). The sample multiple regression equation is:

$$y\text{-}hati = b_0 \ + \ b_1 x_{i1} \ + b_2 x_{i2} + \ldots + b_p x_{ip} \, . \qquad (F\text{-}10)$$

where:

If p = 1, the model is called simple linear regression.

The intercept, b_0 , is where the regression plane intersects with the Y axis.

The bi are the slopes of the regression plane in the direction of xi. These coefficients are called the partial-regression coefficients. Each partial regression coefficient represents the net effect the ith variable has on the dependent variable, holding the remaining X's in the equation constant.

Much of the regression analysis concerns the sample residuals, e_i, defined as

$$e_i = y_i \ - y\text{-}hat_i \qquad (F\text{-}11)$$

Once the ß's have been estimated, various indices are studied to determine the reliability of these estimates. One of the most popular of these reliability indices is the correlation coefficient. The correlation coefficient, or simply the correlation, is an index that ranges from -1 to 1. When the value is near zero, there is no linear relationship. As the correlation gets closer to plus or minus one, the relationship is stronger. A value of one (or negative one) indicates a perfect linear relationship between two variables.

The regression equation is only capable of measuring linear, or straight-line, relationships. If the points were in a circle, for example, regression analysis would not detect a relationship. For this reason, it is always advisable to plot each independent variable with the dependent variable. The analyst watches for curves, outlying points, changes in the amount of spread about the straight-line, and various other anomalies that may occur.

If the data are a random sample from a larger population and the M's are independent and normally distributed, a set of statistical tests may be applied to the b's and the correlation coefficient. These t-tests and F-tests are valid only if the above assumptions are met.

Specific assumptions of the ordinary least squares (OLS) multiple regression model are:

1. Linearity- Multiple regression models the linear relationship between Y and the X’s.
2. Constant variance (homoscedasticity)- The variance of the M's is constant for all values of the X’s.
3. Absence of outliers- Special cases resulting from one-time conditions can result in violation of the constant variance assumption.

4. Normality- The error terms(M's) are assumed to be normally distributed. Non-normally distributed M's may make the results of hypothesis tests and confidence intervals unreliable.

5. Independence- The error terms are assumed to be uncorrelated; this implies that the Y's are also uncorrelated. Absence of independence in the error terms results from model mis-specification and/or serial correlation in time-sequenced data, such as the data being dealt with in the Appendix, Serial correlation among the error terms (most commonly tested for with the Durbin-Watson statistic) results in:

   - regression co-efficients which are unbiased but are not minimum variance;
   - serious underestimation of the means square error, which can result in inflated partial t-tests and confidence intervals which are too narrow;
   - any hypothesis tests or confidence limits based on the t-distribution or the F-distribution would be invalid.

6. Absence of multi-collinearity – Multi-collinearity is the existence of linear or nearly linear relationships among the set of independent variables. Multi-collinearity can result in inaccurate estimates of the regression co-efficients, inflated standard errors of the regression co-efficients, deflate the partial t-tests for the co-efficients, result in false non-significant p-values for the individual co-efficients and degrade the predictability of the model.

Once the regression equation has been estimated then projections can be developed for specified values of $x_{ij;}$ for the projections developed here one of the independent variables will always be a representation of the year. It can be seen here that, where multiple independent variables are present, to project a unique value Y_j – hat, it is necessary to know, project, or assume the value of each of the X_i's. Thus, projections made using multiple regression analysis maybe thought of as being based on at least two conditions:

1. The underlying relationship between the independent variables and the dependent variable does not change over time.
2. Appropriate values are input for each of the X_i's. (The above discussion draws heavily on Hintze, 1995, pp 357-361).

Irrigated acreage was projected through the year 2020 using trend analysis techniques. The method chosen to project Lee and Collier County irrigated golf course acreage used a linear projection model of the form shown in **Equation F-12**.

$$CUMIRR_t = f(Time, Pop_t, D_t) \tag{F-12}$$

where:

$CUMIRR_t$ = *Cumulative irrigated golf course acreage in Collier County in year t.*

Time = *A time trend variable which takes the value of one in 1953 and increases by one unit each year.*

Pop_t = *Reported, projected, or interpolated population (in thousands) in Collier County for year t.*

D_t = *A dichotomous variable equal to one in certain years and zero in other years. For Lee County D=1, for the period 1977 through 1985 inclusive. For Collier County D=1, for the period 1994 and after.*

Due to the small number of golf courses in the Glades, Hendry, and Charlotte Areas, golf course acreage in these areas was held constant at its 1995 acreage throughout the projection horizon.

"Goodness of fit statistics" are used throughout this appendix to evaluate the accuracy of equations in describing time series of historical acreage data. A detailed explanation of goodness of fit statistics can be found in "Econometric Models, Techniques, and Applications" (Intriligator, 1978) and in the on-line User's Guide to NCSS 2000 (Hintze, 1999).

Golf course irrigation requirement estimates were made for 1-in-2 (average) rainfall years and 1-in-10 year droughts using the District's modified Blaney-Criddle model. The irrigation requirements were calculated using a representative irrigation system/rainfall station/soil type combination for each county (**Table F-8**).

Table F-8. Input Variables Used to Determine Golf Course Irrigation Requirements.

County	Irrigation System			Soil	Rainfall Station
	Type	Used By	Efficiency		
Collier	overhead sprinkler	100%	75%	sandy soil with 0.4 inch usable soil water capacity per foot	Naples
Lee	overhead sprinkler	100%	75%	sandy soil with 0.8 inch usable soil water capacity per foot	Fort Myers
Hendry	overhead sprinkler	100%	75%	sandy soil with 0.8 inch usable soil water capacity per foot	LaBelle
Glades	overhead sprinkler	100%	75%	sandy soil with 0.8 inch usable soil water capacity per foot	Moore Haven

Collier County Golf

The golf courses presently in Collier County are described in **Table F-9**.

Table F-9. Historic Irrigated Golf Course Acreage in Collier County.

Golf Course	Year Golf Course Began Irrigating	Irrigated Acreage/ Golf Course	Cumulative Irrigated Acreage
Naples Beach Hotel and Golf Course	1953	95	95
Hole-in-the-Wall Golf Course	1957	120	215
The Country Club of Naples	1960	115	330
Royal Palm Country Club	1960	125	455
Palm River Country Club	1961	75	530
Moorings Country Club	1963	38	568
Island Country Club (a.k.a. Marco Island)	1965	85	653
Hibiscus Golf Course	1968	110	763
Royal Poinciana Golf Course	1969	324	1,087
Brook Meadow Golf Course	1970	120	1,207
Glades Country Club	1972	199	1,406
High Point Country Club	1972	120	1,526
Quail Run Country Club	1972	55	1,581
Riviera Golf Course (a.k.a. Riviera Golf Course of Naples)	1972	85	1,666
Imperial Golf Course	1973	260	1,926
Wilderness Country Club	1974	120	2,046
Marco Shores Country Club	1975	80	2,126
Quality Inn Suite and Golf Club	1978	184	2,310
Lakewood Country Club	1979	48	2,358
Bears Paw Country Club	1980	144	2,502
Wyndemere Country Club (Homeowners Association)	1980	290	2,792
Pelican Bay	1980	100	2,892
The Club at Pelican Bay	1981	125	3,017
Eagle Creek Country Club	1982	160	3,294
Boyne South Golf Club	1982	457	3,751
Quail Creek Country Club	1982	19	3,770
Hideaway Beach Golf Course (a.k.a. Association Habitat)	1984	100	3,870

Table F-9. (Continued) Historic Irrigated Golf Course Acreage in Collier County.

Golf Course	Year Golf Course Began Irrigating	Irrigated Acreage/ Golf Course	Cumulative Irrigated Acreage
Windstar on Naples Bay (a.k.a. Windstar Golf and County Club)	1984	228	4,098
Foxfire Country Club	1985	105	4,203
Lely Classic	1985	25	4,228
Bentley Village Golf Course	1987	12	4,240
Naples Golf Center	1987	153	4,393
Quail Village Golf Course	1987	285	4,678
Vineyards Golf and Country Club (a.k.a. Vineyards of Naples)	1987	203	4,881
Audubon Country Club	1988	65	4,946
Countryside Country Club (a.k.a. Countryside)	1988	132	5,078
Royal Wood Golf and Country Club	1988	119	5,197
Golf Club of Marco	1990	60	5,257
Silver Lakes	1991	170	5,427
Stoneybrook	1991	120	5,547
Valencia Golf Course (a.k.a. Valencia at Orange Tree)	1991	120	5,667
Marriot Golf Course at Marco	1991	120	5,787
Glen Eagle (a.k.a. Embassy Woods Golf and Country Club)	1991	300	6,087
Bonita Bay Club (a.k.a. Bonita Bay East)	1992	155	6,242
Shamrock Golf and Country Club	1992	139	6,381
Colliers Reserve Country Club (a.k.a. Colliers Reserve)	1993	48	6,429
Lakewood Country Club	1993	367	6,796
Quail West Limited	1993	55	6,851
Naples National Golf Course	1993	120	6,971
Stonebridge Country Club Association (a.k.a. Stonebridge Country Club)	1993	497	7,468
Grey Oaks Country Club (a.k.a. Grey Oaks Golf and Country Club)	1994	155	7,623
Heritage Green (a.k.a. Heritage Greens)	1994	119	7,742
The Country Club of Naples (a.k.a. Country Club of Naples)	1994	120	7,862
Pelican Marsh Golf Course	1994	25	7,887

Table F-9. (Continued) Historic Irrigated Golf Course Acreage in Collier County.

Golf Course	Year Golf Course Began Irrigating	Irrigated Acreage/ Golf Course	Cumulative Irrigated Acreage
Ironwood Golf Course	1995	154	8,041
Kensington Golf and Country Club (a.k.a. Kensington)	1995	119	8,160
Marco Shore	1995	36	8,196
Naples Ex Country Club	1995	150	8,346
Naples Golf Estate	1995	240	8,586
Olde Florida Golf Course	1995	191	8,777
Orangetree Development	1995	255	9,032
Pelican Strand Community (a.k.a. Golf and County Club; Pelican Strand)	1996	125	9,157
Bay Colony Golf Course	1996	150	9,307
Arrowhead Golf Club	1998	72	9,379
Lely Mustang Golf Course (a.k.a. Lely Resorts)	1999	150	9,529
Lely Flamingo Island Club (a.k.a. Lely Resorts)	1999	150	9,607
Twineagles	1999	120	9,727
Cypress Woods	1999	155	9,882

Historic and projected population figures were not available for all years. Where actual population figures were not available, a linear interpolation between the two adjacent available population figures was made. This may tend to make population estimates used here more highly correlated with time than they actually are.

When **Equation F-12** was estimated using ordinary least squares regression to obtain the, **Equation F-13** was obtained.

The primary projections for Collier County irrigated golf course acreage are presented in **Table F-10**. Because forecasting is always associated with a degree of uncertainty, primary projections are presented with a band of plus or minus 15 percent around it.

The irrigation requirements in **Table F-11** were calculated by applying these projected irrigated acreages to both the 1-in-2 and 1-in-10 supplemental water requirements for grass (as calculated by the Blaney-Criddle permitting model). Input variables are presented in **Table F-8**.

(F-13)

Multiple Regression Report

Page/Date/Time	1 05-18-1999 16:24:42
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Dependent	Cumacres

Regression Equation Section

Independent Variable	Regression Coefficient	Standard Error	T-Value (Ho: B=0)	Prob Level	Decision (5%)	Power (5%)
Intercept	17840.45	3785.669	4.7126	0.000015	Reject Ho	0.996275
Year2	217.2498	145.2851	1.4953	0.140069	Accept Ho	0.312886
Popt	45.56182	12.44592	3.6608	0.000533	Reject Ho	0.949666
Logpop	-3195.975	1222.014	-2.6153	0.011258	Reject Ho	0.730167
D	-586.7435	157.5236	-3.7248	0.000434	Reject Ho	0.955863
R-Squared	0.984066					

Analysis of Variance Section

Source	DF	Sum of Squares	Mean Square	F-Ratio	Prob Level	Power (5%)
Intercept	1	1.667535E+09	1.667535E+09			
Model	4	5.363676E+08	1.340919E+08	926.3717	0.000000	1.000000
Error	60	8684974	144749.6			
Total(Adjusted)	64	5.450525E+08	8516446			

Root Mean Square Error	380.4597	R-Squared	0.9841
Mean of Dependent	5065.016	Adj R-Squared	0.9830
Coefficient of Variation	0.0751152	Press Value	1.0056E+07
Sum |Press Residuals|	20416.31	Press R-Squared	0.9816

Durbin-Watson Value 0.5908

Table F-10. Total Projected Irrigated Golf Course Acreage for Collier County.

Year	Primary - 15%	Primary	Primary + 15%
1995	7,677	9,032[a]	10,387
1999	8,400	9,882[a]	11,364
2000	8,765	10,312	11,859
2005	10,613	12,485	14,358
2010	12,428	14,621	16,814
2015	14,383	16,922	19,460
2020	16,395	19,288	22,182

a. From **Table F-9**.

Table F-11. Irrigation Requirements for the Primary Golf Course Acreage Projections in Collier County.

Year		1995	2000	2005	2010	2015	2020
Collier County Acreage[a]		9,032	10,312	12,485	14,621	16,922	19,288
Month	**Supplemental Water Requirements (inches/acre)**	**Irrigation Requirements (millions of gallons)**					
1-in-2							
January	1.20	372	448	542	635	735	838
February	1.46	452	545	660	773	895	1,020
March	3.37	1,044	1,258	1,523	1,784	2,065	2,354
April	4.21	1,304	1,572	1,903	2,229	2,580	2,940
May	4.55	1,410	1,699	2,057	2,409	2,788	3,178
June	3.70	1,146	1,381	1,673	19,59	2,267	2,584
July	4.01	1,242	1,497	1,813	2,123	2,457	2,801
August	3.86	1,196	1,441	1,745	2,043	2,365	2,696
September	2.76	855	1,031	1,248	1,461	1,691	1,928
October	3.17	982	1,184	1,433	1,678	1,942	2,214
November	2.53	784	945	1,144	1,339	1,550	1,767
December	1.69	524	631	764	895	1,035	1,180
Total	36.54	11,320	13,643	16,518	19,344	22,388	25,519
1-in-10							
January	1.36	421	508	615	720	833	950
February	1.59	493	594	719	842	974	1,110
March	3.85	1,193	1,438	1,740	2,038	2,359	2,689
April	4.86	1,506	1,815	2,197	2,573	2,978	3,394
May	5.18	1,605	1,934	2,342	2,742	3,174	3,618
June	4.73	1,465	1,766	2,138	2,504	2,898	3,303
July	4.67	1,447	1,744	2,111	2,472	2,861	3,261
August	4.24	1,314	1,583	1,917	2,245	2,598	2,961
September	3.20	991	1,195	1,447	1,694	1,961	2,235
October	3.38	1,047	1,262	1,528	1,789	2,071	2,361
November	2.70	836	1,008	1,221	1,429	1,654	1,886
December	1.85	573	691	836	979	1,134	1,292
Total	41.60	12,887	15,532	18,806	22,023	25,489	29,053

a. Acreage from **Table F-10**

Lee County Golf

The existing golf courses in Lee County are described in **Table F-12**. Lee County has experienced rapid growth in irrigated golf course acreage since the early 1960s. Lee County irrigated golf course acreage increased more than five-fold in between 1960 and 1970. Between 1970 and 1981 Lee County golf course acreage nearly tripled, and it again doubled during the 1980s. As in other counties, the growth in golf course acreage has occurred irregularly on a year-by-year basis.

Table F-12. Historic Irrigated Golf Course Acreage in Lee County.

Golf Course	Year Golf Course Began Irrigating	Irrigated Acreage/ Golf Course	Cumulative Irrigated Acreage
Fort Myers Country Club	1918	120	120
Admiral Lehigh Acres	1960	115	235
Cypress Lake Country Club	1960	100	335
Cape Coral Golf Resort	1963	85	420
Lehigh Acres South (a.k.a. Mirror Lakes)	1967	160	580
Cape Coral Executive Golf Club	1968	20	600
El Rio Golf Club	1968	35	635
South Seas Plantation Golf Club	1969	75	710
Palmetto Pine Country Club	1970	95	805
Mirror Lakes	1970	160	965
Seven Lakes Country Club	1971	125	1,090
Lochmoor Country Club	1972	81	1,171
Myerlee Country Club	1972	15	1,186
San Carlos Golf and Country Club	1972	118	1,304
Bay Beach Golf Club	1973	29	1,333
Estero Woods Village	1975	6	1,339
The Landings Yacht and Golf Club (a.k.a. The Landing)	1975	150	1,489
Six Lakes	1975	43	1,532
Bonita Springs Golf and Country Club	1977	157	1,689
Beachview Golf Club	1978	70	1,759
Eastwood Golf Club	1978	100	1,859
Lake Lawn Country Club	1978	33	1,892
Spanish Wells Country Club	1979	90	1,982

Table F-12. (Continued) Historic Irrigated Golf Course Acreage in Lee County.

Golf Course	Year Golf Course Began Irrigating	Irrigated Acreage/ Golf Course	Cumulative Irrigated Acreage
Forest Country Club	1980	160	2,242
Alden Pines Golf Club	1981	55	2,297
Burnt Store Marina	1981	170	2,651
Lake Fairways Country Club	1981	54	2,705
Cypress Pines Country Club	1982	89	2,794
Riverbend Golf Club (a.k.a. Riverbend East and West)	1982	60	2,854
The Dunes (a.k.a. Dunes Golf and Country Club)	1983	109	2,963
Euro American Investment	1983	122	3,085
Fiddlesticks Country Club	1983	266	3,351
Spring Creek	1983	321	3,672
Eagle Ridge Golf and Tennis Club	1984	68	3,740
Hideaway Beach Association (a.k.a. Hideaway Country Club)	1984	113	3,853
Bonita Bay Club	1985	121	3,974
Tara Woods	1985	4	3,978
Cross Creek Country Club	1985	62	4,040
Deer Run Golf Club	1985	77	4,117
Gasparilla Inn Golf Club	1985	30	4,147
Pine Lakes Country Club	1985	57	4,204
The Vines (a.k.a. The Vines Country Club)	1985	96	4,300
Terraverde Country Club	1985	12	4,312
Whiskey Creek Country Club	1985	51	4,363
Wildcat Run Country Club	1985	80	4,443
Bonita Fairways	1985	40	4,483
Golfview Golf and Racquet Club (a.k.a. Golfview)	1986	27	4,600
Pelican's Nest Golf Club	1986	204	4,804
Gulf Harbour Yacht and Country Club (a.k.a. River's Edge)	1986	205	5,009
Royal Tee	1986	146	5,155
Burnt Store Marina	1987	122	5,277
The Heritage	1987	26	5,303
Kelly Greens Golf and Country Club	1987	27	5,330

Table F-12. (Continued) Historic Irrigated Golf Course Acreage in Lee County.

Golf Course	Year Golf Course Began Irrigating	Irrigated Acreage/ Golf Course	Cumulative Irrigated Acreage
Sabal Springs Golf and Racquet Club	1987	100	5,430
Coral Oaks Golf Club	1988	103	5,533
Country Creek Country Club (a.k.a. Village of Country Creek)	1988	167	5,700
Gateway Golf and Country Club	1988	148	5,848
Golf Villas of Bonita Springs	1988	2	5,850
Olde Hickory (a.k.a. Olde Hickory Golf and Country Club)	1989	97	5,947
Hunters Ridge Country Club	1989	112	6,059
Pelican Bay (Phase Two)	1989	55	6,114
Heron's Glen (a.k.a. Del Vera)	1991	180	6,294
Worthington Country Club	1991	120	6,414
Corkscrew Pines	1993	232	6,646
Sanctuary Golf Shop (a.k.a. The Sanctuary Golf Club)	1993	95	6,741
Huntington (a.k.a. Huntington Gold Course)	1995	41	6,782
Highland Woods	1995	272	7,054
The Colony at Pelican Landing (a.k.a. The Colony)	1995	300	7,354
Las Brias	1996	45	7,399
Westminster Golf Club	1996	120	7,519
Estero Point	1997	115	7,634
Brooks of Bonita Springs	1997	514	7,893
West Bay Golf Club	1999	100	9,007
Golf Club of Quincy	1999	120	9,127

The linear regression model discussed above assumes a constant change in the dependent variable for each one-unit change in one of the independent variables. When dealing with growth over time it is sometimes more appropriate to look at the percentage change over time. This type of a relationship can be modeled through the use of some form of logarithmic transformation. This type of a transformation can improve the specification of the model and reduce the problems created by serially correlated error terms in the absence of the log-transformed variable.

In **Equation F-14** below the following variables are included:

Cumacres = *cumulative irrigated Lee County golf course acres during a given year*

Year2 = *the numeric value of a given year*

D = *a zero-one dichotomous variable equal to zero prior to 1989 and one in 1989 and after*

Leepop = *Lee County population in a particular year as reported by BEBR (or the U. S/ Bureau of the Census in decennial years)*

Logpop = *the natural logarithm of Lee County population in a particular year.*

(F-14)

Multiple Regression Report

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Dependent	cumacres

Regression Equation Section

Independent Variable	Regression Coefficient	Standard Error	T-Value (Ho: B=0)	Prob Level	Decision (5%)	Power (5%)
Intercept	749497	104156.6	7.1959	0.000000	Reject Ho	1.000000
year2	-363.3705	53.28622	-6.8192	0.000000	Reject Ho	0.999999
D	-564.891	90.34115	-6.2529	0.000000	Reject Ho	0.999986
Leepop	7.495067E-02	5.002066E-03	14.9839	0.000000	Reject Ho	1.000000
Logpop	-3509.362	388.0309	-9.0440	0.000000	Reject Ho	1.000000
R-Squared	0.991309					

Analysis of Variance Section

Source	DF	Sum of Squares	Mean Square	F-Ratio	Prob Level	Power (5%)
Intercept	1	1.203081E+09	1.203081E+09			
Model	4	3.01956E+08	7.548901E+07	1739.3859	0.000000	1.000000
Error	61	2647388	43399.8			
Total(Adjusted)	65	3.046034E+08	4686206			

Root Mean Square Error	208.3262	R-Squared	0.9913
Mean of Dependent	4269.485	Adj R-Squared	0.9907
Coefficient of Variation	4.879422E-02	Press Value	3215654
Sum |Press Residuals|	11209.22	Press R-Squared	0.9894

Durbin-Watson Value 1.3032

Equation F-14 was used to develop the primary projection of irrigated golf course acreage in Lee County presented in **Table F-13**. The irrigation requirements in **Table F-14** were calculated by applying projected irrigated acreages to the supplemental water requirements (as calculated by the Blaney-Criddle permitting model). Input variables used are presented in **Table F-8**.

Table F-13. Total Projected Irrigated Golf Course Acreage for Lee County.

Year	Primary - 15%	Primary	Primary + 15%
1995	6,251	7,354[a]	8,457
1999	7,758	9,127[a]	10,496
2000	7,972	9,378	10,785
2005	8,951	10,531	12,110
2010	9,818	11,551	13,284
2015	11,391	13,401	15,411
2020	11,923	14,027	16,131

a. From **Table F-12**.

Table F-14. Irrigation Requirements for the Primary Golf Course Acreage Projections in Lee County.

Year		1995	2000	2005	2010	2015	2020
Lee County Acreage[a]		7,354	9,378	10,531	11,551	13,401	14,027
Month	**Supplemental Water Requirements (inches/acre)**	**Irrigation Requirements (millions of gallons)**					
1-in-2							
January	1.00	266	340	381	418	485	508
February	1.20	320	407	458	502	582	609
March	2.87	764	975	1,094	1,200	1,393	1,458
April	4.04	1,076	1,372	1,540	1,690	1,960	2,052
May	4.41	1,174	1,497	1,682	1,844	2,140	2,240
June	2.57	684	873	980	1,075	1,247	1,305
July	3.24	863	1,100	1,235	1,355	1,572	1,646
August	3.04	809	1,032	1,159	1,271	1,475	1,544
September	2.22	591	754	847	928	1,077	1,128
October	3.09	823	1,049	1,178	1,292	1,499	1,569
November	2.29	610	778	873	958	1,111	1,163
December	1.42	378	482	541	594	689	721
Total	31.39	8,358	10,659	11,969	13,129	15,231	15,943
1-in-10							
January	1.26	336	428	480	527	611	640
February	1.37	365	465	522	573	665	696
March	3.55	945	1,205	1,354	1,485	1,723	1,803
April	4.71	1,254	1,599	1,796	1,970	2,285	2,392
May	5.00	1,331	1,698	1,907	2,091	2,426	2,539
June	3.56	948	1,209	1,357	1,489	1,727	1,808
July	4.13	1,100	1,402	1,575	1,727	2,004	2,098
August	3.62	964	1,229	1,380	1,514	1,757	1,839
September	2.38	634	808	908	995	1,155	1,209
October	3.60	959	1,222	1,373	1,506	1,747	1,828
November	2.39	636	812	911	1,000	1,160	1,214
December	1.54	410	523	587	644	747	782
Total	37.12	9,884	12,604	14,154	15,525	18,011	18,853

a. Acreage from **Table F-13**.

Hendry Area Golf

In 1990, there were two golf courses in Hendry County and they are both located in the LWC Planning Area. These are described in **Table F-15**. No meaningful trend or explanatory model can be developed due to the small number of golf courses in the area. Therefore, projections must rely upon empirical knowledge of the golf industry in this area. The National Golf Foundation in Jupiter, which tracks the stage of development and location of all golf courses nationally, has no record of any golf course development presently occurring in the Hendry Area. Therefore, irrigated golf course acreage was projected to remain constant through the year 2020.

The irrigation requirements in **Table F-16** were calculated by applying the current irrigated acreage to the Blaney-Criddle permitting model. Input variables used are presented in **Table F-8**.

Table F-15. Golf Courses in the Hendry Area.

Golf Course	Year Golf Course Began Irrigating	Irrigated Acreage/ Golf Course	Cumulative Irrigated Acreage
Clewiston Golf Club	1959	62	62
Oxbow Golf Club at Port LaBelle	1974	240	190
Total		386	252

Table F-16. Irrigation Requirements for the Primary Golf Course Acreage Projections in the Hendry Area through the Year 2020.

Year		1995 through 2020		
Hendry County Acreage		252		
Hendry Area Acreage		252		
	1-in-2		1-in-10	
Month	Supplemental Water Requirements (inches/acre)	Irrigation Requirements (millions of gallons)	Supplemental Water Requirements (inches/acre)	Irrigation Requirements (millions of gallons)
January	0.93	9	1.16	11
February	1.15	10	1.30	12
March	2.62	24	3.41	31
April	3.68	34	4.38	40
May	4.12	38	4.65	42
June	2.54	23	3.44	31
July	3.39	31	3.94	36
August	3.30	30	3.55	32
September	2.84	26	3.40	31
October	2.84	26	3.26	30
November	2.11	19	2.05	19
December	1.25	11	1.17	11
Total	30.78	281	35.72	326

Glades Area Golf

Hendry Isles Resort is the only golf course in Glades County and it is in the LWC Planning Area. This golf course opened in 1978 and covers 72 acres, of which 20 acres are irrigated. No additional golf course development is anticipated through 2020 in the Glades Area. The existing acreage has 1-in-2 and 1-in-10 irrigation requirements of 33 MGY and 36 MGY, respectively.

Thermoelectric Power Generation Self-Supply

The LWC Planning Area has one thermoelectric power plant, located in Lee County. Thermoelectric power plants may withdraw large quantities of water for cooling purposes, but the vast majority of this water is not consumed. It is withdrawn from the Caloosahatchee and returned with some evaporative losses. In 1995, the demand for thermoelectric power from this plant was 281 MGY and it is expected to remain the same through 2020.

AGRICULTURAL DEMAND

Agricultural irrigation and cattle watering demand estimates were made by crop type for entire counties. Historical crop acreage data were gathered from the Florida Agricultural Statistics Service (FASS), Institute of Food and Agricultural Sciences (IFAS), Soil Conservation Service (SCS), Division of Plant Industry (DPI), Southwest Florida Water Management District (SWFWMD), and the District.

Agricultural water demand was projected for the LWC Planning Area by county or by county area. Agricultural irrigation and cattle watering demand estimates were made by time horizon (1995, 2000, 2005, 2010, 2015 and 2020) and by month. For all crop types in all areas, general methods were used to project acreage and determine irrigation requirements. Any methods specific to a crop type or an area are described in the corresponding section.

Acreage Projections

Crop acreage projections were needed for whole counties and for county portions (areas) within the LWC Planning areas. For the Hendry, Glades, and Collier areas, crop acreages were 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 from District land use maps and with the cooperation of the local Institute of Food and Agricultural Sciences (IFAS) extension offices. Land availability for the future growth of agriculture is examined in a general way based on District maps and data gathered from Comprehensive Plans.

The techniques chosen to project crop acreage 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 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 method in which crop acreage is projected by IFAS and the other water management districts.

In some cases, a single mathematical model accurately explained past trends and generated a valid future projection. In other cases, several models accurately explained past trends and provided valid, though slightly differing, future projections. In these cases, the projections were averaged. This approach was justified by research performed at the BEBR (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.

If no statistically valid trend or any convincing empirical knowledge of future changes in a crop's acreage was found, the specific crop's acreage was projected at its most recently reported value for future time horizons. Usually these situations arose from relatively low quantity of water use for the crop type within the county or county area.

These projected crop acreages are consistent with the Caloosahatchee Water Management Plan. Apparent differences between the plans occur because of differences in geographic extents and the fact that the LWC Water Supply Plan uses net acres while the CWMP uses gross acres. Lands irrigated by ground water are consistent in both plans.

Projected land uses for 2020 are based on Florida Agricultural Statistics Service (FASS) data. FASS acreages are reported by whole county and the District then translates these reported acreages into the counties partially within the LWC Planning Region based on existing land use and water use permit data. For surface water irrigated lands in the Lake Okeechobee Service Area. The CWMP Advisory Committee recommended an increase beyond the projected acreage to reflect known agricultural plans, specifically for citrus and sugarcane. The additional citrus and sugarcane acreages were located primarily in western Hendry County.

Irrigation Requirements

Average (1-in-2) year and 1-in-10 drought year irrigation requirements were calculated using the District's modified Blaney-Criddle model. Modifications made to the Blaney-Criddle model are described in the District's Management of Water Use Permitting Information Manual Volume III (SFWMD, 1997).

Irrigation requirements are calculated by dividing the supplemental water requirement by the irrigation efficiency (**Equation F-15**). 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. The irrigation requirement equation is as follows:

Irrigation requirement = Supplemental water requirement / Irrigation efficiency *(F-15)*

Supplemental water requirement = Water used for evapotranspiration - effective rainfall *(F-16)*

Projections of irrigation system type, and the effect of the corresponding irrigation efficiencies, were based on the interpretation of current ratios and trends. Three basic types of irrigation systems are currently being used in crop production in the LWC Planning Area: seepage, overhead sprinkler, and micro irrigation systems. The irrigation efficiencies estimated by the District for these systems are 50, 75, and 85 percent, respectively.

Irrigation efficiency depends, in part, on soil type. Soil type, with regard to water use permitting by the District, refers to the soil's usable, water holding capacity. Usable soil water holding capacity has a direct affect on the fraction of rainfall or irrigation that is effective. The District classifies five types of soil with regard to water holding capacity in inches per foot. These holding capacities are 0.4, 0.8, 1.5, and 3.6 inches per foot. Soil types in the county areas of LWC Planning Area are shown in **Figure F-1** (SFWMD, 1985).

Unless otherwise specified, a crops entire acreage was treated as if all took place on the most common soil type permitted for that crop in the respective county. Likewise, unless otherwise stated, the historical weather data from the rainfall station most frequently used to permit allocations for that crop in the respective county is used.

Inputs used to determine irrigation requirements for each crop type within each county or county area are listed in **Table F-17**.

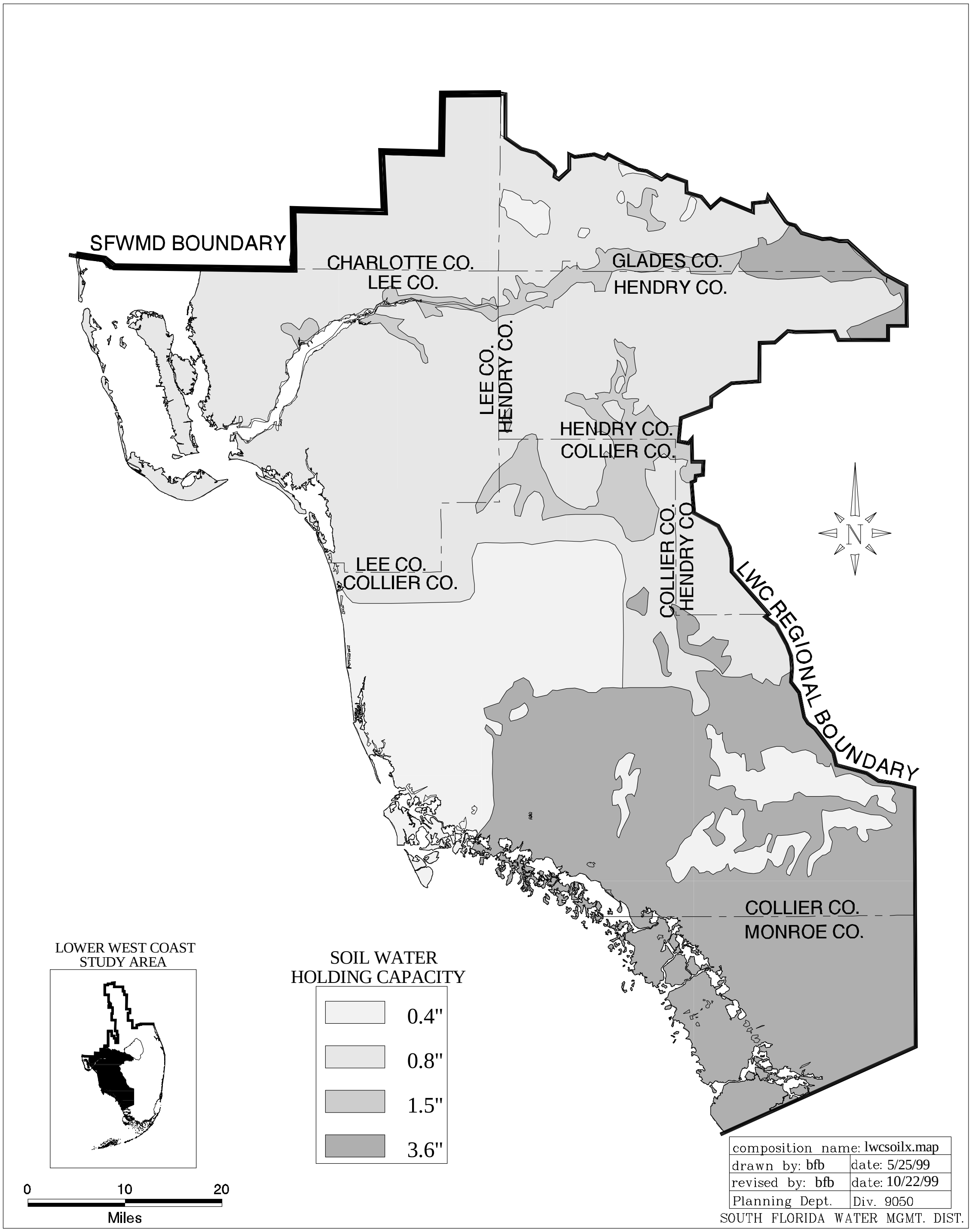

Figure F-1. Soil Types in the Lower West Coast Planning Area.

Table F-17. Inputs Used to Determine Irrigation Requirements.

Crop Type	Irrigation System: Type	Irrigation System: Used By	Irrigation System: Efficiency	Soil	Rainfall Station
Collier County					
Citrus	micro irrigation	72%	85%	sandy soil with 0.8 inch usable soil water capacity/ft.	Immokalee
	overhead sprinkler	4%	75%		
	seepage	24%	50%		
Vegetables	seepage	100%	50%		
Ornamental Nursery	overhead sprinkler (with containerized plants)	100%	50%		Naples
Lee County					
Citrus	micro irrigation	50%	85%	sandy soil with 0.8 inch usable soil water capacity/ft.	Fort Myers
	seepage	50%	50%		
Tropical Fruit	seepage	100%	50%		
Vegetables	seepage	100%	50%		
Sod	seepage	100%	50%		
Ornamental Nursery	overhead sprinkler (with containerized plants)	100%	50%		
Hendry County					
Citrus	micro irrigation	60%	85%	sandy soil with 0.8 inch usable soil water capacity/ft.	LaBelle
	overhead sprinkler	4%	75%		
	seepage	36%	50%		
Field Crops	seepage	100%	50%		
Vegetables	seepage	100%	50%		
Sod	seepage	100%	50%		
Cut Flowers	seepage	100%	50%		
Ornamental Nursery	overhead sprinkler (with containerized plants)	100%	50%		
Glades County					
Citrus	micro irrigation	77%	85%	sandy soil with 0.8 inch usable soil water capacity/ft.	Moore Haven
	overhead sprinkler	3%	75%		
	seepage	20%	50%		
Field Crops	seepage	100%	50%		
Vegetables	seepage	100%	50%		
Ornamental Nursery	overhead sprinkler (with containerized plants)	100%	50%		
Charlotte County					
Citrus	micro irrigation	100%	85%	soil type of 0.8 inch usable soil water capacity/ft.	LaBelle
Field Crops	seepage	100%	50%		
Vegetables	seepage	100%	50%		

Crop Types

Irrigated commercially grown crop categories are 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 are citrus, other fruits and nuts, vegetables, melons and berries, field crops, greenhouse/ nursery, sod, pasture, and miscellaneous. The crops within these categories are shown in **Table F-18**. Although all of these crops are grown commercially somewhere within the Florida, not all are grown within the LWC Planning Area. In the LWC Planning Area the commercially grown crops are citrus, field crops (mainly sugarcane), tropical fruit, vegetables, sod, cut flowers, and ornamental nursery plants. Pasture is almost never irrigated. However, there are some demands for cattle watering.

Table F-18. Agricultural Crop Categories.

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

Citrus

All categories of citrus (oranges, grapefruit, tangerines, etc.) were grouped together for projection purposes. Historical citrus acreage data were gathered from volumes of the Commercial Citrus Inventory, which is published biennially by FASS. The historical projections, presented in the tables, are net acres based on FASS information. During the development of the CWMP additional citrus acres were added to these projections. Based on local knowledge provided by agricultural interests on the CWMP Advisory Committee, an additional 12,748 gross acres of citrus were added to these projections. These 12,748 gross acres were combined with the converted historical projection net acreages resulting in a total of 125,035 gross acres of citrus in the Caloosahatchee Basin for the 2020 demand projections for modeling purposes.

The citrus planting rates in the LWC Planning Area were at historically high levels from 1986 to 1994. Following several freezes in Central Florida during the 1980s citrus production moved from central to southwest Florida. High returns further increased citrus planting rates. Since 1994, citrus acreage has levelled out.

Previous citrus acreage projections based on information through 1990 for Lee and Hendry counties represented an extrapolation of the medium planting rate scenario for years after 1990 as outlined by Behr et. al (1988). Developments since 1994 indicate that the Behr’s medium planting rate has not been realized since 1994. Forecasting equations are presented for Glades, Charlotte, and Collier counties, where recent growth has not been as extreme. Hendry is the only county in the LWC Planning Area with significant citrus nursery acreage and these irrigation requirements are projected separately.

Three types of systems are used to irrigate citrus crops in the LWC Planning Area: micro irrigation, overhead sprinklers, and seepage (**Table F-17**). District permits were used to determine the ratio of acreage being irrigated by these system in 1990. In recent years, micro irrigation has been the system of choice on new citrus groves. It costs less than overhead sprinkler systems and results in higher productivity than seepage systems. However, there is still a substantial citrus acreage in the LWC Planning Area with seepage irrigation, and to a lesser extent, overhead sprinkler irrigation. This ratio was applied to the acreage for 1990 and the corresponding application efficiencies used to calculate irrigation requirements. All citrus planted after 1995 was assumed to have some form of micro irrigation.

Collier County Citrus

Historical citrus acreage in Collier County is presented in **Table F-19**. Collier County citrus acreage was projected using variants of a generic model shown in **Equation F-17**, which has been used by District analysts for projecting citrus acreage in a variety of planning efforts.

Table F-19. Historic Citrus Acreage in Collier County.

Year	Historic	Year	Historic
1966	2,605	1984	8,425
1968	3,933	1986	10,063
1970	5,052	1988	17,309
1972	5,228	1990	23,565
1974	5,474	1992	34,167
1976	5,396	1994	36,534
1978	5,975	1995	36,559[a]
1980	6,706	1996	36,583
1982	7,931	1998	36,655

a. The 1995 acreage is estimated by interpolating between the 1994 and 1996 acreages.

$$COLCIT_t = f(time, D, RP_p, RP_w, RP_o) \qquad (F\text{-}17)$$

where:

$COLCIT_t$ = *Citrus acreage in Collier County in year t*

RP_p, RP_w, RP_o = *The real season average prices of interior region pink and white grapefruit and oranges*

D = *a dichotomous variable equal to zero before 1992 and equal to one from 1992 to the present.*

The dichotomous variable corresponds to the slowing of the rapid citrus growth period in the LWC Planning Area. Models were run which weighted all observations equally and with the weight assigned to a particular observation declining geometrically with time, with the lowest weight being assigned to the earliest observation. Weighted Collier citrus acreage is denoted as $WTCOLCIT_t$. Eight specific submodels were estimated as shown in **Equations F-18** through **F-25**.

$$COLCIT_t = f(time, RP_p, RP_w, RP_o, D) \qquad (F\text{-}18)$$

$$WTCOLCIT_t = f(time, RP_p, RP_w, RP_o, D) \qquad (F\text{-}19)$$

$$COLCIT_t = f(time, D) \qquad (F\text{-}20)$$

$$WTCOLCIT_t = f(time, D) \qquad (F\text{-}21)$$

$$COLCIT_t = f(time, RP_p, RP_o, RP_w) \qquad (F\text{-}22)$$

$$WTCOLCIT_t = f(time, RP_p, RP_w, RP_o) \qquad (F\text{-}23)$$

$$COLCIT_t = f(time) \qquad (F\text{-}24)$$

$$WTCOLCIT_t = f(time) \qquad (F\text{-}25)$$

Historic data from 1966 through 1996 were used to estimate **Equations F-18** through **F-25**. To generate the primary projection the estimates derived from these equations were averaged. Then the residual for 1996 was added to the projection for 1996 to force the observed and the projected acreages to be equal. A residual is the difference between the averaged estimates and the observed acreage.

Projected acreage for 1998 through 2020 were derived using the methods described above. The primary, primary minus 15 percent, and primary plus 15 percent projected acreages are presented in **Table F-20**.

Table F-20. Projected Citrus Acreage in Collier County.

Year	Primary - 15%	Primary	Primary + 15%
1995	31,075	36,559[a]	42,043
1998	31,157	36,655[a]	42,153
2000	33,924	39,911	45,898
2005	31,736	37,336	42,936
2010	40,747	47,938	55,129
2015	44,159	51,952	59,745
2020	47,571	55,966	64,361

a. From **Table F-19**.

The 1-in-2 (average) and 1-in-10 supplemental water requirements are shown in **Table F-21.** The supplemental water requirements were divided by irrigation application efficiency to yield 1-in-2 and 1-in-10 irrigation requirements (**Equation F-15**). For the calculation of irrigation requirements, data from the Immokalee rainfall station, soil with a water holding capacity of 0.8 in./ft., and the 1990 ratio of permitted irrigation systems were used (**Table F-17**). In 1990, 72 percent of the permitted citrus acreage in Collier County used micro irrigation, 24 percent used seepage, and 4 percent used overhead sprinklers.

Table F-21. Irrigation Requirements for the Primary Citrus Acreage Projections in Collier County.

Year		1995	2000	2005	2010	2015	2020
Collier County Acreage[a]		36,559	39,911	43,924	47,938	51,952	55,966
Month	Supplemental Water Requirements (inches/acre)	Irrigation Requirements (millions of gallons)					
1-in-2							
January	1.32	1,542	1,683	1,852	2,022	2,191	2,360
February	1.43	1,659	1,811	1,993	2,175	2,357	2,539
March	2.40	2,803	3,060	3,368	3,676	3,983	4,291
April	3.11	3,632	3,966	4,364	4,763	5,162	5,561
May	3.08	3,597	3,927	4,322	4,717	5,112	5,507
June	1.46	1,705	1,862	2,049	2,236	2,423	2,611
July	2.25	2,628	2,869	3,157	3,446	3,734	4,023
August	2.21	2,581	2,818	3,101	3,385	3,668	3,952
September	1.87	2,184	2,384	2,624	2,864	3,104	3,344
October	2.64	3,084	3,366	3,705	4,043	4,382	4,720
November	2.00	2,336	2,550	2,807	3,063	3,320	3,576
December	1.67	1,951	2,129	2,344	2,558	2,772	2,986
Total	25.44	29,714	32,438	35,700	38,962	42,225	45,487
1-in-10							
January	1.45	1,694	1,849	2,035	2,221	2,407	2,593
February	1.74	2,032	2,219	2,442	2,665	2,888	3,111
March	3.16	3,691	4,029	4,434	4,840	5,245	5,650
April	3.78	4,415	4,820	5,304	5,789	6,274	6,759
May	3.87	4,520	4,935	5,431	5,927	6,423	6,920
June	2.06	2,406	2,627	2,891	3,155	3,419	3,683
July	2.62	3,060	3,341	3,677	4,013	4,349	4,685
August	2.59	3,025	3,302	3,635	3,967	4,299	4,631
September	2.38	2,780	3,035	3,340	3,645	3,950	4,255
October	3.25	3,796	4,144	4,561	4,977	5,394	5,811
November	2.16	2,523	2,754	3,031	3,308	3,585	3,862
December	1.81	2,114	2,308	2,540	2,772	3,004	3,236
Total	30.86	36,044	39,349	43,306	47,263	51,221	55,178

a. Acreage from **Table F-20**.

Lee County Citrus

Table F-22 presents historical citrus acreage in Lee County. The projected citrus acreage for Lee County presented in **Table F-23** were determined using a medium planting rate scenario as outlined by Behr et. al (1988) which developed three scenarios for future citrus planting rates (high, medium, and low). The medium growth rate represents additional growth at half the rate experienced between 1986 and 1988.

Table F-22. Historic Citrus Acreage in Lee County.

Year	Historic	Year	Historic
1966	195	1984	6,575
1968	743	1986	7,313
1970	5,427	1988	8,247
1972	7,290	1990	9,692
1974	7,397	1992	10,559
1976	6,243	1994	12,238
1978	5,384	1995	12,197[a]
1980	5,139	1996	12,155
1982	4,787	1998	11,871

a. The 1995 acreage is estimated by interpolating between the 1994 and 1996 acreages.

Table F-23. Projected Citrus Acreage in Lee County.

Year	Primary - 15%	Primary	Primary + 15%
1995	10,367	12,197[a]	14,027
1998	10,090	11,871[a]	13,652
2000	10,010	11,777	13,544
2005	10,940	12,870	14,800
2010	11,869	13,964	16,059
2015	12,798	15,057	17,316
2020	13,728	16,150	16,573

a. From **Table F-22**.

The 1-in-2 and 1-in-10 supplemental water requirements for citrus were divided by irrigation application efficiency to yield irrigation requirements (**Table F-24**). For the calculation of irrigation requirements, data from the Fort Myers rainfall station, soil with a water holding capacity of 0.8 in./ft., and the 1990 ratio of permitted irrigation systems were used (**Table F-17**). In 1990, 50 percent of the permitted citrus acreage in Lee County was irrigated using micro irrigation and 50 percent was irrigated using seepage irrigation.

Table F-24. Irrigation Requirements for the Primary Citrus Acreage Projections in Lee County.

Year		1995	2000	2005	2010	2015	2020
Lee County Acreage[a]		12,197	11,777	12,870	13,964	15,057	16,150
Month	Supplemental Water Requirements (inches/acre)	Irrigation Requirements (millions of gallons)					
1-in-2							
January	1.51	588	568	621	674	726	779
February	1.53	596	576	629	683	736	789
March	2.63	1,025	990	1,081	1,173	1,265	1,357
April	3.20	1,247	1,204	1,316	1,428	1,539	1,651
May	3.17	1,235	1,193	1,303	1,414	1,525	1,636
June	1.31	510	493	539	584	630	676
July	1.88	733	707	773	839	904	970
August	1.77	690	666	728	790	851	913
September	1.25	487	470	514	558	601	645
October	2.48	966	933	1,020	1,106	1,193	1,280
November	2.29	892	862	942	1,022	1,102	1,182
December	1.76	686	662	724	785	847	908
Total	24.77	9,652	9,320	10,185	11,051	11,915	12,780
1-in-10							
January	1.77	690	666	728	790	851	913
February	1.69	659	636	695	754	813	872
March	3.30	1,286	1,242	1,357	1,472	1,587	1,703
April	3.83	1,492	1,441	1,575	1,709	1,842	1,976
May	3.72	1,450	1,400	1,530	1,660	1,789	1,919
June	2.21	861	832	909	986	1,063	1,140
July	2.69	1,048	1,012	1,106	1,200	1,294	1,388
August	2.30	896	865	946	1,026	1,106	1,187
September	1.40	546	527	576	625	673	722
October	2.97	1,157	1,117	1,221	1,325	1,429	1,532
November	2.39	931	899	983	1,066	1,150	1,233
December	1.88	733	707	773	839	904	970
Total	30.16	11,753	11,348	12,401	13,455	14,508	15,561

a. Acreage from **Table F-23**.

Hendry Area Citrus

Table F-25 presents the historical citrus acreage for all of Hendry County. **Table F-26** presents projections for the whole county derived from a medium planting scenario as outlined by Behr et. al (1988). Seventy-two percent of the Hendry County citrus acreage is within the LWC Planning Area. This percentage was applied to the county projections to obtain the Hendry Area citrus acreage projections which are also presented in **Table F-26**.

Table F-25. Historic Citrus Acreage in Hendry County.

Year	Historic	Year	Historic
1966	16,152	1984	36,807
1968	19,988	1986	40,269
1970	22,447	1988	54,957
1972	22,684	1990	73,754
1974	24,225	1992	87,396
1976	25,944	1994	98,604
1978	28,903	1995	99,187[a]
1980	30,086	1996	99,770
1982	32,944	1998	100,124

a. The 1995 acreage is estimated by interpolating between the 1994 and 1996 acreages.

Table F-26. Projected Citrus Acreage in Hendry County and the Hendry Area.

Year	Hendry County			Hendry Area		
	Primary - 15%	Primary	Primary + 15%	Primary - 15%	Primary	Primary + 15%
1995	84,309	99,187[a]	114,065	60,703	71,415	82,127
1998	85,105	100,124[a]	115,143	61,276	72,089	82,903
2000	87,424	102,852	118,280	62,945	74,053	85,161
2005	89,743	105,580	121,417	64,615	76,018	87,420
2010	92,062	108,308	124,554	66,284	77,982	89,679
2015	94,381	111,036	127,691	67,954	79,946	91,938
2020	96,698	113,762	130,826	69,622	81,909[b]	94,195

a. From **Table F-25**.
b. An additional 12,748 gross acres of citrus were added for modeling purposes resulting in a total of 125,035 gross acres in the Caloosahatchee basin. To prevent misrepresentation, gross acreages and net acreages are not combined in this table.

The supplemental water requirements were divided by irrigation application efficiency to yield the irrigation requirements for the Hendry Area citrus (**Equation F-15**). These are presented in **Table F-27** for both a 1-in-2 year and a 1-in-10 drought year. For the calculation of irrigation requirements, data from the LaBelle rainfall station, soil with a water holding capacity of 0.8 in./ft., and the 1990 ratio of permitted irrigation systems were used (**Table F-17**). In 1990, the ratio of irrigation systems used on permitted citrus acreage in Hendry County was 60 percent micro irrigation, 36 percent seepage, and 4 percent overhead sprinklers.

Table F-27. Irrigation Requirements for the Primary Citrus Acreage Projections in the Hendry Area.

Year		1995	2000	2005	2010	2015	2020
Hendry County Acreage[a]		99,187	102,852	105,580	108,308	111,036	113,762
Hendry Area Acreage[a]		71,415	74,053	76,018	77,982	79,946	81,909
Month	Supplemental Water Requirements (inches/acre)	Irrigation Requirements (millions of gallons)					
1-in-2							
January	0.90	2,053	2,129	2,186	2,242	2,299	2,355
February	1.08	2,464	2,555	2,623	2,691	2,758	2,826
March	2.43	5,544	5,749	5,902	6,054	6,207	6,359
April	3.38	7,712	7,997	8,209	8,421	8,633	8,845
May	3.74	8,533	8,848	9,083	9,318	9,552	9,787
June	2.27	5,179	5,371	5,513	5,655	5,798	5,940
July	3.17	7,233	7,500	7,699	7,898	8,097	8,295
August	3.10	7,073	7,334	7,529	7,723	7,918	8,112
September	2.68	6,115	6,341	6,509	6,677	6,845	7,013
October	2.76	6,297	6,530	6,703	6,876	7,049	7,222
November	2.28	5,202	5,394	5,537	5,680	5,823	5,966
December	1.57	3,582	3,714	3,813	3,911	4,010	4,108
Total	29.27	66,782	69,249	71,086	72,923	74,759	76,595
1-in-10							
January	1.12	2,555	2,650	2,720	2,790	2,861	2,931
February	1.56	3,559	3,691	3,789	3,887	3,984	4,082
March	3.21	7,324	7,594	7,796	7,997	8,199	8,400
April	4.06	9,263	9,605	9,860	10,115	10,370	10,624
May	4.25	9,697	10,055	10,322	10,588	10,855	11,122
June	3.15	7,187	7,453	7,650	7,848	8,046	8,243
July	3.71	8,465	8,777	9,010	9,243	9,476	9,708
August	3.34	7,620	7,902	8,112	8,321	8,531	8,740
September	3.24	7,392	7,665	7,869	8,072	8,275	8,479
October	3.18	7,255	7,523	7,723	7,923	8,122	8,322
November	1.23	2,806	2,910	2,987	3,064	3,142	3,219
December	1.49	3,400	3,525	3,619	3,712	3,806	3,899
Total	34.23	78,098	80,984	83,132	85,280	87,428	89,574

a. Acreage is from **Table F-26**.

Hendry Area Citrus Nurseries

The only portion of the LWC Planning Area which has significant citrus nursery acreage is the Hendry Area. Citrus nursery acreage in the Hendry Area has been quite volatile, with acreage generally responding to the same types of factors as influence citrus acreage. Given the volatility in historic citrus nursery acreage in the Hendry Area and the recent slow down in citrus acreage growth, the decision was made to hold citrus nursery acreage at its 1995 level, which is approximately 145 acres. The estimated irrigation requirements for citrus nursery acreage in the Hendry Area is 160.1 MGY.

Glades Area Citrus

The same eight generic models, described for Collier County in **Equations F-18** through **F-25**, were run for Glades County. On the basis of statistical goodness-of-fit criteria an equation of the form of **Equation F-21** was selected. The results are shown in **Equation F-26**. The independent variables included in **Equation F-21** below are as follows:

TIME = *one in 1966 and increases by one unit per year thereafter*

D_3 = *a dichotomous variable equal to zero prior to 1980 and one in 1980 and thereafter*

The dichotomous variable corresponds fairly closely to the onset of the series of severe winters, so the D variable picks up a portion of the interregional shift in citrus production within Florida associated with severe winters in the mid-1980's.

Equation F-26 was estimated using weighted least squares, with the highest weight being assigned to the most recent year for which data was available and with weights declining geometrically with time.

The logic of this formulation is that Lee County citrus acreage was almost flat from 1966 to 1978; the weighting method selected applies the greatest weight to the most recent data. Weighted regression was selected to account for the observed heteroscedasticity of the Glades County citrus data.

Historical citrus acreage in Glades County are presented in **Table F-28**. When projections were made using **Equation F-26**, adjusted to pass through the 1998 historic citrus acreage, the results shown in **Table F-29** were obtained. Fifty-two percent of the Glades County citrus acreage is within the LWC Planning Area. This percentage was applied to the county projections to obtain the Glades Area citrus acreage projections (**Table F-29**).

Table F-28. Historic Citrus Acreage in Glades County.

Year	Historic	Year	Historic
1966	1,413	1984	5,141
1968	1,461	1986	6,076
1970	1,572	1988	6,235
1972	1,639	1990	7,523
1974	1,661	1992	9,136
1976	1,615	1994	9,270
1978	1,613	1995	9,336
1980	3,395	1996	9,402
1982	4,026	1998	10,776

(F-26)

Multiple Regression Report

Page/Date/Time	1 07-07-1999 16:05:47
Database	C:\My Documents\DATA\Wumps\Citrus\Glacit.S0
Dependent	GLACIT
Weight	WEIGHT

Regression Equation Section

Independent Variable	Regression Coefficient	Standard Error	T-Value (Ho: B=0)	Prob Level	Decision (5%)	Power (5%)
Intercept	-1254.708	554.5659	-2.2625	0.040097	Reject Ho	0.558103
TIME	330.5913	30.05212	11.0006	0.000000	Reject Ho	1.000000
D3	969.9697	488.3197	1.9863	0.066932	Accept Ho	0.456211
R-Squared	0.968245					

Regression Coefficient Section

Independent Variable	Regression Coefficient	Standard Error	Lower 95% C.L.	Upper 95% C.L.	Standardized Coefficient
Intercept	-1254.708	554.5659	-2444.133	-65.28213	0.0000
TIME	330.5913	30.05212	266.1359	395.0467	0.8570
D3	969.9697	488.3197	-77.37193	2017.311	0.1547
T-Critical	2.144787				

Analysis of Variance Section

Source	DF	Sum of Squares	Mean Square	F-Ratio	Prob Level	Power (5%)
Intercept	1	3.855331E+08	3.855331E+08			
Model	2	8.089883E+07	4.044942E+07	213.4407	0.000000	1.000000
Error	14	2653158	189511.3			
Total(Adjusted)	16	8.355199E+07	5222000			

Root Mean Square Error	435.3289	R-Squared	0.9682
Mean of Dependent	6634.969	Adj R-Squared	0.9637
Coefficient of Variation	0.0656113	Press Value	2.128602E+08
Sum |Press Residuals|	23896.56	Press R-Squared	-1.5476

Normality Tests Section

Assumption	Value	Probability	Decision(5%)
Skewness	2.4418	0.014614	Rejected
Kurtosis	1.5161	0.129494	Accepted
Omnibus	8.2609	0.016075	Rejected

Serial-Correlation Section

Lag	Correlation	Lag	Correlation	Lag	Correlation
1	0.603577	9	0.132122	17	
2	0.263842	10	0.129558	18	
3	-0.028691	11	0.078291	19	
4	-0.277835	12	0.119781	20	
5	-0.394043	13	0.037731	21	
6	-0.358361	14	-0.061802	22	
7	-0.130131	15	-0.075028	23	
8	-0.031908	16	0.025211	24	

Above serial correlations significant if their absolute values are greater than 0.485071

Durbin-Watson Value 0.8865

Table F-29. Projected Citrus Acreage in Glades County and the Glades Area.

Year	Glades County			Glades Area		
	Primary - 15%	Primary	Primary + 15%	Primary - 15%	Primary	Primary + 15%
1995	7,936	9,336[a]	10,736	4,127	4,855	5,583
1998	9,160	10,777[a]	12,393	4,763	5,604	6,444
2000	9,554	11,240	12,926	4,968	5,845	6,722
2005	10,542	12,402	14,262	5,482	6,449	7,417
2010	11,529	13,563	15,598	5,995	7,053	8,111
2015	12,516	14,725	16,934	6,509	7,657	8,806
2020	13,504	15,877	18,270	7,022	8,261	9,501

a. From **Table F-28**.

The supplemental water requirements were divided by irrigation application efficiency to yield the irrigation requirements for the Glades Area citrus (**Equation F-15**). These are presented in **Table F-27** for both a 1-in-2 year and a 1-in-10 drought year. For the calculation of irrigation requirements, data from the Moore Haven rainfall station, soil with a water holding capacity of 0.8 in./ft., and micro irrigation estimated application efficiency were used (**Table F-17**). Although a sizeable acreage of citrus in the Glades Area has not converted to micro irrigation, the decision was made to estimate irrigation requirements based on the micro irrigation system efficiencies. This was done because micro irrigation is becoming the standard irrigation system in the area. Although existing permit allocations will be recognized, for long range planning purposes it is deemed desirable to plan for micro irrigation efficiencies.

Table F-30. Irrigation Requirements for the Primary Citrus Acreage Projections in the Glades Area.

Year		1995	2000	2005	2010	2015	2020
Glades County Acreage[a]		9,336	11,240	12,402	13,563	14,725	15,887
Glades Area Acreage[a]		4,855	5,845	6,449	7,053	7,657	8,261
Month	**Supplemental Water Requirements (inches/acre)**	**Irrigation Requirements (millions of gallons)**					
1-in-2							
January	1.45	225	271	299	327	355	383
February	1.46	226	273	301	329	357	385
March	2.38	369	444	490	536	582	628
April	2.86	444	534	589	644	700	755
May	2.92	453	545	602	658	714	771
June	1.97	306	368	406	444	482	520
July	2.46	382	459	507	554	602	649
August	2.47	383	461	509	557	604	652
September	1.75	271	327	361	394	428	462
October	2.44	379	456	503	550	597	644
November	2.13	330	398	439	480	521	562
December	1.65	256	308	340	372	404	435
Total	25.92	4,020	4,840	5,340	5,840	6,341	6,841
1-in-10							
January	1.62	251	303	334	365	396	428
February	1.58	245	295	326	356	387	417
March	3.09	479	577	637	696	756	816
April	3.47	538	648	715	782	849	916
May	3.56	552	665	733	802	871	940
June	2.83	439	528	583	638	692	747
July	3.11	483	581	641	701	761	821
August	2.73	423	510	562	615	668	721
September	2.16	335	403	445	487	528	570
October	2.92	453	545	602	658	714	771
November	2.19	340	409	451	493	536	578
December	1.78	276	332	367	401	435	470
Total	31.04	4,814	5,796	6,395	6,994	7,593	8,192

a. Acreage is from **Table F-29**.

Charlotte Area Citrus

Historic citrus acreage within Charlotte County is presented in **Table F-31**.

Table F-31. Historic Citrus Acreage in Charlotte County.

Year	Historic	Year	Historic
1966	5,048	1984	8,220
1968	6,052	1986	8,759
1970	6,734	1988	9,345
1972	6,640	1990	11,718
1974	6,549	1992	15,981
1976	6,408	1995	20,589
1978	6,100	1994	19,995
1980	6,122	1996	21,183
1982	6,120	1998	21,522

A variety of variables and functional forms were tested, and models of the general form of **Equation F-17** were found to best explain past trends in citrus acreage in Charlotte County, as was the case for Collier and Glades Counties. The dichotomous variable D was assigned as follows:

D = *a dichotomous variable equal to zero before 1984 and equal to one from 1984 to the present*

The dichotomous variable corresponds fairly closely to the onset of the series of severe winters, so the D variable picks up a portion of the interregional shift in citrus production within Florida associated with these severe winters. On the basis of these goodness-of-fit statistics, **Equation F-27** was estimated, based on functional form **Equation F-22**. The independent variables included in **Equation F-27** are as follows:

TIME = *one in 1966 and increases by one unit per year thereafte*

WHITEINT= *the real price of white interior region grapefruit*

REALO = *the real average price of all oranges*

PINKINT = *the real price of pink interior region grapefruit*

D = *a dichotomous variable equal to zero prior to 1994 and one in 1994 and thereafter*

Equation F-27 was estimated using weighted least squares, with the highest weight being assigned to the most recent year for which data was available and with weights declining geometrically with time. Like Glades County, Charlotte County experienced little growth in citrus acreage between 1966 and 1980.

Equation F-27 was utilized to project the Charlotte County citrus acreage (**Table F-32**). The percent of Charlotte County citrus acreage located within the Charlotte Area is 15 percent. To obtain projected citrus acreage for the Charlotte Area, the projected acreage for the county was multiplied by 15 percent (**Table F-32**).

(F-27)

Multiple Regression Report

Page/Date/Time	1 04-12-1999 09:46:17
Database	C:\My Documents\LWCWSP\charcit.S0
Dependent	CHARCIT
Weight	Weight

Regression Equation Section

Independent Variable	Regression Coefficient	Standard Error	T-Value (Ho: B=0)	Prob Level	Decision (5%)	Power (5%)
Intercept	-3211.662	4456.808	-0.7206	0.486176	Accept Ho	0.101141
TIME	327.2331	66.86897	4.8936	0.000476	Reject Ho	0.993309
WHITEINT	-965.6926	397.4951	-2.4294	0.033443	Reject Ho	0.600533
REALO	-116.0678	392.6572	-0.2956	0.773044	Accept Ho	0.058438
PINKINT	2189.808	728.2482	3.0070	0.011931	Reject Ho	0.781452
D	12799.77	2703.675	4.7342	0.000615	Reject Ho	0.990115
R-Squared	0.979194					

Regression Coefficient Section

Independent Variable	Regression Coefficient	Standard Error	Lower 95% C.L.	Upper 95% C.L.	Standardized Coefficient
Intercept	-3211.662	4456.808	-13021.03	6597.706	0.0000
TIME	327.2331	66.86897	180.0555	474.4107	0.4254
WHITEINT	-965.6926	397.4951	-1840.573	-90.81165	-0.3170
REALO	-116.0678	392.6572	-980.3005	748.1649	-0.0340
PINKINT	2189.808	728.2482	586.9443	3792.671	0.6442
D	12799.77	2703.675	6849.025	18750.52	0.9709
T-Critical	2.200985				

Analysis of Variance Section

Source	DF	Sum of Squares	Mean Square	F-Ratio	Prob Level	Power (5%)
Intercept	1	1.46212E+09	1.46212E+09			
Model	5	3.252992E+08	6.505985E+07	103.5408	0.000000	0.999999
Error	11	6911849	628349.9			
Total(Adjusted)	16	3.322111E+08	2.076319E+07			

Root Mean Square Error	792.6852	R-Squared	0.9792
Mean of Dependent	12921.1	Adj R-Squared	0.9697
Coefficient of Variation	6.134812E-02	Press Value	8.534025E+07
Sum |Press Residuals|	19920.97	Press R-Squared	0.7431

The 1-in-2 (average) and 1-in-10 supplemental water requirements for the Charlotte Area are shown in **Table F-33.** The supplemental water requirements were divided by irrigation application efficiency to yield 1-in-2 and 1-in-10 irrigation requirements (**Equation F-15**). For the calculation of irrigation requirements, data from the LaBelle rainfall station, soil with a water holding capacity of 0.8 in./ft., and the estimated application efficiency of micro irrigation were used (**Table F-17**). All citrus permitted by the District in August 1990 in the Charlotte Area had micro irrigation and all future citrus is expected to be irrigated with similar systems.

Table F-32. Projected Citrus Acreage in Charlotte County and the Charlotte Area.

Year	Charlotte County			Charlotte Area		
	Primary - 15%	Primary	Primary + 15%	Primary - 15%	Primary	Primary + 15%
1995	17,501	20,589[a]	23,677	2,625	3,088	3,551
1998	18,294	21,522[a]	24,750	2,744	3,228	3,713
2000	18,850	22,176	25,503	2,827	3,326	3,825
2005	20,241	23,813	27,385	3,036	3,572	4,108
2010	21,631	25,449	29,266	3,245	3,817	4,390
2015	23,022	27,085	31,148	3,453	4,063	4,672
2020	24,413	28,721	33,029	3,662	4,308	4,954

a. From **Table F-31**.

Table F-33. Irrigation Requirements for the Primary Citrus Acreage Projections in the Charlotte Area.

Year		1995	2000	2005	2010	2015	2020
Charlotte County Acreage[a]		20,589	22,176	23,813	25,449	27,085	28,721
Charlotte Area Acreage		3,088	3,326	3,572	3,817	4,063	4,308
Month	**Supplemental Water Requirements (inches/acre)**	**Irrigation Requirements (millions of gallons)**					
1-in-2							
January	1.43	141	152	163	174	186	197
February	1.47	145	156	168	179	191	202
March	2.39	236	254	273	291	310	329
April	2.86	282	304	326	349	371	394
May	2.91	287	309	332	355	378	401
June	1.29	127	137	147	157	167	178
July	2.03	200	216	232	248	264	279
August	2.02	199	215	231	246	262	278
September	1.84	182	196	210	224	239	253
October	2.24	221	238	256	273	291	308
November	2.11	208	224	241	257	274	290
December	1.58	156	168	180	193	205	217
Total	24.17	2,396	2,581	2,772	2,962	3,153	3,343
1-in-10							
January	1.67	165	177	191	204	217	230
February	1.62	160	172	185	198	210	223
March	3.16	312	336	361	385	410	435
April	3.52	347	374	402	429	457	484
May	3.40	335	361	388	415	441	468
June	2.11	208	224	241	257	274	290
July	2.52	249	268	288	307	327	347
August	2.25	222	239	257	274	292	310
September	2.36	233	251	269	288	306	325
October	2.65	261	282	302	323	344	365
November	2.05	202	218	234	250	266	282
December	1.50	148	159	171	183	195	206
Total	27.86	2,749	2,960	3,179	3,397	3,616	3,834

a. Acreage is from **Table F-32**.

Field Crops

Sugarcane is the most significant field crop within the LWC Planning Area. It is produced commercially in the Hendry and Glades areas. Other field crops grown within the LWC Planning Area include rice, seed corn, and soybean. Rice is produced commercially in the Glades Area and seed corn and soybean are produced commercially in the Charlotte Area.

Sugarcane

Historical sugarcane acreage data were gathered from annual volumes of the Field Crops Summary (FASS, various issues). Approximately 20 percent more land is associated with sugarcane production than will be reported as production by FASS. This is due to the manner in which sugar cane is propagated. Sugarcane is initially propagated vegetatively by planting stalk cuttings. The first harvest takes place approximately 13 months after planting. Roots are left in the ground (ratooned) and yield additional crops of sugarcane which take about 12 months to reach maturity. Sugar production per unit of land surface declines gradually and progressively with each additional ratoon, and there comes a point where the increased yields associated with replanting outweigh the cost of replanting. In Florida this point comes on average after four years (1 planting and 3 ratoons). The final ratoon on a parcel of land will be harvested from November through March and replanting will take place from September through January. During the months between harvesting and replanting, no sugarcane is on that parcel and the land is fallowed during this period. This land will not require irrigation and, therefore, is not included in the projections presented here.

Sugarcane acreage projections were developed using trend analysis. Sugar cane acreage growth is limited by available space or haulage distance to the nearest sugar mill.The historical projections, presented in the tables, are net acres based on FASS information. During the development of the CWMP additional sugarcane acres were added to these projections. Based on local knowledge provided by agricultural interests on the CWMP Advisory Committee, an additional 45,210 gross acres of sugarcane were added to these projections. These 45,210 gross acres were combined with the converted historical projection's net acreages resulting in a total of 125,007 gross acres of sugarcane in the Caloosahatchee basin for the 2020 demand projections for modeling purposes. A variety of variables and functional forms were tested and two models which were able to explain past trends in sugarcane acreage are shown in **Equations F-28** and **F-29**.

$$A_{jt} = a + (b_1 \text{ x } t) + (b_2 \text{ x } D) \tag{F-28}$$

$$A_{jt} = a + (b_1 \text{ x } P_{re}) + (b_2 \text{ x } t) + (b_3 \text{ x } t \text{ x } D) \tag{F-29}$$

where:

A_{jt} = *sugarcane acreage in area j in time t*

t = *a linear trend variable*

P_{re} = *the real price of sugarcane received by farmers*

D = *a dichotomous variable equal to zero prior to 1985 and equal to one from 1985 to the present*

Hendry Area Sugarcane

Historic sugarcane acreages for Hendry County are presented in **Table F-34**.

Table F-34. Historic Sugarcane Acreage in Hendry County[a].

Year	Historic	Year	Historic
1975	50,637	1987	61,720
1976	52,545	1988	62,525
1977	51,579	1989	60,252
1978	53,214	1990	76,467
1979	57,217	1991	78,533
1980	58,173	1992	77,500
1981	62,476	1993	75,433
1982	72,750	1994	75,433
1983	69,281	1995	72,333
1984	74,923	1996	72,333
1985	56,571	1997	73,366
1986	58,257		

a. An additional 45,210 gross acres of sugarcane were added for modeling purposes resulting in a total of 125,007 gross acres in the Caloosahatchee Basin. To prevent misrepresentation, gross acreages and net acreages are not combined in this table.

After examining a variety of functional forms, it was concluded that a flat projection for sugarcane and seed cane was appropriate. Consequently, Hendry County sugar and seed acreage was held flat at its 1997 level of 73,366 acres. The percentage of Hendry County sugarcane acreage within the LWC Planning Area is 49 percent, resulting in a constant primary projected sugarcane acreage of 36,927 acres for the Hendry Area through the year 2020. The primary range is from 31,388 to 42,466 acres.

There are two basic soil types, muck and sand, on which sugarcane is grown in Hendry County. Presently there are approximately 35,000 acres of sugarcane produced annually on muck in Hendry County and this is anticipated to remain constant over the projection period. All expansion in sugarcane acreage is expected to take place on sand. All modeling estimates are based on sandland sugarcane production. Sugarcane is assumed to use seepage irrigation, with an irrigation application efficiency of 50 percent. 1-in-2 and 1-in-10 irrigation requirements were calculated for the primary projection, and are shown in **Table F-35.** For the calculation of irrigation requirements, data from the LaBelle rainfall station and soil with a water holding capacity of 0.8 in./ft. were used (**Table F-17**).

Table F-35. Irrigation Requirements for the Primary Sugarcane Acreage Projections in the Hendry Area.

Year		1995	2000 through 2020
Hendry County Acreage[a]		72,233	73,366
Hendry Area Acreage		35,443	36,927
Month	Supplemental Water Requirements (inches/acre)	Irrigation Requirements (millions of gallons)	
1-in-2			
January	0.56	1,077	1,093
February	0.19	365	371
March	1.68	3,230	3,280
April	2.36	4,537	4,608
May	2.84	5,459	5,545
June	1.77	3,403	3,456
July	2.55	4,902	4,979
August	2.86	5,498	5,584
September	2.01	3,864	3,924
October	3.32	6,382	6,482
November	2.32	4,460	4,530
December	1.76	3,383	3,436
Total	24.25	46,616	47,348
1-in-10			
January	0.80	1,538	1,562
February	0.34	654	664
March	2.42	4,652	4,725
April	3.00	5,767	5,857
May	3.33	6,401	6,502
June	2.62	5,036	5,115
July	3.07	5,902	5,994
August	3.10	5,959	6,053
September	2.55	4,902	4,979
October	3.76	7,228	7,341
November	2.26	4,344	4,413
December	1.67	3,210	3,261
Total	28.92	55,594	56,466

a. Acreage is from **Table F-34**.

Glades Area Sugarcane

Historic Glades County sugarcane acreage is shown in **Table F-36**. The Glades County sugarcane acreage has been constant at 19,633 acres for the past eight years. This flat trend in acreage is projected to continue through 2020. Eighty-three percent of this sugarcane acreage, or 16,295 acres, is in the LWC Planning Area and the primary range is from 13,851 acres to 18,739 acres.

Table F-36. Historic Sugarcane Acreage in Glades County.[a]

Year	Historic	Year	Historic
1975	16,636	1987	20,020
1976	18,545	1988	20,321
1977	16,842	1989	20,119
1978	18,260	1990	19,633
1979	19,454	1991	19,633
1980	20,096	1992	19,633
1981	22,908	1993	19,633
1982	22,904	1994	19,633
1983	22,924	1995	19,633
1984	26,015	1996	19,633
1985	15,599	1997	19,633
1986	17,165		

a. An additional 45,210 gross acres of sugarcane were added for modeling purposes resulting in a total of 125,007 gross acres in the Caloosahatchee Basin. To prevent misrepresentation, gross acreages and net acreages are not combined in this table.

Average (1-in-2) and 1-in-10 irrigation requirements were calculated for the primary projection using **Equation F-15** (**Table F-37**). For the calculation of irrigation requirements, data from the Moore Haven rainfall station and soil with a water holding capacity of 0.8 in./ft. were used. Sugarcane is grown on both muck and sand in the Glades Area. Presently there are approximately 13,000 acres of sugarcane produced annually on muck. Sugarcane is assumed to use seepage irrigation, with an irrigation application efficiency of 50 percent. The input variables used are summarized in **Table F-17** at the beginning of the crop discussion.

Table F-37. Irrigation Requirements for the Primary Sugarcane Acreage Projections in the Glades Area through the Year 2020.

Year	1995 through 2020			
Glades County Acreage	19,633			
Glades Area Acreage	16,295			
	1-in-2		1-in-10	
Month	Supplemental Water Requirements (inches/acre)	Irrigation Requirements (millions of gallons)	Supplemental Water Requirements (inches/acre)	Irrigation Requirements (millions of gallons)
January	0.61	540	0.77	681
February	0.20	177	0.31	274
March	1.68	1,487	2.37	2,097
April	2.37	2,097	2.97	2,628
May	2.86	2,531	3.50	3,098
June	2.47	2,186	3.36	2,974
July	2.99	2,646	3.67	3,248
August	3.33	2,947	3.61	3,195
September	1.93	1,708	2.34	2,071
October	3.54	3,133	4.05	3,584
November	2.34	2,071	2.40	2,124
December	1.83	1,620	1.97	1,743
Total	26.14	23,134	31.31	27,710

Glades Area Rice

Rice is grown in Glades County during the summer months in rotation with sugarcane or winter vegetables, taking place on land that would otherwise be fallow. All of the rice grown within Glades County is within the Glades Area. Rice acreage in the Glades Area was assessed at 200 acres in 1995 by the local IFAS extension offices and research centers. Based on milling capacity, acreage is projected to increase to 800 acres by 2020.

The 1-in-2 and 1-in-10 supplemental water requirements for rice in the Glades Area are shown in **Table F-38.** The supplemental water requirements were divided by irrigation application efficiency to yield 1-in-2 and 1-in-10 irrigation requirements (**Equation F-15**). For the calculation of irrigation requirements, data from the Moore Haven rainfall station, soil with a water holding capacity of 0.8 in./ft., and the estimated application efficiency of seepage irrigation were used (**Table F-17**).

Table F-38. Irrigation Requirements for the Primary Rice Acreage Projections in the Glades Area.

Year		1995	2000 through 2020
Glades County Acreage		200	800
Glades Area Acreage		200	800
Month	**Supplemental Water Requirements (inches/acre)**	**Irrigation Requirements (millions of gallons)**	
1-in-2			
January	1.33	14	58
February	2.72	30	118
March	3.66	40	159
April	0.00	0	0
May	0.00	0	0
June	0.00	0	0
July	0.00	0	0
August	0.00	0	0
September	0.00	0	0
October	1.97	21	86
November	3.62	39	157
December	2.80	30	122
Total	16.09	175	699
1-in-10			
January	1.50	16	65
February	2.85	31	124
March	4.43	48	192
April	0.00	0	0
May	0.00	0	0
June	0.00	0	0
July	0.00	0	0
August	0.00	0	0
September	0.00	0	0
October	2.43	26	106
November	3.69	40	160
December	2.94	32	128
Total	17.84	194	775

Charlotte Area Seed Corn and Soy Beans

Field crop production in the Charlotte Area 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. For 1995, the local IFAS extension office estimated Charlotte County seed corn production at 2,100 acres and soybean production at 1,000 acres. This acreage is all located within the Charlotte Area. While fluctuations are anticipated, the magnitude of this acreage is typical and projected acreages for these crops were continued at their current level.

The 1-in-2 and 1-in-10 supplemental water requirements for rice in the Glades Area are shown in **Table F-39.** The supplemental water requirements were divided by irrigation application efficiency to yield 1-in-2 and 1-in-10 irrigation requirements (**Equation F-15**). For the calculation of irrigation requirements, data from the LaBelle rainfall station, soil with a water holding capacity of 0.8 in./ft., and the estimated application efficiency of seepage irrigation were used (**Table F-17**).

Table F-39. Irrigation Requirements for Seed Corn and Soy Bean Acreage in the Charlotte Area through the Year 2020.

Year	1995 through 2020			
Charlotte County Acreage	3,100			
Charlotte Area Acreage	3,100			
	1-in-2		1-in-10	
Month	Supplemental Water Requirements (inches/acre)	Irrigation Requirements (millions of gallons)	Supplemental Water Requirements (inches/acre)	Irrigation Requirements (millions of gallons)
January	0.37	62	0.59	99
February	1.86	313	2.02	340
March	3.16	532	3.98	670
April	0.00	0	0.00	0
May	0.00	0	0.00	0
June	0.00	0	0.00	0
July	0.00	0	0.00	0
August	0.00	0	0.00	0
September	0.00	0	0.00	0
October	0.35	59	0.71	120
November	2.53	426	2.48	418
December	2.31	389	2.22	374
Total	10.58	1,782	12.00	2,020

Tropical fruit

With the exception of citrus, all categories of tropical fruit (avocados, mangoes, etc.) were grouped together for projection purposes. Lee is the only county in the LWC Planning Area with significant tropical fruit acreage.

Lee County Tropical Fruit

In 1995, Lee County had 1,930 acres of tropical fruit (IFAS, 1989). A statistically valid trend could not be established due to insufficient historical data. However, the local IFAS extension office estimated that presently tropical fruit acreage is increasing at a rate of approximately 50 acres a year. This leads to estimates of tropical fruit acreage to be 2,180 acres in 2000, 2,430 acres in 2005, 2,680 acres in 2010, 2,930 acres in 2015, and 3,180 acres in 2020 (**Table F-40**).

The District's Blaney-Criddle permitting model has no category for tropical fruit as a grouping. The crop category of avocado was used to calculate irrigation requirements for all tropical fruit since they currently make up over 80 percent of the permitted noncitrus tropical fruit acreage in Lee County.

Ninety percent of the tropical fruit acreage currently permitted belongs to one large permittee which produces the bulk of avocados in Lee County. Although the current acreage is mostly seepage irrigated it is felt by the local IFAS extension office that future tropical fruit acreage will be irrigated with micro irrigation for reasons similar to those which justify its use on future citrus acreage.

The irrigation requirements for 1995 through 2020 were estimated assuming that the tropical fruit was irrigated with a 50 percent efficiency factor. Average (1-in-2) and 1-in-10 irrigation requirements for the primary tropical fruit acreage projections for Lee County are presented in **Table F-40.** Data from the Fort Myers rainfall station and soil with a water holding capacity of 0.8 in./ft. were used (**Table F-17**).

Table F-40. Irrigation Requirements for the Primary Tropical Fruit Acreage Projections in Lee County.

Year		1995	2000	2005	2010	2015	2020
Lee County Acreage		1,930	2,180	2,430	2,680	2,930	3,180
Month	**Supplemental Water Requirements (inches/acre)**	**Irrigation Requirements (millions of gallons)**					
1-in-2							
January	0.20	21	24	26	29	32	35
February	0.67	70	79	88	98	107	116
March	2.15	225	255	284	313	342	371
April	3.20	335	379	422	466	509	553
May	3.63	381	430	479	528	578	627
June	1.92	201	227	253	279	306	332
July	2.27	238	269	300	330	361	392
August	1.77	186	210	234	258	282	306
September	0.84	88	99	111	122	134	145
October	1.69	177	200	223	246	269	292
November	1.25	131	148	165	182	199	216
December	0.48	50	57	63	70	76	83
Total	20.06	2,103	2,375	2,647	2,920	3,192	3,465
1-in-10							
January	0.44	46	52	58	64	70	76
February	0.82	86	97	108	119	130	142
March	2.80	294	332	370	408	446	484
April	3.83	401	453	505	557	609	661
May	4.19	439	496	553	610	667	724
June	2.86	300	339	377	416	455	494
July	3.10	325	367	409	451	493	535
August	2.30	241	272	304	335	366	397
September	0.99	104	117	131	144	158	171
October	2.17	227	257	286	316	345	375
November	1.34	140	159	177	195	213	231
December	0.59	62	70	78	86	94	102
Total	25.44	2,667	3,012	3,358	3,703	4,048	4,394

Vegetables

A variety of vegetable crops are grown in the LWC Planning Area. These include cucumbers, peppers, squash, eggplant, tomatoes, potatoes, latin vegetables, and watermelon. They were grouped together for projection purposes. This was validated by the lack of significant difference in the irrigation requirements of different types of vegetables cultivated in the LWC Planning Area, and because different types of vegetables are often grown interchangeably.

Historic vegetable acreages were determined using data reported in the FASS Vegetable Summaries. In some instances, data on a specific crop within a specific county was not available. In these case either an estimate or default value was provided by the local IFAS extension office. Adjustments then had to be made to all of the data to account for double-cropping, nonharvested acreage, and the land between rows.

Historic acreages were assembled following the steps listed below for Collier, Lee, and Hendry counties. The data available for Glades and Charlotte counties was insufficient for this method to be used. The resulting historic acreages for Collier, Lee, and Hendry counties are presented in **Tables F-42**, **F-45**, and **F-48**.

1. Data was gathered from FASS Vegetable Summaries and/or from the local IFAS extension office.
2. Much of the vegetable land is double-cropped, and as many of the acreage data sources report harvested production, these data had to be adjusted to reflect acres of land in production. FASS and IFAS reports acreage as acres of production, i.e., 10 acres of land cultivated twice a year is reported as 20 acres. Acreages of double-cropped vegetables (cucumbers, peppers, squash, tomatoes, and eggplants) were divided by two to reflect the two growing seasons, and summed to yield the double-cropped subtotal.
3. The double-cropped and single-cropped vegetable acreages were subtotaled.
4. An examination of historical planted versus harvested acreage for vegetable crops within South Florida showed that an average of 15 percent of the acreage cultivated is not harvested. As FASS presently only reports harvested acreage, this 15 percent needed to be added to reflect the nonharvested vegetable row acreage. Therefore, the subtotal of all crops was increased by 15 percent to account for nonharvested acreage.
5. Vegetable acreage data reported in the in the FASS Vegetable Summaries and by IFAS represent the estimated area of land in the production rows, or, as it is sometimes termed, “under plastic”. The District's model for estimating irrigation requirements is based on total land acreage, which includes the

land necessary for vegetable production, but not in rows (spaces between rows, irrigation furrows, etc.). Land in rows represents approximately 60 percent of this total land (Pitts, 1991), so the row acreage was divided by 0.6 to yield the total acreage column.

Vegetable fields are usually planted and harvested sequentially, therefore, some portion of the land acreage used for vegetable production is commonly vacant. This temporal area of vegetable land vacancy effects total irrigation requirement, but it is difficult to quantify, because many eventualities occur which change production timing. For instance, freezes may necessitate replanting, which would delay the spring growing season; or growers may enter into a contract to harvest vegetables in any time window, which would in turn determine their growing season. Also, as seepage irrigation is the predominant type of irrigation system used for vegetable production, some of these vacant fields are unavoidably irrigated, either in part or whole. With these constraints in mind, generalized cultivation schedules were developed for each county with the assistance of the local IFAS extension office (**Table F-41).**

Vegetables are planted throughout the year, and crop evapotranspiration values depend on planting dates. In order to determine the supplemental irrigation requirements (**Equation F-16**) for vegetables, average evapotranspiration values were developed based on an average of Blaney-Criddle values with planting dates at the beginning of each month.

Vegetable acreage within the LWC Planning Area was particularily low during the 1996-97 growing season. This is due in part to unusually low vegetable prices. While more recent data from the 1997-98 Vegetable Summary indicates that the 1997-98 vegetable acreage increased over the 1996-97 levels, the downward trend is expected to continue. However, the ability of growers to move rapidly into and out of vegetable production makes long range forcasting difficult.

Table F-41. Generalized Cultivation Schedule for Vegetable Crops.

		Tomatoes	Cucumbers	Squash	Peppers	Potatoes	Watermelons	Total
Total Acres Produced		8,500	450	350	2,750	1,600	1,900	15,550
Total Acres of Land		4,250	225	175	1,375	1,600	1,900	9,525
Crops per year		2	2	2	2	1	1	
Percent in Ground								
January	Acres Produced	50%	50%	50%	50%	100%	50%	
	Acres of Land	22%	1%	1%	7%	17%	10%	58%
February	Acres Produced	100%	100%	100%	100%	100%	100%	
	Acres of Land	45%	2%	2%	14%	17%	20%	100%
March	Acres Produced	100%	100%	100%	100%	66%	100%	
	Acres of Land	45%	2%	2%	14%	11%	20%	94%
April	Acres Produced	100%	100%	100%	100%	33%	100%	
	Acres of Land	45%	2%	2%	14%	6%	20%	89%
May	Acres Produced	50%	50%	50%	50%	0%	50%	
	Acres of Land	22%	1%	1%	7%	0%	10%	42%
June	Acres Produced	0%	0%	0%	0%	0%	0%	
	Acres of Land	0%	0%	0%	0%	0%	0%	0%
July	Acres Produced	0%	0%	0%	0%	0%	0%	
	Acres of Land	0%	0%	0%	0%	0%	0%	0%
August	Acres Produced	50%	50%	50%	50%	0%	0%	
	Acres of Land	22%	1%	1%	7%	0%	0%	32%
September	Acres Produced	100%	100%	100%	100%	0%	0%	
	Acres of Land	45%	2%	2%	14%	0%	0%	63%
October	Acres Produced	100%	100%	100%	100%	100%	0%	
	Acres of Land	45%	2%	2%	14%	17%	0%	80%
November	Acres Produced	100%	100%	100%	100%	100%	0%	
	Acres of Land	45%	2%	2%	14%	17%	0%	80%
December	Acres Produced	50%	50%	50%	50%	100%	0%	
	Acres of Land	22%	1%	1%	7%	17%	0%	48%

Collier County Vegetables

Table F-42 shows historical vegetable acreage in Collier County. Acreage data for cucumbers, peppers, squash, tomatoes, and watermelons were gathered from FASS Vegetable Summaries. A default value for potatoes was estimated by the local IFAS vegetable extension agent.

Table F-42. Historic Collier County Vegetable Acreage.

	Step 1[a]				Step 2	Step 1		Step 3	Step 4	Step 5
	Double-Cropped					Single-Cropped				
Year	Cucumbers	Peppers	Squash	Tomatoes	Double-Cropped Subtotal	Watermelons	Potatoes	Subtotal of all Crops	Nonharvested Subtotal	Total
1967	3,250	3,180	760	2,060	4,625	2,900	1,600	9,125	10,494	17,490
1968	3,600	2,630	450	2,000	4,340	2,700	1,600	8,640	9,936	16,560
1969	4,070	3,530	340	1,940	4,940	3,000	1,600	9,540	10,971	18,285
1970	2,750	2,430	520	3,240	4,470	2,300	1,600	8,370	9,626	16,043
1971	2,900	2,950	420	2,885	4,578	2,900	1,600	9,078	10,439	17,399
1972	2,850	2,930	460	3,400	4,820	2,590	1,600	9,010	10,362	17,269
1973	2,700	3,650	460	3,520	5,165	1,600	1,600	8,365	9,620	16,033
1974	2,450	3,500	520	3,230	4,850	1,700	1,600	8,150	9,373	15,621
1975	3,400	3,890	1,000	3,775	6,033	1,450	1,600	9,083	10,445	17,408
1976	3,700	5,050	1,050	4,380	7,090	1,200	1,600	9,890	11,374	18,956
1977	3,070	5,850	1,900	5,110	7,965	1,400	1,600	10,965	12,610	21,016
1978	3,050	6,250	1,550	6,630	8,740	1,350	1,600	11,690	13,444	22,406
1979	2,600	4,750	1,500	6,800	7,825	1,850	1,600	11,275	12,966	21,610
1980	2,350	4,050	1,550	7,235	7,593	2,150	1,600	11,343	13,044	21,740
1981	2,450	4,000	1,700	9,130	8,640	2,400	1,600	12,640	14,536	24,227
1982	2,500	3,800	1,550	7,510	7,680	2,500	1,600	11,780	13,547	22,578
1983	2,100	3,400	1,800	7,950	7,625	2,700	1,600	11,925	13,714	22,856
1984	1,900	3,000	1,900	8,650	7,725	3,100	1,600	12,425	14,289	23,815
1985	1,600	2,800	2,000	8,800	7,600	3,500	1,600	12,700	14,605	24,342
1986	2,100	3,100	1,700	9,400	8,150	3,500	1,600	13,250	15,237	25,396
1987	1,700	3,800	1,500	12,000	9,500	3,400	1,600	14,500	16,675	27,792
1988	1,350	4,800	1,100	14,560	10,905	4,000	1,600	16,505	18,981	31,635
1989	1,350	5,100	1,000	16,250	11,850	4,600	1,600	18,050	20,758	34,596
1990	1,300	5,200	700	13,750	10,475	4,700	1,600	16,775	19,291	32,152
1991	1,000	5,400	550	13,660	10,305	3,300	1,600	15,205	17,486	29,143
1992	1,750	4,500	600	14,100	10,475	4,000	1,600	16,075	18,486	30,810
1993	1,330	5,525	500	12,900	10,128	3,000	1,600	14,728	16,937	28,228
1994	800	6,000	1,100	12,700	10,300	4,000	1,600	15,900	18,285	30,475
1995	725	4,075	1,250	10,325	8,188	2,800	1,600	12,588	14,476	24,126
1996	700	3,060	650	10,400	7,405	2,500	1,600	11,505	13,231	22,051
1997	450	2,750	350	8,500	6,025	1,900	1,600	9,525	10,954	18,256

a. Steps from **page F-63**.

ARIMA (auto regressive integrated moving average) modeling was used to forecast future vegetable acreage in Collier County. For a discussion of ARIMA modeling, see Box, Jenkins, and Reinsel (1994) and Hintze (1999). ARIMA modeling takes a series of data points, such as Collier County vegetable acreage, and by examining auto correlations in the data, develops a description of a stochastic process which describes the observed data and can be used to forecast future values in the series. The model developed to forecast Collier County vegetable acreage, shown in **Equation F-30** below, represents a (2,1,0) (two auto regressive terms, first differencing, no moving average terms) logarithmic model. The resulting projected acreages for Collier County vegetables is shown in **Table F-43**.

(F-30)

ARIMA Report

Page/Date/Time	1 04-14-1999 13:49:10
Database	C:\MY DOCUMENTS\LWCWSP\COLVEG.S0
Variable	LOG10(TOTVEG)-MEAN

Model Description Section

Series	LOG10(TOTVEG)-MEAN
Model	Regular(2,1,0) Seasonal(No seasonal parameters)
Mean	4.348372
Observations	31
Iterations	1
Pseudo R-Squared	85.853993
Residual Sum of Squares	4.430294E-02
Mean Square Error	1.582248E-03
Root Mean Square	3.977748E-02

Model Estimation Section

Parameter Name	Parameter Estimate	Standard Error	T-Value	Prob Level
AR(1)	8.303617E-02	0.1914817	0.4337	0.664542
AR(2)	0.3054164	0.1907544	1.6011	0.109355

Asymptotic Correlation Matrix of Parameters

	AR(1)	AR(2)
AR(1)	1.000000	0.024034
AR(2)	0.024034	1.000000

Table F-43. Projected Vegetable Acreage the Collier County.

Year	Primary - 15%	Primary	Primary + 15%
1995	20,507	24,126[a]	27,745
1997	15,518	18,256[a]	20,994
2000	13,057	15,361	17,666
2005	12,174	14,322	16,471
2010	11,921	14,025	16,128
2015	11,646	13,701	15,756
2020	11,549	13,587	15,625

a. From **Table F-43**

Table F-44 shows the supplemental water requirements and the irrigation requirements for vegetables in Collier County during 1-in-2 years and 1-in-10 drought years. Data from the Immokalee rainfall station and soil with a water holding capacity of 0.8 in./ft. were used in the calculations (**Table F-17**).

Table F-44. Irrigation Requirements for the Primary Vegetable Acreage Projections in Collier County.

Year		1995	2000	2005	2010	2015	2020
Collier County Acreage[a]		24,126	15,361	14,322	14,025	13,701	13,587
Month	Supplemental Water Requirements (inches/acre)	Irrigation Requirements (millions of gallons)					
1-in-2							
January	0.99	1,297	826	770	754	737	731
February	1.96	2,568	1,635	1,525	1,493	1,458	1,446
March	2.12	2,778	1,769	1,649	1,615	1,578	1,564
April	0	0	0	0	0	0	0
May	0	0	0	0	0	0	0
June	0	0	0	0	0	0	0
July	0	0	0	0	0	0	0
August	0	0	0	0	0	0	0
September	0	0	0	0	0	0	0
October	1.84	2,411	1,535	1,431	1,402	1,369	1,358
November	2.58	3,381	2,152	2,007	1,965	1,920	1,904
December	1.59	2,083	1,327	1,237	1,211	1,183	1,173
Total	11.08	14,518	9,244	8,619	8,440	8,245	8,176
1-in-10							
January	1.12	1,468	934	871	853	833	826
February	2.28	2,988	1,902	1,774	1,737	1,697	1,682
March	2.86	3,748	2,386	2,225	2,179	2,128	2,111
April	0.00	0	0	0	0	0	0
May	0.00	0	0	0	0	0	0
June	0.00	0	0	0	0	0	0
July	0.00	0	0	0	0	0	0
August	0.00	0	0	0	0	0	0
September	0.00	0	0	0	0	0	0
October	2.42	3,171	2,019	1,882	1,843	1,801	1,786
November	2.75	3,603	2,294	2,139	2,095	2,046	2,029
December	1.74	2,280	1,452	1,353	1,325	1,295	1,284
Total	13.16	17,244	10,979	10,237	10,024	9,793	9,711

a. Acreages are from **Table F-46**.

Lee County Vegetables

Table F-45 shows the historical vegetable acreage in Lee County by type. Historical acreage data for cucumbers, peppers, tomatoes, and watermelons were gathered from FASS Vegetable Summaries. Historical squash and potato acreage was assessed as a constant percentage of production in the "South" region of Florida (as reported by FASS), based on production data provided by the local IFAS extension office for the 1988-1989 growing season (IFAS, 1991). A default value of 1,000 acres of latin vegetables was based on production reported by the local IFAS extension office for the 1988-89 growing season (IFAS, 1989). A default value of 500 acres was entered for watermelon for the six year period between 1977 and 1982. During this period FASS incorporated Lee County's watermelon acreage with several other counties and reported a total for the "South" region.

Table F-45. Historic Vegetable Acreage in Lee County.

	Step 1[a]				Step 2	Step 1			Step 3	Step 4	Step 5
	Double-Cropped					Single-Cropped					
Year	Cucumbers	Peppers	Squash	Tomatoes	Double-Cropped Subtotal	Potatoes	Latin	Watermelon	Subtotal of all Crops	Nonharvested Subtotal	Total
1974	1,580	1,650	674	600	2,252	278	1,000	600	4,130	4,750	7,917
1975	1,500	1,830	907	640	2,438	251	1,000	450	4,140	4,761	7,935
1976	1,550	1,850	953	485	2,419	215	1,000	450	4,085	4,697	7,829
1977	1,380	1,950	1,209	650	2,595	215	1,000	500	4,310	4,957	8,261
1978	1,500	2,230	1,079	1,145	2,977	215	1,000	500	4,692	5,396	8,994
1979	1,500	2,280	1,130	1,595	3,253	233	1,000	500	4,986	5,734	9,556
1980	1,350	1,950	1,163	1,790	3,126	215	1,000	500	4,842	5,568	9,280
1981	1,400	1,800	1,209	1,040	2,725	260	1,000	500	4,485	5,158	8,596
1982	1,450	1,900	1,395	1,210	2,978	278	1,000	500	4,756	5,469	9,115
1983	1,450	1,750	1,442	920	2,781	188	1,000	500	4,469	5,140	8,566
1984	1,600	1,650	1,488	650	2,694	269	1,000	600	4,563	5,248	8,747
1985	2,000	1,600	1,581	1,030	3,106	305	1,000	1,000	5,411	6,222	10,371
1986	2,000	1,350	1,279	1,670	3,150	287	1,000	800	5,237	6,022	10,037
1987	1,800	1,500	1,093	1,700	3,047	287	1,000	700	5,034	5,789	9,648
1988	1,650	1,700	977	1,480	2,903	287	1,000	800	4,991	5,739	9,565
1989	1,450	1,800	900	1,540	2,845	359	1,000	1,100	5,304	6,100	10,166
1990	1,650	1,600	900	1,350	2,750	455	1,000	900	5,105	5,871	9,785
1991	1,700	1,650	750	2,310	3,205	455	1,000	900	5,560	6,394	10,657
1992	1,500	1,600	1,000	2,200	3,150	455	1,000	900	5,505	6,331	10,551
1993	1,450	1,350	1,100	2,800	3,350	455	1,000	1,600	6,405	7,366	12,276
1994	0	800	2,200	3,000	3,000	455	1,000	1,400	5,855	6,733	11,222
1995	0	1,265	1,600	2,725	2,795	455	1,000	1,000	5,250	6,038	10,063
1996	0	0	1,150	2,475	1,813	455	1,000	1,100	4,368	5,023	8,371
1997	0	0	450	2,000	1,225	455	1,000	1,000	3,680	4,232	7,053

a. Steps from **page F-63**.

Since acreage estimates for all vegetable crops were aggregated for projection purposes, there is no single price measure which accurately reflects the economic returns to vegetable production. Consequently, double exponential smoothing was used to project Lee County vegetable acreage. The basic equations for double exponential smoothing are shown in **Equations F-31** through **F-34**. For a more detailed discussion of double exponential smoothing see Hintze (1999) and Thomopoulos (1983).

$$F_t = a_t + \quad b_t \qquad (F\text{-}31)$$

$$at = Xt + (1\text{-}I)2et \qquad (F\text{-}32)$$

$$bt = bt\text{-}1 + I2\ et \qquad (F\text{-}33)$$

$$et = Ft - Xt \qquad (F\text{-}34)$$

When the double exponential smoothing model shown in **Equations F-31** through **F-34** was used to forecast Lee County vegetable acreage, the results shown in **Equation F-35** were obtained. Projected acreages are presented in **Table F-46**.

Forecast Summary Section *(F-35)*

Log10(Variable)Historic

Number of Rows26

Mean 9245.923

Pseudo R-Squared0.341084

Mean Square Error953378.9

Mean |Error|676.0744

Mean |Percent Error|7.447038

Forecast MethodDouble Smooth

Search CriterionNone

Alpha 0.3

Intercept (A)4.374196

Slope (B) -1.786233E-02

Warning Missing values were detected and replaced.

Table F-46. Projected Vegetable Acreage Lee County.

Year	Primary - 15%	Primary	Primary + 15%
1994-95	8,553	10,062[a]	11,571
1996-97	5,995	7,053[a]	8,111
1997-98	4,622	5,438	6,253
1999-00	4,099	4,822	5,545
2004-05	2,964	3,487	4,010
2009-10	2,040	2,401	2,761
2014-15	1,288	1,516	1,743
2019-20	676	796	915

a. From **Table F-45**.

Lee County vegetable irrigation requirements were estimated based on two three-month growing seasons: September through December and January through March. For the calculation of irrigation requirements, data from the Fort Myers rainfall station and soil with a water holding capacity of 0.8 in./ft. were used. Vegetables are assumed to use seepage irrigation systems with an irrigation application efficiency of 50 percent. Average (1-in-2) and 1-in-10 irrigation requirements for the primary vegetable acreage projection for Lee County are presented in **Table F-47**.

Table F-47. Irrigation Requirements for the Primary Vegetable Acreage Projections in Lee County.

Year		1995	2000	2005	2010	2015	2020
Lee County Acreage[a]		10,062	4,822	3,487	2,401	1,516	796
Month	Supplemental Water Requirements (inches/acre)	Irrigation Requirements (millions of gallons)					
1-in-2							
January	1.17	639	306	222	153	96	51
February	2.06	1,126	539	390	269	170	89
March	2.34	1,279	613	443	305	193	101
April	0.00	0	0	0	0	0	0
May	0.00	0	0	0	0	0	0
June	0.00	0	0	0	0	0	0
July	0.00	0	0	0	0	0	0
August	0.00	0	0	0	0	0	0
September	0.00	0	0	0	0	0	0
October	1.67	913	437	316	218	138	72
November	2.89	1,579	757	547	377	238	125
December	1.68	918	440	318	219	138	73
Total	11.82	6,459	3,096	2,239	1,541	973	511
1-in-10							
January	1.43	781	375	271	186	118	62
February	2.23	1,219	584	422	291	184	96
March	3.00	1,639	786	568	391	247	130
April	0.00	0	0	0	0	0	0
May	0.00	0	0	0	0	0	0
June	0.00	0	0	0	0	0	0
July	0.00	0	0	0	0	0	0
August	0.00	0	0	0	0	0	0
September	0.00	0	0	0	0	0	0
October	2.14	1,169	560	405	279	176	93
November	2.99	1,634	783	566	390	246	129
December	1.81	989	474	343	236	149	78
Total	13.60	7,432	3,562	2,576	1,773	1,120	588

a. Acreages are from **Table F-46**.

Hendry County Vegetables

Table F-48 shows historical acreages used for Hendry County vegetable production. Acreage data for cucumbers, peppers, tomatoes, and watermelons were gathered from FASS Vegetable Summaries. A default value for squash and eggplant was estimated by the local IFAS extension office.

Table F-48. Historic Vegetable Acreage in Hendry County.

	Step 1[a]				Step 2	Step 1	Step 3	Step 4	Step 5
	Double-Cropped					Single-Cropped			
Year	Cucumbers	Peppers	Tomatoes	Squash and Eggplant	Double-Cropped Subtotal	Watermelons	Subtotal of all Crops	Non-harvested Subtotal	Total
1966-67	950	800	5,810	600	4,080	3,800	7,880	9,062	15,103
1967-68	1,225	950	5,680	600	4,228	4,200	8,428	9,692	16,153
1968-69	1,290	1,200	4,720	600	3,905	3,500	7,405	8,516	14,193
1969-70	1,200	1,920	4,975	600	4,348	3,100	7,448	8,565	14,274
1970-71	1,240	1,930	4,420	600	4,095	3,600	7,695	8,849	14,749
1971-72	1,060	1,780	3,710	600	3,575	3,880	7,455	8,573	14,289
1972-73	900	1,580	4,110	600	3,595	2,450	6,045	6,952	11,586
1973-74	900	1,500	2,720	600	2,860	2,200	5,060	5,819	9,698
1974-75	1,500	1,670	2,255	600	3,013	2,050	5,063	5,822	9,703
1975-76	1,700	2,100	2,305	600	3,353	1,650	5,003	5,753	9,588
1976-77	1,850	2,200	1,030	600	2,840	1,900	4,740	5,451	9,085
1977-78	1,750	2,250	2,095	600	3,348	1,550	4,898	5,632	9,387
1978-79	1,750	2,200	2,580	600	3,565	1,500	5,065	5,825	9,708
1979-80	1,600	1,850	2,775	600	3,413	1,950	5,363	6,167	10,278
1980-81	1,650	1,760	2,530	600	3,270	2,500	5,770	6,635	11,059
1981-82	1,700	1,700	2,080	600	3,040	2,600	5,640	6,486	10,810
1982-83	1,600	1,600	1,530	600	2,665	3,100	5,765	6,630	11,050
1983-84	1,500	1,300	1,085	600	2,243	3,000	5,243	6,029	10,048
1984-85	1,200	1,200	1,370	600	2,185	2,800	4,985	5,733	9,555
1985-86	1,600	1,300	1,580	600	2,540	2,600	5,140	5,911	9,852
1986-87	1,800	1,700	1,700	600	2,900	2,500	5,400	6,210	10,350
1987-88	1,450	1,800	2,360	600	3,105	2,500	5,605	6,446	10,743
1988-89	1,600	3,000	3,270	600	4,235	2,500	6,735	7,745	12,909
1989-90	1,650	2,500	2,550	600	3,650	2,200	5,850	6,727	11,212
1990-91	1,150	1,900	3,830	600	3,740	1,900	5,640	6,486	10,810
1991-92	1,400	2,150	4,700	600	4,425	2,300	6,725	7,734	12,890
1992-93	1,150	2,000	3,950	600	3,850	2,500	6,350	7,303	12,171
1993-94	900	2,800	5,050	600	4,675	2,900	7,575	8,711	14,519
1994-95	1,600	2,760	5,200	600	5,080	2,500	7,580	8,717	14,528
1995-96	1,350	4,405	4,125	600	5,240	3,200	8,440	9,706	16,177
1996-97	1,300	3,100	3,300	600	4,150	2,600	6,750	7,763	12,938

a. Steps from **page F-63**.

Since acreage estimates for all vegetable crops were aggregated for projection purposes, there is no single price measure that accurately reflects the economic returns to vegetable production. Consequently an ARIMA model was used to forecast the Hendry County vegetable acreage. This is the same general approach as was used to project Collier County vegetable acreage. A model using log-transformed data with a trend and one auto regressive, no differencing, and one moving average term was estimated as shown in **Equation F-36** below.

(F-36)

ARIMA Report

Page/Date/Time	1 04-16-1999 14:46:31
Database	
Variable	LOG10(Historic)-TREND

Model Description Section

Series	LOG10(Historic)-TREND
Model	Regular(1,0,1) Seasonal(No seasonal parameters)
Trend Equation	(4.071891)+(-1.696033E-04)x(date)
Observations	31
Iterations	2
Pseudo R-Squared	69.379696
Residual Sum of Squares	5.657366E-02
Mean Square Error	1.950816E-03
Root Mean Square	4.416804E-02

Model Estimation Section

Parameter Name	Parameter Estimate	Standard Error	T-Value	Prob Level
AR(1)	0.767853	0.2210278	3.4740	0.000513
MA(1)	-0.1477162	0.3364121	-0.4391	0.660594

Asymptotic Correlation Matrix of Parameters

	AR(1)	MA(1)
AR(1)	1.000000	0.850659
MA(1)	0.850659	1.000000

Projections for both Hendry County and the Hendry Area are presented in **Table F-49.** Fifty percent of Hendry County's vegetable acreage is within the LWC Planning Area. Projected vegetable acreage for the Hendry Area were determined by multiplying the projected vegetable acreage for the county by this percentage.

Table F-49. Projected Vegetable Acreage in Hendry County and the Hendry Area.

Year	Hendry County			Hendry Area		
	Primary - 15%	Primary	Primary + 15%	Primary - 15%	Primary	Primary + 15%
1995	12,349	14,528[a]	16,707	6,174	7,264	8,354
1999	8,288	9,751	11,214	4,876	5,607	2,438
2000	8,184	9,628	11,072	4,814	5,536	2,407
2005	7,925	9,324	10,723	4,662	5,361	2,331
2010	7,843	9,227	10,611	4,614	5,306	2,307
2015	7,807	9,185	10,563	4,593	5,281	2,296
2020	7,783	9,157	10,531	4,579	5,265	2,289

a. From **Table F-48**.

Table F-50 shows the supplemental water requirements and the irrigation requirements for vegetables in the Hendry Area during 1-in-2 years and 1-in-10 drought years. Data from the LaBelle rainfall station and soil with a water holding capacity of 0.8 in./ft. were used in the calculations (**Table F-17**).

Table F-50. Irrigation Requirements for the Primary Vegetable Acreage Projections in the Hendry Area.

Year		1995	2000	2005	2010	2015	2020
Hendry County Acreage[a]		14,528	9,628	9,324	9,227	9,185	9,157
Hendry Area Acreage[a]		7,264	5,536	5,361	5,306	5,281	5,265
Month	Supplemental Water Requirements (inches/acre)	Irrigation Requirements (millions of gallons)					
1-in-2							
January	1.10	1,250	828	802	794	790	788
February	2.00	2,272	1,506	1,458	1,443	1,437	1,432
March	2.10	2,386	1,581	1,531	1,515	1,509	1,504
April	0.00	0	0	0	0	0	0
May	0.00	0	0	0	0	0	0
June	0.00	0	0	0	0	0	0
July	0.00	0	0	0	0	0	0
August	0.00	0	0	0	0	0	0
September	0.00	0	0	0	0	0	0
October	1.46	1,659	1,099	1,065	1,054	1,049	1,046
November	2.69	3,056	2,026	1,962	1,941	1,932	1,926
December	1.50	1,704	1,129	1,094	1,082	1,078	1,074
Total	10.85	12,328	8,170	7,912	7,830	7,794	7,770
1-in-10							
January	1.33	1,511	1,001	970	960	955	952
February	2.16	2,454	1,626	1,575	1,559	1,552	1,547
March	2.87	3,261	2,161	2,093	2,071	2,062	2,055
April	0	0	0	0	0	0	0
May	0	0	0	0	0	0	0
June	0	0	0	0	0	0	0
July	0	0	0	0	0	0	0
August	0	0	0	0	0	0	0
September	0	0	0	0	0	0	0
October	1.85	2,102	1,393	1,349	1,335	1,329	1,325
November	2.64	3,000	1,988	1,925	1,905	1,896	1,891
December	1.42	1,613	1,069	1,035	1,025	1,020	1,017
Total	12.27	13,941	9,239	8,948	8,854	8,814	8,787

a. Acreages are from **Table F-49**.

Glades Area Vegetables

The Glades Area vegetable production is included in the "West Central" area as defined by the FASS Vegetable Summaries, and acreage data for the Glades Area individually is not available from FASS. The only vegetable acreage data available was that supplied by the local IFAS extension agent, and only for 1989. Due to the lack of historical data future vegetable acreage was projected at its current level. Present vegetable production is very modest in the Glades Area (approximately 473 acres), and is projected to remain constant by the local extension office. The primary projection for the six time horizons is therefore 473 acres, and the primary range is from 317 to 545 acres.

Vegetable crops grown in the Glades Area are usually cultivated twice a year between August and May with 100% of the cultivated crops in ground during all six months. Irrigation requirements were calculated using data collected from the Moore Haven rainfall station and soil with a water holding capacity of 0.8 in./ft. **Table F-51** presents estimated vegetable irrigation requirements in the Glades Area based on the projected constant vegetable acreage of 473 acres.

Table F-51. Irrigation Requirements for the Primary Vegetable Acreage Projections in the Glades Area through the Year 2020.

Year	**1995 through 2020**			
Glades County Acreage	763			
Glades Area Acreage	473			
	1-in-2		**1-in-10**	
Month	**Supplemental Water Requirements (inches/acre)**	**Irrigation Requirements (millions of gallons)**	**Supplemental Water Requirements (inches/acre)**	**Irrigation Requirements (millions of gallons)**
January	1.12	29	1.33	33
February	1.97	51	2.16	54
March	2.10	54	2.87	72
April	0	0	0.00	0
May	0	0	0.00	0
June	0	0	0.00	0
July	0	0	0.00	0
August	0	0	0.00	0
September	0	0	0.00	0
October	1.64	42	1.85	54
November	2.72	70	2.64	71
December	1.57	40	1.42	44
Total	11.13	286	12.26	328

Charlotte Area Vegetables

Charlotte County's historical vegetable acreage is combined with other counties' data when published in the FASS Vegetable Summaries. Because of this consolidation, data from the Vegetable Summaries were not suitable to establish crop acreages or production trends. Vegetable acreage in Charlotte County is estimated at 2,402 land acres, based on communication with the local Cooperative Extension Service representative.

No meaningful trend or explanatory mathematical model could be developed due to the lack of historical vegetable acreage data for Charlotte County. Therefore, irrigated vegetable acreage was projected to remain constant at 2,402 acres (with a primary range of 2,042 to 2,762 acres) through the year 2020. The projection of a constant vegetable acreage for Charlotte County is not inconsistent with the vegetable acreage projections developed for neighboring Hendry and Lee counties, where there were enough data to establish trends.

Unpublished SCS maps for 1989 show that about 96 percent of the vegetable production in Charlotte County takes place in the LWC Planning Area portion of the county. The vegetable land acreage estimate for the Charlotte Area was based on this ratio, and is equal to 2,306 acres with a primary range of 1,960 to 2,652.

The generalized vegetable cultivation schedule in the Charlotte Area is October through March with 100% of the 2,306 acres planted**. Table F-52** shows the supplemental water requirements and irrigation requirements for vegetable crops using the primary acreage projection and the cultivation schedule. For the calculation of irrigation requirements, data from the LaBelle rainfall station and soil with a water holding capacity of 0.8 in./ft. were used (**Table F-17**).

Table F-52. Irrigation Requirements for the Primary Vegetable Acreage Projections in the Charlotte Area through the Year 2020.

Year		1995 through 2020		
Charlotte County Acreage		2,402		
Charlotte Area Acreage		2,306		
	1-in-2		1-in-10	
Month	Supplemental Water Requirements (inches/acre)	Irrigation Requirements (millions of gallons)	Supplemental Water Requirements (inches/acre)	Irrigation Requirements (millions of gallons)
January	1.10	138	1.33	167
February	2.00	250	2.16	271
March	2.10	263	2.87	359
April	0.00	0	0.00	0
May	0.00	0	0.00	0
June	0.00	0	0.00	0
July	0.00	0	0.00	0
August	0.00	0	0.00	0
September	0.00	0	0.00	0
October	1.46	183	1.85	232
November	2.69	337	2.64	331
December	1.50	188	1.42	178
Total	10.86	1,360	12.26	1,535

Sod

There is some variation in the production practices of sod in the LWC Planning Area. Some harvested sod is irrigated, and some is not, serving largely as pasture until the sod is sold. As the objective here is to project irrigation requirement, only irrigated sod is addressed. Historical acreages of sod were provided by the local IFAS extension offices and research centers.

Lee County Sod

There were 650 acres of irrigated sod in Lee County in 1989 (IFAS, 1989). No meaningful trend or explanatory mathematical model could be developed due to the lack of historical sod acreage data in Lee County; and no convincing empirical knowledge of future changes in sod acreage was available from the local IFAS extension office. Therefore, irrigated sod acreage was projected to remain relatively constant through the year 2020 at 650 acres, and the primary range is from 553 to 748 acres.

The irrigation requirements in **Table F-53** were calculated by applying the current irrigated acreage to the District's modified Blaney-Criddle permitting model. Input variables used were 650 acres of grass, sandy soil with 0.8 in./ft. water holding capacity, seepage systems with an irrigation application efficiency of 50 percent, and data from the Fort Myers rainfall station (**Table F-17**).

Table F-53. Irrigation Requirements for the Primary Sod Acreage Projections in Lee County through the Year 2020.

Year		1995 through 2020		
Lee County Acreage		650		
	1-in-2		1-in-10	
Month	Supplemental Water Requirements (inches/acre)	Irrigation Requirements (millions of gallons)	Supplemental Water Requirements (inches/acre)	Irrigation Requirements (millions of gallons)
January	1.00	35	1.26	44
February	1.29	46	1.37	48
March	2.87	101	3.55	125
April	4.04	143	4.71	166
May	4.41	156	5.00	177
June	2.57	91	3.56	126
July	3.24	114	4.13	146
August	3.04	107	3.62	128
September	2.22	78	2.38	84
October	3.09	109	3.60	127
November	2.51	89	2.61	92
December	1.76	62	1.88	66
Total	31.95	1,128	37.68	1,330

Cut Flowers

Cut flower acreages are not included with the ornamental nursery acreage reported by the Division of Plant Industry, and are projected separately. Hendry is the only county in the LWC Planning Area with a significant cut flower acreage.

Hendry Area Cut Flowers

Currently there is only one company producing cut flowers (gladiolus) commercially in the Hendry Area. The local IFAS extension office estimated that approximately 1,000 acres of land is used at any one time for this purpose. No meaningful trend or explanatory mathematical model could be developed due to the lack of historical flower acreage data in the Hendry Area. Therefore, irrigated cut flower acreage was projected to remain constant through the year 2020. The primary projection through the year 2020 is 1,000 acres, and the primary range is from 850 to 1,150 acres.

Table F-54 shows the supplemental water requirements and irrigation requirements for Hendry Area cut flowers. For the calculation of irrigation requirements,

Table F-54. Irrigation Requirements for the Primary Cut Flower Acreage Projections in the Hendry Area through the Year 2020.

Year		1995 through 2020		
Hendry Area Acreage		1,000		
	1-in-2		1-in-10	
Month	Supplemental Water Requirements (inches/acre)	Irrigation Requirements (millions of gallons)	Supplemental Water Requirements (inches/acre)	Irrigation Requirements (millions of gallons)
January	0.93	51	1.16	63
February	1.15	62	1.30	71
March	2.62	142	3.41	185
April	3.68	200	4.38	238
May	4.12	224	4.65	253
June	2.54	0	3.44	0
July	3.39	0	3.94	0
August	3.30	0	3.55	0
September	2.84	154	3.40	185
October	2.84	154	3.26	177
November	2.32	126	2.26	123[a]
December	1.58	86	1.50	81[a]
Total	31.32	1,199	36.25	1,375

a. Indicates 1-in-10 irrigation requirements are less than 1-in-2 irrigation requirements.

data from the LaBelle rainfall station, soil with a water holding capacity of 0.8 in./ft. were used, and seepage irrigation systems with an irrigation application efficiency of 50 percent (**Table F-17**). Currently the Blaney-Criddle permitting model has no category of cut flowers so the value for sod is used for permitting purposes. Cut flowers grown in the Hendry Area are usually cultivated from September through May, with no production taking place in the months of June, July, and August. The absence of this crop in the summer months is reflected in the irrigation requirement calculation.

Ornamental Nursery

Historical commercial nursery acreage data were gathered from annual volumes of the Division of Plant Industry’s Annual Reports (FDACS, Various Issues).

The majority of ornamental nurseries in the LWC Planning Area use overhead sprinkler systems for irrigation. Normally, overhead sprinkler irrigation systems are estimated by the District to have an irrigation application efficiency of 75 percent. However, an indeterminable number of nurseries containerize their plants, and this reduces the irrigation application efficiency to approximately 20 percent. To account for this range of efficiencies an overall efficiency of 50 percent was assumed.

Currently the District's Blaney-Criddle permitting model has no category for ornamental nursery, and the value for grass is used for permitting purposes.

Collier County Ornamental Nurseries

Collier County ornamental nursery acreage is expanding. However, due to the inconsistent nature of historical acreage data, no meaningful trend or explanatory mathematical model could be developed. In 1995, there were 1,288 acres of ornamental nursery in Collier County. In 1996, there were 1,246 acres. A reasonable projected growth rate for the next five years is 30 acres per year. If this rate is applied throughout the projection period, it leads to estimates of 1,365 acres in 2000, 1,515 acres in 2005, 1,665 acres in 2010, 1,815 acres in 2015, and 1,965 acres in 2020. Historical and projected Collier County ornamental nursery acreages are shown in **Tables F-55** and **F-56**, respectively**.**

Irrigation requirements for the ornamental nursery acreage projections are shown in **Table F-57**. For the calculation of irrigation requirements, data from the Naples rainfall station and soil with a water holding capacity of 0.8 in./ft. were used **(Table F-17**).

Table F-55. Historic Ornamental Nursery Acreage in Collier County.

Year	Historic	Year	Historic
1972	416	1985	227
1973	600	1986	226
1974	336	1987	528
1975	1035	1988	578
1976	360	1989	946
1977	496	1990	1,382
1979	329	1991	1,507
1980	286	1992	1,400
1981	291	1993	1,605
1982	328	1994	1,267
1983	328	1995	1,288
1984	260	1996	1,245

Table F-56. Projected Ornamental Nursery Acreage in Collier County.

Year	Primary - 15%	Primary	Primary + 15%
1995	1,095	1,288[a]	1,481
2000	1,160	1,365	1,570
2005	1,288	1,515	1,742
2010	1,415	1,665	1,915
2015	1,543	1,815	2,087
2020	1,670	1,965	2,260

a. From **Table F-55**.

Table F-57. Irrigation Requirements for the Primary Ornamental Nursery Acreage Projections in Collier County.

Year		1995	2000	2005	2010	2015	2020
Collier County Acreage[a]		1,288	1,365	1,515	1,665	1,815	1,965
Month	**Supplemental Water Requirements (inches/acre)**	**Irrigation Requirements (millions of gallons)**					
1-in-2							
January	1.09	76	81	90	99	107	116
February	1.35	94	100	111	122	133	144
March	3.30	231	245	272	298	325	352
April	4.07	285	302	335	368	401	434
May	4.24	297	314	349	383	418	453
June	3.16	221	234	260	286	312	337
July	3.44	241	255	283	311	339	367
August	3.31	232	245	272	299	326	353
September	2.22	155	165	183	201	219	237
October	2.91	204	216	239	263	287	311
November	2.66	186	197	219	241	262	284
December	1.97	138	146	162	178	194	210
Total	33.73	2,360	2,501	2,775	3,050	3,325	3,600
1-in-10							
January	1.27	89	94	104	115	125	136
February	1.49	104	110	123	135	147	159
March	3.86	270	286	318	349	381	412
April	4.82	337	357	397	436	475	514
May	4.97	348	368	409	449	490	530
June	4.34	304	322	357	392	428	463
July	4.19	293	311	345	379	413	447
August	3.74	262	277	308	338	369	399
September	2.72	190	202	224	246	268	290
October	3.15	220	234	259	285	311	336
November	2.85	199	211	235	258	281	304
December	2.15	150	159	177	194	212	229
Total	39.53	2,765	2,931	3,253	3,575	3,897	4,219

a. Acreages are from **Table F-56**.

Lee County Ornamental Nurseries

In order to project Lee County ornamental nursery acreage, a model of the form shown in **Equation F-37** was estimated.

$$LEENON_t = f(Time, D, logtime) \qquad (F\text{-}37)$$

where:

$LEENON_t$ = *Lee County ornamental nursery acreage in year t.*

Time = *A time trend variable equal to one in 1972 and is increased by one unit per year thereafter.*

D = *one in 1993 and after, zero otherwise.*

Logtime = *The natural logarithm of time.*

The D variable was included to take into account a large increase from 739 acres to 939 acres in 1993 (**Table F-58**). It is hypothesized that this one-time increase in ornamental nursery acreage may have been associated with replacement of plants damaged by the freezes in the mid- to late-1980's.

Table F-58. Historic Ornamental Nursery Acreage in Lee County.

Year	Historic	Year	Historic
1972	251	1985	441
1973	264	1986	398
1974	158	1987	625
1975	285	1988	486
1976	232	1989	508
1977	267	1990	606
1978		1991	717
1979	251	1992	739
1980	370	1993	939
1981	406	1994	1,090
1982	437	1995	1,303
1983	413	1996	1,553
1984	430		

When **Equation F-37** was estimated using ordinary least squares, the results in **Equation F-38** were obtained. **Equation F-38** was estimated using ordinary least squares, with variables defined as:

Historic = *historic Lee County ornamental nursery acreage*

D_2 = *a dichotomous variable equal to one in 1993 and after and zero prior to 1993*

Time = *a time-trend variable equal to one in 1972 and increasing one unit per year thereafter*

Logtime = *the natural logarithm of Time*

Equation F-38 was used to generate the primary projection for Lee County ornamental nursery acreage. The resulting projections are shown in **Table F-59.**

(F-38)

Multiple Regression Report

Page/Date/Time	1 04-21-1999 12:23:59
Database	C:\My Documents\DATA\Wumps\Nursery\Leenurs.S0
Dependent	historic

Regression Equation Section

Independent Variable	Regression Coefficient	Standard Error	T-Value (Ho: B=0)	Prob Level	Decision (5%)	Power (5%)
Intercept	244.8879	76.77889	3.1895	0.004605	Reject Ho	0.858403
D2	421.283	82.87559	5.0833	0.000057	Reject Ho	0.997928
Time	42.7734	10.18032	4.2016	0.000439	Reject Ho	0.978947
logtime	-142.6481	76.77893	-1.8579	0.077967	Accept Ho	0.424235
R-Squared	0.928344					

Regression Coefficient Section

Independent Variable	Regression Coefficient	Standard Error	Lower 95% C.L.	Upper 95% C.L.	Standardized Coefficient
Intercept	244.8879	76.77889	84.7299	405.0458	0.0000
D2	421.283	82.87559	248.4075	594.1584	0.4522
Time	42.7734	10.18032	21.53762	64.00919	0.8934
logtime	-142.6481	76.77893	-302.8061	17.50996	-0.3412
T-Critical	2.085963				

Analysis of Variance Section

Source	DF	Sum of Squares	Mean Square	F-Ratio	Prob Level	Power (5%)
Intercept	1	7224689	7224689			
Model	3	2686282	895427.1	86.3699	0.000000	1.000000
Error	20	207347	10367.35			
Total(Adjusted)	23	2893629	125809.9			

Root Mean Square Error	101.8202	R-Squared	0.9283
Mean of Dependent	548.6608	Adj R-Squared	0.9176
Coefficient of Variation	0.1855795	Press Value	353568.1
Sum |Press Residuals|	2064.954	Press R-Squared	0.8778

Normality Tests Section

Assumption	Value	Probability	Decision(5%)
Skewness	0.9091	0.363315	Accepted
Kurtosis	2.2330	0.025547	Rejected
Omnibus	5.8128	0.054671	Accepted

Serial-Correlation Section

Lag	Correlation	Lag	Correlation	Lag	Correlation
1	0.120003	9	0.091533	17	-0.057428
2	-0.280154	10	-0.128723	18	-0.064190
3	-0.310203	11	-0.120973	19	0.053514
4	0.170672	12	-0.062546	20	0.014712
5	0.208626	13	-0.134322	21	0.094524
6	-0.168922	14	0.146646	22	-0.048111
7	-0.088579	15	0.111027	23	0.032244
8	-0.089416	16	0.059356	24	-0.049290

Above serial correlations significant if their absolute values are greater than 0.408248

Durbin-Watson Value 1.3911

Table F-59. Projected Ornamental Nursery Acreage in Lee County.

Year	Primary - 15%	Primary	Primary + 15%
1995	1,108	1,303[a]	1,498
1996	1,320	1,553[a]	1,786
1997	1,352	1,591	1,829
2000	1,448	1,703	1,959
2005	1,610	1,895	2,179
2010	1,776	2,089	2,402
2015	1,943	2,286	2,628
2020	2,111	2,484	2,857

a. From **Table F-58**.

Supplemental water requirements(**Table F-60**) were applied to ornamental nursery acreage projections (**Table F-59**) to calculate the irrigation requirements for ornamental nurseries shown in **Table F-60**. Calculations were made using data collected from the Fort Myers rainfall station and soil with a water holding capacity of 0.8 in./ft.

Table F-60. Irrigation Requirements for the Primary Ornamental Nursery Acreage Projections in Lee County.

Year		1995	2000	2005	2010	2015	2020
Lee County Acreage[a]		1,303	1,703	1,895	2,089	2,286	2,484
Month	Supplemental Water Requirements (inches/acre)	Irrigation Requirements (millions of gallons)					
1-in-2							
January	1.00	71	92	103	113	124	135
February	1.29	91	119	133	146	160	174
March	2.87	203	265	295	326	356	387
April	4.04	286	374	416	458	502	545
May	4.41	312	408	454	500	548	595
June	2.57	182	238	265	292	319	347
July	3.24	229	300	333	368	402	437
August	3.04	215	281	313	345	377	410
September	2.22	157	205	228	252	276	300
October	3.09	219	286	318	351	384	417
November	2.51	178	232	258	285	312	339
December	1.76	125	163	181	200	219	237
Total	31.95	2,261	2,955	3,288	3,625	3,967	4,310
1-in-10							
January	1.26	89	117	130	143	156	170
February	1.37	97	127	141	155	170	185
March	3.55	251	328	365	403	441	479
April	4.71	333	436	485	534	585	635
May	5.00	354	462	515	567	621	675
June	3.56	252	329	366	404	442	480
July	4.13	292	382	425	469	513	557
August	3.62	256	335	373	411	449	488
September	2.38	168	220	245	270	295	321
October	3.60	255	333	371	408	447	486
November	2.61	185	241	269	296	324	352
December	1.88	133	174	193	213	233	254
Total	37.68	2,667	3,485	3,878	4,275	4,678	5,083

a. Acreages are from **Table F-59**.

Hendry Area Ornamental Nurseries

Only the portion of Hendry County within the LWC Planning Area has ornamental nurseries. Therefore, the historic and projected acreages are the same for both the whole county and the Hendry Area. Historic acreage is presented in **Table F-61.**

Table F-61. Historic Ornamental Nursery Acreage in Hendry County and the Hendry Area.

Year	Historic	Year	Historic
1972	1,005	1985	124
1973	111	1986	200
1974	37	1987	245
1975	263	1988	487
1976	49	1989	281
1977	59	1990	930
1978		1991	1,294
1979	67	1992	1,340
1980	77	1993	1,266
1981	126	1994	1,135
1982	150	1995	1,067
1983	110	1996	1,047
1984	164		

An equation of the form **Equation F-39** was used to project ornamental nursery acreage for the Hendry Area.

$$A_i = f(t, D_t) \tag{F-39}$$

where:

A_i = *ornamental nursery acreage in the Hendry Area in year i.*

t = *a trend variable which takes on a value of one in 1972 and is increased by one unit per year*

D_t = *a dichotomous variable which takes on a value of one for the period 1976-1989 inclusive and zero otherwise. For projection purposes the value of* D_t *is held at zero throughout the period to be projected.*

Equation F-39 was estimated and **Equation F-40** resulted. In **Equation F-40** below, estimated using ordinary least squares, the variables were defined as:

Historic = *historic Hendry County ornamental nursery acreage*

D_1 = *a zero-one dichotomous variable equal to one for the period 1976-1989 and zero otherwise. For projection purposes* D_1 *was held at zero.*

t = *a time trend variable taking on the value of one in 1972 and increasing one unit per year thereafter.*

When the Hendry Area ornamental nursery acreage projected using **Equation F-40**, the results shown in **Table F-62** were obtained.

(F-40)

Multiple Regression Report

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Database	C:\My Documents\DATA\Wumps\Nursery\Hennur.S0
Dependent	Historic

Regression Equation Section

Independent Variable	Regression Coefficient	Standard Error	T-Value (Ho: B=0)	Prob Level	Decision (5%)	Power (5%)
Intercept	330.6841	113.9374	2.9023	0.008520	Reject Ho	0.790316
D1	-589.2336	91.02675	-6.4732	0.000002	Reject Ho	0.999986
TIME	35.71216	6.253393	5.7108	0.000011	Reject Ho	0.999744
R-Squared	0.817781					

Regression Coefficient Section

Independent Variable	Regression Coefficient	Standard Error	Lower 95% C.L.	Upper 95% C.L.	Standardized Coefficient
Intercept	330.6841	113.9374	93.73824	567.63	0.0000
D1	-589.2336	91.02675	-778.5341	-399.9331	-0.6168
TIME	35.71216	6.253393	22.70752	48.7168	0.5442
T-Critical	2.079614				

Analysis of Variance Section

Source	DF	Sum of Squares	Mean Square	F-Ratio	Prob Level	Power (5%)
Intercept	1	5638467	5638467			
Model	2	4446914	2223457	47.1231	0.000000	0.999972
Error	21	990865.2	47184.05			
Total(Adjusted)	23	5437779	236425.2			

Root Mean Square Error	217.2189	R-Squared	0.8178
Mean of Dependent	484.7021	Adj R-Squared	0.8004
Coefficient of Variation	0.4481493	Press Value	1574254
Sum |Press Residuals|	4242.887	Press R-Squared	0.7105

Normality Tests Section

Assumption	Value	Probability	Decision(5%)
Skewness	2.1100	0.034862	Rejected
Kurtosis	2.2874	0.022172	Rejected
Omnibus	9.6842	0.007890	Rejected

Serial-Correlation Section

Lag	Correlation	Lag	Correlation	Lag	Correlation
1	0.113491	9	0.030588	17	-0.188701
2	-0.292463	10	0.077493	18	-0.275455
3	-0.274108	11	0.080209	19	-0.006402
4	-0.013650	12	0.092865	20	0.132678
5	0.002015	13	-0.055909	21	0.188035
6	-0.059219	14	-0.048341	22	0.095951
7	-0.051724	15	0.026307	23	-0.026038
8	-0.073768	16	0.140154	24	-0.114009

Above serial correlations significant if their absolute values are greater than 0.408248

Durbin-Watson Value 1.3212

Table F-62. Projected Ornamental Nursery Acreage in Hendry County and the Hendry Area.

Year	Primary - 15%	Primary	Primary + 15%
1995	907	1,067[a]	1,227
1996	890	1,047[a]	1,204
2000	1,011	1,190	1,368
2005	1,163	1,368	1,573
2010	1,315	1,547	1,779
2015	1,466	1,725	1,984
2020	1,618	1,904	2,189

a. From **Table F-61**.

Supplemental water requirements for sod on soil with a water holding capacity of 0.8 in./ft.soil in the Hendry Area (**Table F-63**) were applied to the ornamental nursery acreage projections (**Table F-62**) to calculate the irrigation requirements shown in **Table F-63**. Rainfall data used was from the LaBelle station.

Table F-63. Irrigation Requirements for the Primary Ornamental Nursery Acreage Projections in the Hendry Area.

Year		1995	2000	2005	2010	2015	2020
Hendry County Acreage[a]		1,067	1,190	1,368	1,547	1,725	1,904
Hendry Area Acreage		1,067	1,190	1,368	1,547	1,725	1,904
Month	**Supplemental Water Requirements (inches/acre)**	**Irrigation Requirements (millions of gallons)**					
1-in-2							
January	0.93	36	40	46	52	58	64
February	1.15	44	50	57	64	72	79
March	2.62	101	113	130	147	164	181
April	3.68	142	159	182	206	230	254
May	4.12	159	178	204	231	257	284
June	2.54	98	109	126	142	159	175
July	3.39	131	146	168	190	212	234
August	3.30	127	142	163	185	206	228
September	2.84	110	122	141	159	177	196
October	2.84	110	122	141	159	177	196
November	2.32	90	100	115	130	145	160
December	1.58	61	68	78	89	99	109
Total	31.32	1,210	1,350	1,551	1,754	1,956	2,159
1-in-10							
January	1.16	45	50	57	65	72	80
February	1.30	50	56	64	73	81	90
March	3.41	132	147	169	191	213	235
April	4.38	169	189	217	245	274	302
May	4.65	180	200	230	260	290	321
June	3.44	133	148	170	193	215	237
July	3.94	152	170	195	221	246	272
August	3.55	137	153	176	199	222	245
September	3.40	131	146	168	190	212	234
October	3.26	126	140	161	183	204	225
November	2.26	87	97	112	127	141	156
December	1.50	58	65	74	84	94	103
Total	36.25	1,400	1,562	1,796	2,030	2,264	2,499

a. Acreages are from **Table F-62**.

Glades Area Ornamental Nurseries

All of the Glades County ornamental nursery acreage is located within the LWC portion of the county. Therefore, the historic and projected acreages are the same for both the whole county and the Glades Area. Historic acreage is presented in **Table F-64**.

Table F-64. Historic Ornamental Nursery Acreage in Glades County and the Glades Area.

Year	Historic	Year	Historic
1979	4	1988	607
1980	68	1989	409
1981	83	1990	502
1982	83	1991	1,392
1983	68	1992	1,429
1984	103	1993	1,476
1985	109	1994	1,472
1986	164	1995	1,431
1987	528	1996	1,310

In order to forecast ornamental nursery acreage for the Glades Area, a model was developed using data for the period 1976 through 1996. The functional form of this model is outlined in **Equation F-41**.

$$Glncn_i = f(t, D_i) \qquad (F\text{-}41)$$

where:

$Glncn_i$ = *acreage of Glades ornamental nursery in year i.*

t = *a trend variable which takes on a value of four in 1979 and increases by one unit each year.*

D_i = *a dichotomous variable where D_i is one in 1992 through 1995 inclusive and zero otherwise.*

The model which was estimated using ordinary least squares is shown in **Equation F-42**, which was adjusted to generate the primary projection for Glades Area ornamental nursery acreage. In equation F-37 below, estimated using ordinary least squares , the variables were defined as:

GLNONCIT= *Glades County non-citrus nursery acreage*

Time = *a time trend variable equal to four in 1979 and increase one unit per year thereafter. Data for the years 1976 through 1978 inclusive were excluded from the analysis because of the insignificant acreage of nurseries in Glades County*

D = *a zero-one dichotomous variable equal to one in 1992 through 1995 inclusive and zero otherwise. This period corresponds to the period of peak ornamental nursery acreage in Glades County.*

The resulting projections are shown in **Table F-65.**

Table F-65. Projected Ornamental Nursery Acreage in Glades County and the Glades Area.

Year	Primary - 15%	Primary	Primary + 15%
1995	1,216	1,431	1,646
1996	1,114	1,310	1,507
2000	1,392	1,637	1,883
2005	1,740	2,047	2,354
2010	2,087	2,456	2,824
2015	2,435	2,865	3,295
2020	2,783	3,274	3,765

(F-42)

Multiple Regression Report

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Database	C:\My Documents\DATA\Wumps\Nursery\Glanur.S0
Filter	Year>1978
Dependent	GLNONCIT

Regression Equation Section

Independent Variable	Regression Coefficient	Standard Error	T-Value (Ho: B=0)	Prob Level	Decision (5%)	Power (5%)
Intercept	-494.8523	144.7866	-3.4178	0.003816	Reject Ho	0.891066
Time	81.84061	12.33783	6.6333	0.000008	Reject Ho	0.999987
D	432.801	153.9671	2.8110	0.013164	Reject Ho	0.747828
R-Squared	0.889959					

Regression Coefficient Section

Independent Variable	Regression Coefficient	Standard Error	Lower 95% C.L.	Upper 95% C.L.	Standardized Coefficient
Intercept	-494.8523	144.7866	-803.4577	-186.2469	0.0000
Time	81.84061	12.33783	55.54314	108.1381	0.7228
D	432.801	153.9671	104.6278	760.9742	0.3063
T-Critical	2.131450				

Analysis of Variance Section

Source	DF	Sum of Squares	Mean Square	F-Ratio	Prob Level	Power (5%)
Intercept	1	7016258	7016258			
Model	2	5528082	2764041	60.6565	0.000000	0.999998
Error	15	683531.8	45568.79			
Total(Adjusted)	17	6211614	365389.1			

Root Mean Square Error	213.4685	R-Squared	0.8900
Mean of Dependent	624.3333	Adj R-Squared	0.8753
Coefficient of Variation	0.3419143	Press Value	957541.6
Sum |Press Residuals|	3163.631	Press R-Squared	0.8458

Normality Tests Section

Assumption	Value	Probability	Decision(5%)
Skewness	2.1806	0.029213	Rejected
Kurtosis	2.0843	0.037134	Rejected
Omnibus	9.0993	0.010571	Rejected

Serial-Correlation Section

Lag	Correlation	Lag	Correlation	Lag	Correlation
1	0.135196	9	-0.034080	17	0.021626
2	-0.167913	10	-0.028307	18	
3	-0.010295	11	0.089969	19	
4	-0.023783	12	0.177211	20	
5	-0.062573	13	0.024334	21	
6	-0.215276	14	-0.006046	22	
7	-0.228474	15	-0.026617	23	
8	-0.128282	16	-0.016691	24	

Above serial correlations significant if their absolute values are greater than 0.471405

Durbin-Watson Value 1.6757

Supplemental water requirements for sod on a soil with a 0.8 in./ft. water holding capacity in the Glades Area (**Table F-66**) were applied to the ornamental nursery acreage projections (**Table F-65**) to calculate the irrigation requirements shown in **Table F-66**. Rainfall data was from the Moore Haven station.

Table F-66. Irrigation Requirements for the Primary Ornamental Nursery Acreage Projections in the Glades Area.

Year		1995	2000	2005	2010	2015	2020
Glade County and Glades Area Acreage[a]		1,431	1,637	2,047	2,456	2,865	3,274
Month	**Supplemental Water Requirements (inches/acre)**	**Irrigation Requirements (millions of gallons)**					
1-in-2							
January	0.96	75	85	107	128	149	171
February	1.14	89	101	127	152	177	203
March	2.61	203	232	290	348	406	464
April	3.68	286	327	409	491	573	654
May	4.12	320	366	458	550	641	733
June	3.27	254	291	364	436	509	581
July	3.86	300	343	429	515	601	686
August	3.78	294	336	420	504	588	672
September	2.75	214	244	306	367	428	489
October	3.05	237	271	339	407	475	542
November	2.34	182	208	260	312	364	416
December	1.65	128	147	183	220	257	293
Total	33.19	2,580	2,951	3,690	4,427	5,164	5,902
1-in-10							
January	1.13	88	100	126	151	176	201
February	1.26	98	112	140	168	196	224
March	3.34	260	297	371	446	520	594
April	4.32	336	384	480	576	672	768
May	4.81	374	428	535	642	748	855
June	4.22	328	375	469	563	657	750
July	4.57	355	406	508	610	711	813
August	4.07	316	362	452	543	633	724
September	3.18	247	283	354	424	495	565
October	3.54	275	315	394	472	551	629
November	2.40	187	213	267	320	373	427
December	1.78	138	158	198	237	277	317
Total	38.62	3,002	3,434	4,294	5,152	6,009	6,867

a. Acreages are from **Table F-65**.

Improved Pasture/Cattle Watering

Improved pasture has, by District definition, the facilities in place to carry out irrigation. However, these facilities were usually designed and installed for drainage and are rarely used for irrigation. This is because the returns associated with cattle production no longer 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 is made here that improved pasture will not be irrigated throughout the projection period. Although this assumption may not be the case in some rare instances, it is much closer to actual production practices than the values given by any irrigation requirement model.

Total pasture acreage, improved and unimproved, does affect the water required for stock watering by limiting cattle population. Total pasture was projected by subtracting land expansion for other purposes from the current acreage of pasture. Note that pasture acreage includes wetlands which will not be converted to other agricultural uses.

Water required for stock watering was calculated as a function of the number and type of cattle (beef or dairy), which, in turn, was appraised as a function of the acreage used for pasture. Water demand projections for stock watering are based on the District allocation of 12 gallons/day/cow for beef cattle and 150 gallons/cow/day for dairy cattle.

Collier County Cattle Watering

The 1990 Collier County pasture acreage estimate was obtained from the local IFAS extension office. Historical and primary projected changes in acreage for other uses were applied to that figure. The resulting projections for pasture acreage are presented in **Table F-67.** In 1995, Collier County had approximately 14,500 head of cattle (FASS, 1977) with no significant amount for dairy use. These cattle account for 330,000 acres of improved and unimproved pasture.

Table F-67. Projected Water Use for Cattle Watering in Collier County.

Year	Approximate Head of Cattle	Million Gallons/ Day	Million Gallons/ Year
1995	14,500	0.18	64
2000	14,000	0.17	61
2005	13,000	0.16	57
2010	12,500	0.15	55
2015	11,500	0.14	50
2020	10,500	0.13	46

Lee County Cattle Watering

The 1990 pasture acreage estimate was obtained from the local IFAS extension office. Historical and primary projected changes in acreage for other uses were applied to that figure. In 1995 Lee County had 15,000 head of beef cattle and no dairy cattle (FASS, 1997). The association between cattle and acreage is approximately 7.9 acres per head of cattle.

The acreage of pasture and the corresponding population of beef cattle will be reduced with the expansion of other crops in Lee County. This projected reduction in beef cattle population and the related water use for cattle watering (based on the primary acreage projections of other crops) is shown in **Table F-68**.

Table F-68. Projected Water Use for Cattle Watering in Lee County.

Year	Approximate Head of Cattle	Million Gallons/ Day	Million Gallons/ Year
1995	15,000	0.18	66
2000	14,700	0.18	64
2005	14,400	0.17	63
2010	14,000	0.17	61
2015	13,600	0.16	60
2020	13,300	0.16	58

Hendry Area Cattle Watering

In 1995, Hendry County had 109,000 head of beef cattle (FASS). It is estimated that 42 percent of the cattle are in the Hendry Area. The acreage of pasture and the corresponding population of cattle will be reduced with the expansion of other crops in the Hendry Area. This projected reduction in cattle population and the related water use for cattle watering is shown in **Table F-69**.

Table F-69. Projected Water Use for Cattle Watering in Hendry County and the Hendry Area.

Year	Approximate Head of Cattle		Million Gallons/Day	Million Gallons/Year
	Hendry County	Hendry Area		
1995	109,000	45,780	0.55	201
2000	117,000	49,140	0.59	215
2005	112,000	47,040	0.56	206
2010	107,000	44,940	0.54	197
2015	102,000	42,840	0.51	188
2020	97,500	40,950	0.49	179

Glades Area Cattle Watering

The 1995, Glades County had 76,000 head of beef cattle. Of these 76,000, approximately one-third, or 25,333, were in the Glades Area. The association between cattle and acreage is about 5.1 acres per head of cattle. This projected reduction in beef cattle population and the related water use for cattle watering is shown in **Table F-70**.

In 1989/1990, Glades County had approximately 4,000 head of dairy cattle. The dairy cattle population in Glades County is expected to remain relatively constant over the projection period.

Table F-70. Historic and Projected Cattle Water Use in Glades County and the Glades Area.

Year	Approximate Head of Cattle		Million Gallons/Day	Million Gallons/Year
	Glades County	Glades Area		
1995	76,000	25,333	0.304	111
2000	74,000	24,667	0.296	108
2005	71,000	23,667	0.284	104
2010	69,000	23,000	0.276	101
2015	66,000	22,000	0.264	96
2020	64,000	21,333	0.256	93

Charlotte Area Cattle Watering

There is little cattle raising in the Charlotte Area. Within the limits of estimation error, cattle watering use in the Charlotte Area is estimated at zero.

Aquaculture

Collier County Aquaculture

All aquacultural operations within the LWC Planning Area are located within Collier County. Aquacultural operations withdraw water for circulation purposes and to replace evaporative losses. The replacement amount, based on District permit allocations, was assessed at 376 MGY in 1995 and is projected to remain at this level through 2020.

TOTAL IRRIGATED ACREAGE

Irrigated acreages for the LWC Planning Area are presented in **Table F-71**.

Table F-71. Irrigated Acreages for the Lower West Coast Planning Area.

Use Classification	1995 Acreage	2020 Acreage
COLLIER COUNTY		
URBAN		
Golf Course Self-Supplied	5,225	10,703
Golf Course Reuse-Supplied	3,807	8,585
Landscape	7,527	14,368
TOTAL COLLIER COUNTY URBAN	16,559	33,656
AGRICULTURE		
Citrus	36,559	55,966
Vegetables	24,126	13,587
Ornamental Nursery	1,288	1,965
TOTAL COLLIER COUNTY AGRICULTURE	61,973	71,518
LEE COUNTY		
URBAN		
Golf Course Self-Supplied	4,398	9,402
Golf Course Reuse-Supplied	2,956	4,625
Landscape	6,076	9,623
TOTAL LEE COUNTY URBAN	13,430	23,650
AGRICULTURE		
Citrus	12,197	16,150
Tropical Fruit	1,930	3,180
Vegetables	10,062	796
Sod	650	650
Ornamental Nursery	1,303	2,484
TOTAL LEE COUNTY AGRICULTURE	26,142	23,260
HENDRY AREA		
URBAN		
Golf Course Self-Supplied	233	233
Golf Course Reuse-Supplied	19	19
TOTAL HENDRY AREA URBAN	252	252
AGRICULTURE		
Citrus[a]	71,415	81,909
Citrus Nursery	145	145
Sugarcane[b]	35,443	36,927
Vegetables	7,264	5,265
Cut Flowers	1,000	1,000
Ornamental Nursery	1,067	1,904
TOTAL HENDRY AREA AGRICULTURE	116,334	127,150
GLADES AREA		
URBAN		

Table F-71. (Continued) Irrigated Acreages for the Lower West Coast Planning Area.

Use Classification	1995 Acreage	2020 Acreage
Golf Course Self-Supplied	15	15
Golf Course Reuse-Supplied	5	5
Total Glades Area Urban	20	20
AGRICULTURE		
Citrus	4,855	8,261
Sugarcane	16,295	16,295
Rice	200	800
Vegetables	473	473
Ornamental Nursery	1,431	3,274
TOTAL GLADES AREA AGRICULTURE	23,254	29,103
CHARLOTTE AREA		
AGRICULTURE		
Citrus	3,088	4,308
Seed Corn and Soybeans	3,100	3,100
Vegetables	2,306	2,306
TOTAL CHARLOTTE AREA AGRICULTURE	8,494	9,714
LWC PLANNING AREA (Totals)		
URBAN		
Golf Course Self-Supplied	10,004	20,486
Golf Course Reuse-Supplied	6,788	13,235
Landscape	13,603	13,603
AGRICULTURE		
Citrus[a]	128,114	166,594
Citrus Nursery	145	145
Sugarcane[b]	51,738	53,222
Seed Corn and Soybeans	3,100	3,100
Rice	200	800
Tropical Fruit	1,930	3,180
Vegetables	44,231	22,427
Sod	650	650
Cut Flowers	1,000	1,000
Ornamental Nursery	5,089	9,627
LWC PLANNING AREA TOTAL AGRICULTURE	236,197	260,745
LWC PLANNING AREA TOTAL URBAN	30,395	47,324
LWC PLANNING AREA GRAND TOTAL	266,592	308,069

a. An additional 12,748 gross acres of citrus were added for modeling purposes resulting in a total of 125,035 gross acres in the Caloosahatchee basin. To prevent misrepresentation, gross acreages and net acreages are not combined in this table.

b. An additional 45,210 gross acres of sugarcane were added for modeling purposes resulting in a total of 125,007 gross acres in the Caloosahatchee basin. To prevent misrepresentation, gross acreages and net acreages are not combined in this table.

TOTAL AVERAGE ANNUAL WATER DEMAND

Estimated and projected demands for the LWC Planning Area are shown in **Table F-72**. Demands are presented by land use classification, with agricultural use broken down into its components. Neither the Charlotte or Monroe county areas have significant urban demands. The Monroe County Area has no significant agricultural demands. Total estimated and projected demands for the LWC Planning Area are shown in **Table F-73**.

Table F-72. Annual Water Demand by Use Classification.

Use Classification	Annual Water Demand (MGY)	
	1995	2020
COLLIER COUNTY		
URBAN		
Public Water Supplied	16,213	29,930
Domestic Self-Supplied	1,971	2,172
Commercial and Industrial Self-Supplied	2,181	4,163
Recreation		
Landscape Self-Supplied	10,093	19,267
Golf Course Self-Supplied	6,548	14,161
Golf Course Reuse	4,772	11,358
Golf Course Total	11,320	25,519
Recreation Total	21,413	44,786
Recreation Self-Supply (to compare with Table F-7)	16,641	33,428
TOTAL URBAN	**41,778**	**81,051**
AGRICULTURE		
Citrus	29,714	45,487
Vegetables	14,518	8,176
Ornamental Nursery	2,360	3,600
Cattle Watering	64	46
Aquaculture	376	376
TOTAL AGRICULTURE	**47,032**	**57,685**
TOTAL COLLIER COUNTY WATER DEMAND	**88,810**	**138,736**
LEE COUNTY		
URBAN		
Public Water Supplied	15,662	24,320
Domestic Self-Supplied	2,197	3,154
Commercial and Industrial Self-Supplied	1,974	3,126
Recreation		
Landscape Self-Supplied	7,012	11,105
Golf Course Self-Supplied	4,999	10,686
Golf Course Reuse	3,359	5,257
Golf Course Total	8,358	15,943
Recreation Total	15,370	27,048
Recreation Self-Supply (to compare with Table F-7)	12,011	21,791
Thermoelectric Power Generation Self-Supply	281	281

Table F-72. (Continued) Annual Water Demand by Use Classification.

Use Classification	Annual Water Demand (MGY)	
	1995	2020
TOTAL URBAN	**35,484**	**57,929**
AGRICULTURE		
Citrus	9,652	12,780
Tropical Fruit	2,103	3,465
Vegetables	6,459	511
Sod	1,128	1,128
Ornamental Nursery	2,261	4,310
Cattle Watering	66	58
TOTAL AGRICULTURE	**21,669**	**22,252**
TOTAL LEE COUNTY WATER DEMAND	**57,153**	**80,181**
HENDRY AREA		
URBAN		
Public Water Supplied	1,456	2,183
Domestic Self-Supplied	632	829
Recreation		
Landscape Self-Supplied	0	0
Golf Course Self-Supplied	267	267
Golf Course Reuse	14	14
Golf Course Total	281	281
Recreation Total	281	281
Recreation Self-Supply (to compare with Table F-7)	267	267
TOTAL URBAN	**2,355**	**3,293**
AGRICULTURE		
Citrus	66,782	76,595
Citrus Nursery	160	160
Sugarcane	46,616	47,348
Vegetables	12,328	7,770
Cut Flowers	1,199	1,199
Ornamental Nursery	1,210	2,159
Cattle Watering	201	179
TOTAL AGRICULTURE	**128,496**	**135,410**
TOTAL HENDRY AREA WATER DEMAND	**130,789**	**138,703**
GLADES AREA		
URBAN		
Public Water Supplied	106	183
Domestic Self-Supplied	113	190
Recreation		
Landscape Self-Supplied	0	0
Golf Course Self-Supplied	24	24
Golf Course Reuse	9	9
Golf Course Total	33	33
Total Recreation	33	33

Table F-72. (Continued) Annual Water Demand by Use Classification.

Use Classification	Annual Water Demand (MGY)	
	1995	2020
Recreation Self-Supply (to compare with Table F-7)	24	24
TOTAL URBAN	**252**	**406**
AGRICULTURE		
Citrus	4,020	6,841
Sugarcane	23,134	23,134
Rice	175	699
Vegetables	286	286
Ornamental Nursery	2,580	5,902
Cattle Watering	111	93
TOTAL AGRICULTURE	**30,306**	**36,955**
TOTAL GLADES AREA WATER DEMAND	**30,558**	**37,361**
CHARLOTTE AREA		
URBAN		
Public Water Supplied	0	0
Domestic Self-Supplied	29	84
TOTAL URBAN	**29**	**84**
AGRICULTURE		
Citrus	2,396	3,343
Seed Corn and Soybeans	1,782	1,782
Vegetables	1,360	1,360
TOTAL AGRICULTURE	**5,538**	**6,485**
TOTAL CHARLOTTE AREA WATER DEMAND	**5,567**	**6,569**

Table F-73. Total Annual Water Demand by Use Classification.

LWC PLANNING AREA TOTAL BY USE (MGY)	Estimated 1995	Estimated 2020	Percent of Use 1995	Percent of Use 2020
URBAN				
Public Water Supplied	33,438	56,615	10.7	14.1
Domestic Self-Supplied	4,942	6428	1.6	1.6
Commercial and Industrial Self-Supplied	4,155	7,289	1.3	1.8
Recreation	37,097	72,148	11.9	18.0
Thermoelectric Power Generation Self-Supply	281	281	0.1	0.1
TOTAL URBAN	**79,913**	**142,761**	**25.5**	**35.6**
AGRICULTURE				
Citrus	112,564	145,046	36.0	36.1
Citrus Nursery	160	160	0.1	0.0
Sugarcane	69,750	70,482	22.3	17.6
Rice	175	699	0.1	0.2
Seed Corn and Soybean	1,782	1,782	0.6	0.4
Tropical Fruit	2,103	3,465	0.7	0.9
Vegetables	34,951	18,103	11.2	4.5
Sod	1,128	1,128	0.4	0.3
Cut Flowers	1,199	1,199	0.4	0.3
Ornamental Nursery	8,411	15,971	2.7	4.0
Cattle Watering	442	376	0.1	0.1
Aquaculture	376	376	0.1	0.1
TOTAL AGRICULTURE	**233,041**	**258,787**	**74.5**	**64.4**
TOTAL ANNUAL WATER DEMAND FOR THE LWC PLANNING AREA	**312,954**	**401,548**	**---**	**---**

REFERENCES CITED

Behr R., M. Brown, and G. Fairchild. 1988. *Florida Citrus Production Trends 1989-1990 through 1998-1999*. Florida Department of Citrus, University of Florida, Gainesville, FL. 21 pp.

Cornish G., and R. Whitten. 1988. *The Golf Course*. New York: The Rutledge Press.

Florida Cattlemen's Association. 1990. Okeechobee still has the most cows; Osceola ranks second in beef cows. *The Florida Cattleman and Livestock Journal*, 54 (9): 60.

Florida Department of Agriculture and Consumer Services. 1972-1990. *Annual Report*. Division of Plant Industry, FDACS, Gainesville, FL. Multi-volumes.

Florida Department of Agriculture and Consumer Services. 1989-1990. *Citrus Summary*. Florida Agricultural Statistics Service, FDACS, Orlando, FL. 45 pp.

Florida Department of Agriculture and Consumer Services. 1966-1990. *Commercial Citrus Inventory*. Florida Agricultural Statistics Service, FDACS, Orlando, FL. Multi-volumes.

Florida Department of Agriculture and Consumer Services. 1975-1990. *Field Crops Summary*. Florida Agricultural Statistics Service, FDACS, Orlando, FL Multi-volumes.

Florida Department of Agriculture and Consumer Services. 1974-1990. *Vegetable Summary*. Florida Agricultural Statistics Service, FDACS, Orlando, FL. Multi-volumes.

Florida Department of Commerce. 1990. *The Official Florida Golf Guide*. Office of Sports Promotion, FDOC, Tallahassee, FL.

Florida Golfweek. 1989. Golf Guide to the South. *Florida Golfweek*, Dundee, FL.

Intriligator, Michael D. 1978. *Econometric Models, Techniques, and Applications*. Englewood Cliffs: Prentice-Hall, Inc.

Mahmoud E. 1984. Accuracy in forecasting: a survey. *Journal of Forecasting*, 3 (2).

National Golf Foundation. 1997. *Golf Course Directory*. National Golf Foundation, Jupiter, FL.

Smajstrla A.G., B. Boman, G. Clark, D. Haman, D. Harrison, F. Izuno, D. Pitts, and F. Zazueta. 1991. *Efficiencies of Florida Agricultural Irrigation Systems*. Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL. 11 pp.

South Florida Water Management District. 1987. *Water Resources Data and Related Technical Information to Assist Local Government Planning in Charlotte County*. SFWMD, West Palm Beach, FL.

South Florida Water Management District. 1998, *Districtwide Water-Supply Assessment*, Planning Department, SFWMD, West Palm Beach, FL. Vari pag.

Strategic Mapping, Inc. 1992. Block Groups, Census Tract and Data #2A & #2B for the State of Florida on CD-ROM.

U.S. Bureau of the Census. 1992. Census of Population and Housing, 1990: Summary Tape 3 on CD-ROM - Florida. Washington, D.C.

U.S. Geological Survey. 1989. *Water Resources Data Florida, Water Year 1989-- Volume 3B*, Southwest Florida Ground Water. U.S. Geological Survey Water-Data Report FL-89-3B. U.S. Geological Survey, Tampa, FL. 327 pp.

Appendix G
WATER QUALITY

AMBIENT GROUND WATER QUALITY

Ambient ground water quality of the Lower West Coast (LWC) Planning Area was assessed with the use of the Ambient Ground Water Quality Monitoring Network (AGWQMN). The AGWQMN is a statewide network of Monitor wells (and associated database) which is maintained by a cooperative agreement between the Florida Department of Environmental Protection and the water management districts. The purpose of the AGWQMN is to typify regional ambient water quality. It is not intended to include wells which monitor zones of discharge of landfills, contamination sites, or any other anthropogenic pollution sources, nor is it intended to delineate specific saltwater intrusion impacts. The aquifer classifications used by the AGWQMN in the LWC Planning Area are the Surficial, Intermediate, and Floridan aquifer systems. Refer to Chapter 3 of the LWC Water Supply Plan Support Document for a review of the hydrogeology and aquifer systems.

Information derived from the first four years of AGWQMN sampling (1984 through 1987) within the SFWMD was summarized and published in Technical Publication 89-1, "South Florida Water Management District Ambient Ground Water Quality," (Herr and Shaw, 1989). In 1994, LWC Water Supply Plan district staff utilized all available data from the wells which were located within the LWC Planning Area, encompassing a time span from 1984 through 1990 (SFWMD, 1994). The water quality parameters reviewed in 1994 were those which can affect the treatability of a potential drinking water source. Parameters included chloride, sodium, total dissolved solids, iron, total organic carbon, total alkalinity, nitrate/nitrogen, hardness, and color. Average data values of all sampling events for each well were obtained with the use of the GWIS database.

The following is a brief summary of the selected water quality parameters obtained from the AGWQMN data search for the LWC Planning Area for the 2000 LWC Water Supply Plan. The water quality parameters reviewed are those which can affect the treatability of a potential drinking water source. These include chloride, sulfate, and total dissolved solids. **Tables G-12** and **G-13** (presented later in this appendix) are suggested references for the potable drinking water standards which apply to these parameters. All units are stated in milligrams per liter (mg/L). The water quality maps of the ambient water quality data alone do not depict the extent of saltwater intrusion along the coast, due to the deficiency of AGWQMN wells in the affected coastal areas.

Tables G-1 through **G-7** present May 1999 water levels for surface water and for the water table, lower Tamiami, Sandstone, and the mid-Hawthorn aquifers.

Table G-1. May 1999 Stage Data.

State Planar (NAD83)							
x (ft)	**y (ft)**	**Station**	**DBKEY**	**Year**	**Month**	**Day**	**Water Level (NGVD)**
781893.7	939374	CV10-H	15669	1999	5	18	13.45
616521.4	939908.2	CV5-T	15450	1999	5	18	13.68
672858.1	848412.7	G136-H	15968	1999	5	18	11.89
672858.1	848412.7	G136-T	15969	1999	5	18	11.16
690048.6	1013614	S127-H	15817	1999	5	18	13.55
690048.6	1013614	S127-T	15818	1999	5	18	13.52
655714.5	979975.7	S129+H	15064	1999	5	18	13.34
655714.5	979975.7	S129+T	15065	1999	5	18	13.69
655714.5	979975.7	S129-H	15821	1999	5	18	13.34
655714.5	979975.7	S129-T	15822	1999	5	18	13.68
626855.5	961608.9	S131-H	15719	1999	5	18	12.88
681364.3	882847.8	S169-H	15591	1999	5	18	13.82
681364.3	882847.8	S169-T	15592	1999	5	18	11.09
666724.5	708874.9	S190-H	15986	1999	5	18	11.61
666724.5	708874.9	S190-T	15985	1999	5	18	10.03
610885.1	917599	S47B-H	15945	1999	5	18	13.03
610684.6	900030.1	S47D-H	15692	1999	5	18	10.53
610684.6	900030.1	S47D-T	15693	1999	5	18	10.75
668671.9	892737.1	S4-T	15732	1999	5	18	13.65
605025.8	1012320	S70-H	15765	1999	5	18	25.54
605025.8	1012320	S70-T	15764	1999	5	18	19.05
633108.9	981597.8	S71-H	15948	1999	5	18	19.08
633108.9	981597.8	S71-T	15949	1999	5	18	13.56
654268.8	1002998	S72-H	15768	1999	5	18	19.98
654268.8	1002998	S72-T	15767	1999	5	18	13.49
614811.1	1038865	S75-H	15771	1999	5	18	25.28
614811.1	1038865	S75-T	15773	1999	5	18	20.02
474254.8	673824.1	BCYPR7	16066	1999	5	19	4.22
400656.3	705604.6	COCO1_H	16226	1999	5	19	5.86
407393	705665.5	COCO2_H	DU520	1999	5	19	5.78
407302	705666.1	COCO2_T	DU521	1999	5	19	5.86
399560.2	705005.4	COCOH.E_H	4284	1999	5	19	1.26
402126	707817.2	COCOH.PR	4234	1999	5	19	7.18
398468.5	705113	COCOH.W_H	4268	1999	5	19	3.53
466804.3	759579.5	CORK	DO540	1999	5	19	17.72

Source- SFWMD (DBHYDRO).

Table G-1. (Continued) May 1999 Stage Data.

State Planar (NAD83)							
x (ft)	**y (ft)**	**Station**	**DBKEY**	**Year**	**Month**	**Day**	**Water Level (NGVD)**
416559.1	668354.4	D2-7_H	16018	1999	5	19	3.78
415824.6	683504.2	D2-8_H	15977	1999	5	19	6.37
421554.7	764149.1	FP4	FF818	1999	5	19	14.64
420188.4	763651.8	FP5	FF799	1999	5	19	14.51
483291.1	678229	FU4_H	FI252	1999	5	19	5.1
695105.6	726055.4	G155_H	15791	1999	5	19	11.88
695014.7	726055.3	G155_T	15790	1999	5	19	10.96
673798.9	768244.7	G342C_H	JJ121	1999	5	19	11.72
673708	768244.6	G342C_T	JJ123	1999	5	19	10.84
673802.8	759056.8	G342D_H	J6399	1999	5	19	12.05
673802.8	759056.8	G342D_H	JJ127	1999	5	19	12.04
673802.8	759056.8	G342D_T	J6403	1999	5	19	11.4
673802.8	759056.8	G342D_T	JJ128	1999	5	19	11.43
694336	772196	G344A_H	JJ133	1999	5	20	10.87
694245.2	772195.9	G344A_T	JJ135	1999	5	20	10.79
694524.9	764421.8	G344D_H	JJ148	1999	5	20	10.84
694434	764421.7	G344D_T	JJ150	1999	5	20	10.81
689277	733723.8	G352S_H	G6559	1999	5	20	10.67
689186	733723.7	G352S_T	G6560	1999	5	19	11.79
695281.3	732921.2	G354C_H	G6563	1999	5	19	11.41
695190.3	732921.1	G354C_T	G6564	1999	5	19	10.91
691098.1	731504	G392S_H	G6561	1999	5	19	11.35
691007.1	731503.9	G392S_T	G6562	1999	5	19	11.75
691100.7	728374.1	G393B_H	G6565	1999	5	19	10.94
691009.7	728374	G393B_T	G6566	1999	5	19	10.84
695014.2	726560.1	G605	GA118	1999	5	19	10.88
694923.2	726560.1	G606	GA115	1999	5	19	10.85
695651.4	726156.9	G607_H	FI260	1999	5	19	10.86
695651.4	726156.9	G607_T	FI261	1999	5	19	10.87
695287.5	726156.5	G88_T	15794	1999	5	19	10.84
696106.8	725652.5	G89_O	16745	1999	5	19	9.13
651087.3	853256.2	G96_H	6933	1999	5	19	14.29
650996.6	853256.2	G96_T	6934	1999	5	19	11.93
430588.2	667974.9	GOLD.951	16039	1999	5	20	4.55
436018.9	678649.2	GOLD.W3_H	5376	1999	5	19	4.75

Source- SFWMD (DBHYDRO).

Table G-1. (Continued) May 1999 Stage Data.

State Planar (NAD83)							
x (ft)	**y (ft)**	**Station**	**DBKEY**	**Year**	**Month**	**Day**	**Water Level (NGVD)**
399164.6	669667.4	GORDON2_H	FI256	1999	5	20	1.51
399073.5	669668	GORDON2_T	13004	1999	5	19	0.99
406164.4	651451	HALDEMAN_H	4228	1999	5	19	2.71
406073.2	651451.5	HALDEMAN_T	4230	1999	5	19	0.1
431008.5	661308.7	HEND84	16037	1999	5	19	4.05
430010	627590.4	HENDTAMI_T	4258	1999	5	19	1.38
497182.6	739159.2	KEAIS846	15110	1999	5	19	18.41
500633.3	712894.7	KEAIS858	16065	1999	5	19	15.7
661543.9	650820.3	L28.GAP	4582	1999	5	19	11.72
678991.5	746135.7	L3.2	16586	1999	5	19	11.9
673619.2	763398.2	L3BRN	16569	1999	5	19	12.03
694559.2	726660.7	L3BRS_O	16244	1999	5	19	11.91
673619.5	762691.5	L3DF	16242	1999	5	19	12.06
411318	644151.3	LELYUS41	16044	1999	5	19	1.35
326546.6	797907.7	MARKERH	15290	1999	5	19	0.69
662898.7	728865	NFEED_O	16753	1999	5	19	11.53
397558.2	705118.5	NNDC_H	4262	1999	5	19	4.03
417129.2	848791.7	ORANGE2	15815	1999	5	19	1.27
666724.5	708874.9	S190_H	15986	1999	5	20	11.61
666633.5	708874.9	S190_T	15985	1999	5	20	10.03
428219.5	869429.9	S79_H	J8191	1999	5	19	3.24
428128.9	869430.4	S79_T	J8192	1999	5	19	1.29
544273.8	696097.7	SR29OKA	16052	1999	5	19	12.48
451910.9	611325.7	TAMIATOM	4254	1999	5	19	1.25
433187.1	624746.7	TAMIHEND_H	16035	1999	5	19	1.77
424160.4	625198.5	TOWER	16034	1999	5	19	1.18
694833.1	725651.3	USSO_O	16748	1999	5	19	9.11
663165.8	763799.1	USSSUGAR	15243	1999	5	19	3.37
631778.3	715544.2	WFEED_O	16751	1999	5	19	14.78
557393.3	892852.9	S78_H	J8185	1999	5	19	11.19
-2118802	985823.5	S78_T	J8186	1999	5	19	3.04
628359.1	910717.5	S77_H	J8188	1999	5	19	13.52
628359.1	910717.5	S77_T	JI497	1999	5	19	11.11

Source- SFWMD (DBHYDRO).

Table G-2. May 1999 Water Levels for the Water Table Aquifer.

State Planar (NAD83)				Well Construction										
x (ft)	y (ft)	Station	USGS ID	Case Diam.(in)	Case Depth (ft)	Total Depth (ft)	POR	Measuring Point Elevation (NGVD)	Year	Month	Day	Time	Water Level (NGVD)	Agency
567168	759248	C-0131	262521081161901	6	22	54	6/52 to current	29.65	1999	5	17	15:10	21.5	a
396649.9	675640	C-0392	261124081470101	8	28	30	1/65 to current	9.98	1999	5	24	23:59	0.95	a
553768.8	592990.6	C-0495	255748081181801	6	8	70	1/71 to current	10.08	1999	5	18	17:18	4.08	a
538149.9	588386.4	C-0496	260111081243901	6	8	57	1/71 to current	11.85	1999	5	19	23:59	4.11	a
526662.9	713110	C-0503	261741081235401	6	8	20	1/72 to current	22.3	1999	5	16	23:59	30.3	a
477963.9	645840.7	C-0690	260632081324702	4	43	48	10/80 to current	11.87	1999	5	19	23:59	3.67	a
463760	689823.2	C-0953	261347081351201	6	12	40	10/84 to current	16.34	1999	5	19	23:59	4.68	a
543290	736890.5	C-0966	262136081204201	6	30	40	10/84 to current	27.55	1999	5	17	18:13	16.34	a
441412.4	628137.5	C-0968	260334081391601	6	8	23	10/84 to current	9.35	1999	5	17	23:59	6.01	a
477836.4	658966.8	C-0972	260843081324202	6	25	40	10/84 to current	13.59	1999	5	20	13:22	3.76	a
444135.7	662352	C-0976	260915081385901	6	10	40	10/84 to current	15.25	1999	5	20	17:57	3.94	a
459783.7	735681.6	C-0978	262121081355501	6	15	40	10/84 to current	22.86	1999	5	18	23:59	14.85	a
444544.6	689611.6	C-0980	261343081384801	6	15	30	10/84 to current	17.77	1999	5	20	10:28	5.32	a
500093.5	739249.3	C-0981	262158081283401	6	40	60	10/84 to current	20.24	1999	5	18	23:59	12.81	a
498357.7	712802.1	C-0984	261733081285501	6	30	40	10/84 to current	23.38	1999	5	19	12:36	15.1	a
542497.8	678837.4	C-0986	261200081204901	6	28	40	10/84 to current	20.39	1999	5	21	11:39	11.29	a
498748.7	695535.3	C-0988	261444081284901	4	95	160	10/84 to current	20.41	1999	5	18	23:59	9.4	a
538058	588184.7	C-0995	255703081213801	2	28	37	3/85 to current	7.22	1999	5	20	16:44	1.58	a
430577.4	700285.4	C-0997	261530081412001	4	12	22	3/85 to current	16.76	1999	5	18	23:59	6.02	a
389231.2	698303.9	C-0999	261508081484902	4	13	23	4/85 to current	10.7	1999	5	25	13:14	7.45	a
403855.9	677212.3	C-1052	260919081460501	4	10	25	4/86 to current	8.05	1999	5	25	9:59	2.25	a

a. USGS
b. SFWMD
c. SFWMD (Howdi)
d. Drilled May 1998; electronically activated in July 1999. This data was manually collected (May 1999).

Table G-2. (Continued) May 1999 Water Levels for the Water Table Aquifer.

State Planar (NAD83)				Well Construction										
x (ft)	y (ft)	Station	USGS ID	Case Diam.(in)	Case Depth (ft)	Total Depth (ft)	POR	Measuring Point Elevation (NGVD)	Year	Month	Day	Time	Water Level (NGVD)	Agency
403855.9	677212.3	C-1054	261127081461001	4	10	25	4/86 to current	12.03	1999	5	25	9:48	5.71	a
431194.5	662014.5	C-1055	261211081441301	4	10	25	4/86 to current	13.37	1999	5	18	11:24	4.35	a
400928.7	705502	C-1057	261537081461201	8	8	10.5	4/86 to current	10.89	1999	5	25	9:06	5.74	a
393183.1	704236.7	C-1059	261604081480901	4	10	25	4/86 to current	12.82	1999	5	25	13:22	4.62	a
393802.2	686562.5	C-1061	261311081480101	4	10	25	4/86 to current	17.78	1999	5	25	12:19	11.8	a
394573.3	663839	C-1062	260925081475101	4	10	24	4/86 to current	13.97	1999	5	25	11:32	6.27	a
448468.7	616390.6	C-1063	260137081375901	4	30	55	4/86 to current	9.58	1999	5	17	23:59	0.37	a
501995.3	585774.8	C-1066	255637081281402	4	102	180	4/86 to current	4.29	1999	5	18	16:30	0.01	a
478245	625747.4	C-1067	260314081323101	4	30	65	4/86 to current	9.2	1999	5	20	15:03	1.68	a
559979.2	716252.2	C-1071	261823081171901	4	20	35	4/86 to current	22.98	1999	5	16	23:59	14.37	a
508273	763351.4	C-1078	262558081270501	4	13	38	4/8 to current	34.99	1999	5	17	11:42	22.99	a
429259.6	623656.7	C-1092	260251081412801	4	ND	19	7/93 to current	7.73	1999	5	18	12:41	1.45	a
400928.7	705502	C-1093	261356081461101	4	ND	17	7/93 to current	13.29	1999	5	25	9:15	7.87	a
397042	695125.3	C-1094	261435081472701	4	ND	19	7/93 to current	12.56	1999	5	25	13:05	4.47	a
460782.5	715583.9	C-1097	261802081354802	4	15	18	7/93 to current	18.44	1999	5	19	9:08	9.75	a
403855.9	677212.3	C-1100	261023081463702	4	11	16	9/93 to current	6.33	1999	5	25	10:29	2.08	a
316792.7	860798.2	L-0721	264153082022301	4	9	18	7/68 to current	1.00	1999	5	18	9:38	1	a
404779.9	831900	L-0728	263712081461201	4	18	19	7/68 to current	22.65	1999	5	17	17:29	18.34	a
413223.7	769749.9	L-0739	262657081443501	4	18	20	8/68 to current	21.18	1999	5	26	9:19	17.74	a
334255.1	819862	L-1136	263532081592202	4	15	20	6/70 to current	12.71	1999	5	17	13:13	4.1	a
461031.7	847452.4	L-1137	263950081355402	4	15	20	6/70 to current	24.14	1999	5	17	16:30	16.43	a

a. USGS
b. SFWMD
c. SFWMD (Howdi)
d. Drilled May 1998; electronically activated in July 1999. This data was manually collected (May 1999).

Table G-2. (Continued) May 1999 Water Levels for the Water Table Aquifer.

State Planar (NAD83)				Well Construction										
x (ft)	y (ft)	Station	USGS ID	Case Diam.(in)	Case Depth (ft)	Total Depth (ft)	POR	Measuring Point Elevation (NGVD)	Year	Month	Day	Time	Water Level (NGVD)	Agency
470850.1	769961.6	L-1138	262703081340202	4	15	20	6/70 to current	27.69	1999	5	17	10:20	21.66	a
307553.2	764130.6	L-1403	262549082035301	4	3	12	1/71 to current	8.58	1999	5	23	23:59	-0.18	a
458589.6	810608.3	L-1964	263344081361702	4	14	24	12/74 to current	33.4	1999	5	17	15:44	24.16	a
423613.8	872787.7	L-1976	264359081424702	4	5	15	9/74 to current	15.54	1999	5	17	10:14	8.87	a
428773.6	771076.6	L-1985	262713081414701	4	43	50	12/74 to current	20.96	1999	5	26	9:13	7.68	a
407618.3	805528.1	L-1995	263251081452803	4	14	24	1/75 to current	28.57	1999	5	25	23:59	21.7	a
419168.3	792334.3	L-1999	263041081433103	4	16	26	11/74 to current	29.92	1999	5	26	10:09	20.66	a
470656.3	869622.9	L-2202	264329081340402	4	7.4	17.4	9/75 to current	20.03	1999	5	17	11:11	12.51	a
439787	809388.6	L-2204	263329081394301	2	147	220	8/70 to current	30.65	1999	5	17	15:21	24.07	a
389459.5	763330.3	L-2308	262552081485703	4	12	13.5	7/76 to current	17.99	1999	5	24	10:20	10.15	a
348700.5	784006.1	L-2529	262944081560801	4	304	545	1/78 to current	6.04	1999	5	19	15:33	25.8	a
283215.9	848966.7	L-2549	263955082083103	4	58	80	1/78 to current	10.88	1999	5	17	15:03	3.61	a
429228.1	771074.2	L-2550	262711081413701	6	67	134	3/92 to current	21.07	1999	5	24	23:59	7.02	a
318049.3	814334.7	L-3207	263440082022002	1.25	8	18	5.78 to current	8.91	1999	5	17	11:57	1.45	a
419256	759517.1	L-5667	262513081432601	4	22	32	4/83 to current	19.09	1999	5	25	17:40	13.47	a
398253.3	759337.5	L-5669	262511081471801	4	23	30	11/82 to current	18.3	1999	5	25	10:40	10.56	a
394813.6	805606	L-5720	263249081474402	4	20	30	4/86 to current	24.4	1999	5	26	12:38	18.64	a
401010.6	734178	L-5722	262102081464401	4	11	21	3/86 to current	13.36	1999	5	25	15:09	5.35	a
396930	721480.1	L-5726	261859081481901	4	22	32	4/86 to current	13.9	1999	5	25	14:00	7.73	a
389473.1	751112.1	L-5730	262351081485401	4	27	40	10/87 to current	16.34	1999	5	24	10:32	11.44	a
406227.6	724150.5	L-5744	261900081454601	4	10	15	6/87 to current	13.34	1999	5	22	15:40	6.35	a

a. USGS
b. SFWMD
c. SFWMD (Howdi)
d. Drilled May 1998; electronically activated in July 1999. This data was manually collected (May 1999).

Table G-2. (Continued) May 1999 Water Levels for the Water Table Aquifer.

State Planar (NAD83)				Well Construction										
x (ft)	y (ft)	Station	USGS ID	Case Diam.(in)	Case Depth (ft)	Total Depth (ft)	POR	Measuring Point Elevation (NGVD)	Year	Month	Day	Time	Water Level (NGVD)	Agency
398260.8	745705.8	L-5746	262258081471801	4	10	15	7/87 to current	15.39	1999	5	25	15:01	9.29	a
466283.8	794547.8	WF1	---	2	16.5	18.5	d	32.26	1999	5	26	---	25.25	b
463191.2	788549.9	WF2	---	2	17.5	19.5	d	33.29	1999	5	26	---	25.41	b
455728.1	785154.2	WF3	---	2	18	20	d	30.35	1999	5	26	---	25.95	b
456105.6	779798.8	WF4	---	2	20	22	d	30.88	1999	5	26	---	25.7	b
460626.8	782660.4	WF5	---	2	18	20	d	31.72	1999	5	26	---	25.401	b
458263.9	780058.9	WF6	---	2	14	19	d	31.4	1999	5	26	---	25.24	b
460482.1	780467.3	WF7	---	2	17.5	19.5	d	31.79	1999	5	26	---	25.36	b
425346.7	770514.6	FP2	---	2	11.78	13.78	7/97-current	23.01	1999	5	19	---	10.61	b
422138.3	766198.6	FP3	---	2	16.9	18.9	7/97-current	22.57	1999	5	19	---	13.01	b
421603.5	764364.8	FP4	---	2	18	20	7/97-current	22.58	1999	5	19	---	13.04	b
614334.8	835809.2	HE - 5	263700081070001	6	8.7	13	1/41-12/95	29.72	1999	5	18	12:41	24.38	c
682483.8	832464.6	HE - 339	263700080550001	4	11	12.5	1/64-current	15.51	1999	5	19	11:59	14.87	c
519050.5	806832.8	HE - 554	263310081250902	4	5	15	10/77-current	35.24	1999	5	19	11:00	24.06	c
513717.3	840675.9	HE - 851	263845081260703	4	5	13	10/77-current	32.26	1999	5	19	10:23	26.06	c
546696.7	822502.7	HE - 852	263548081200601	4	9	14	9/77-current	32.39	1999	5	19	11:21	25.25	c
644637.8	818726.2	HE - 854	263515081012001	4	8	14	9/77-current	24.57	1999	5	18	12:28	19.69	c
614750.7	797642.8	HE - 856	263035081073502	4	6	11	8/77-current	29.65	1999	5	18	11:55	23.93	c
586827	882494.1	HE - 857	264535081130701	4	12	17	11/77 to current	20.44	1999	5	19	8:42	13.68	c
613997.1	860850	HE - 858	264235081074401	4	12	17	9/77 to current	24.87	1999	5	18	12:48	21.42	c
630993.4	772792	HE - 860	262735081044601	4	9	14	9/77 to current	29.33	1999	5	18	10:41	22.55	c
691293.4	715349.8	HE - 862	261735080534002	4	7	10	9/77 to current	17.13	1999	5	18	9:44	8.8	c
633553.6	801667.1	HE -1036	263213081040801	2	5	10	10/87-current	26.68	1999	5	18	12:12	22.78	c
593139.6	740421.5	HE -1043	262214081113002	2	5	10	10/87-current	23.41	1999	5	18	11:17	18.85	c

a. USGS
b. SFWMD
c. SFWMD (Howdi)
d. Drilled May 1998; electronically activated in July 1999. This data was manually collected (May 1999).

Table G-2. (Continued) May 1999 Water Levels for the Water Table Aquifer.

State Planar (NAD83)				Well Construction											
x (ft)	y (ft)	Station	USGS ID	Case Diam.(in)	Case Depth (ft)	Total Depth (ft)	POR	Measuring Point Elevation (NGVD)	Year	Month	Day	Time	Water Level (NGVD)	Agency
621493.4	713431.1	HE -1062	261746081061803	2	5	10	10/87 - current	18.34	1999	5	18	10:09	13.6	c
642832.9	852349.3	HE -1069	264046081022802	2	3	13	10/87- current	20.31	1999	5	18	13:06	15.32	c
543657.8	840079.6	HE -1077	263339081203901	6	5	10	1/88- current	30.26	1999	5	19	10:36	23.34	c

a. USGS
b. SFWMD
c. SFWMD (Howdi)
d. Drilled May 1998; electronically activated in July 1999. This data was manually collected (May 1999).

Table G-3. Additional May 1999 Water Levels for the Water Table Aquifer.

NAD 83									
x (ft)	y (ft)	Station	Ground Elevation	Lower Detection Limit 1999	Mean Wet Season Water Table	Year	Month	Day	Water Level (NGVD)
363961.8	853393.1	16-GW1	10.00	4.15	8.09	1999	5	20-28	4.15
357008.3	847865.8	16-GW3	11.60	6.41	9.59	1999	5	20-28	6.41
359508.8	854998.7	16Y-GW1	14.70	9.76	12.32	1999	5	20-28	9.76
368840.5	850509.1	17-GW1	5.30	---	4.18	1999	5	20-28	1.56
369576.7	870622	17-GW3	17.29	13.01	16.15	1999	5	20-28	11.64
370813.3	884304.3	17-GW4	23.50	21.66	23.09	1999	5	20-28	22.23
373488.5	869806.4	18 -GW2	16.80	---	13.92	1999	5	20-28	11.42
378872.4	861107.1	19 -GW1	8.80	3.84	7.49	1999	5	20-28	4.07
376989.2	864631.4	20 -GW1	13.70	---	12.04	1999	5	20-28	8.76
379537.9	871339.8	20 -GW2	17.60	---	16.74	1999	5	20-28	13.84
376487.9	878936.2	20-GW3	22.10	---	20.6	1999	5	20-28	17.29
385234.9	868939.3	21-GW2	16.69	---	13.9	1999	5	20-28	11.67
388957.6	880791.8	22-GW1	22.40	---	21.69	1999	5	20-28	18.14
392729.5	866771.8	23-GW1	5.90	1.97	4.03	1999	5	20-28	1.97
394582.8	884754.8	23-GW2	25.00	---	24.83	1999	5	20-28	20.26
397050	870136.4	24-GW1	17.60	---	16.81	1999	5	20-28	13.62
395616.1	875721.8	24-GW2	21.10	---	20.7	1999	5	20-28	17.08
405421.4	869299.8	26-GW1	6.26	---	4.8	1999	5	20-28	1.94
402675.9	874100.4	26-GW2	19.40	---	18.41	1999	5	20-28	15.49
417578.1	873285.2	27-GW1	22.47	---	21.96	1999	5	20-28	5.66
407831.8	880976.3	27-GW2	9.60	5.66	8.62	1999	5	20-28	21.68
404497.1	878393.6	27O-GW1	24.50	---	23.64	1999	5	20-28	18.96
422527.1	872835.4	28-GW1	13.30	9.68	12.21	1999	5	20-28	9.68
422542.8	875619.9	28-GW2	13.70	8.66	12.73	1999	5	20-28	8.66
428014.8	871772.6	29-GW1	10.20	---	9.65	1999	5	20-28	5.95
432254.5	871084.3	29-GW2	13.70	---	12.85	1999	5	20-28	8.94
464458.2	799068.9	37-GW1	30.70	---	28.36	1999	5	20-28	25.53
468923.4	810499.1	37-GW2	30.80	22.1	25.88	1999	5	20-28	23.62
464212.8	816881.7	37-GW3	28.40	---	25.57	1999	5	20-28	23.87
465231.3	837356.9	37-GW4	24.30	---	22.76	1999	5	20-28	21.26
465569.5	852015.6	37-GW5	20.70	18.07	19.85	1999	5	20-28	18.07
460649	858461.7	37-GW6	17.30	---	15.96	1999	5	20-28	14.11
448541.8	842707.5	38-GW1	21.00	---	19.54	1999	5	20-28	15.11
445823.2	854171.8	38-GW2	17.00	12.21	15.08	1999	5	20-28	12.21
432051.8	853454.8	38-GW3	19.30	---	17.11	1999	5	20-28	12.28

Source- Lee County Public Works Environmental Services.

Table G-3. (Continued) Additional May 1999 Water Levels for the Water Table Aquifer.

NAD 83									
x (ft)	y (ft)	Station	Ground Elevation	Lower Detection Limit 1999	Mean Wet Season Water Table	Year	Month	Day	Water Level (NGVD)
457017.6	861750.5	38-GW4	13.90	---	11.36	1999	5	20-28	7.9
434600.3	862285.4	38-GW5	10.30	6.28	9.52	1999	5	20-28	7.01
443468	861693.9	38-GW6	15.60	---	14.65	1999	5	20-28	11.71
420846.4	864240.4	39-GW1	10.65	---	8.68	1999	5	20-28	5.6
428908	866194.9	39-GW2	8.52	---	6.51	1999	5	20-28	4.13
423169	861562.7	39-GW3	12.71	---	9.26	1999	5	20-28	6.31
423418.6	867072.3	39-GW4	---	---	3.7	1999	5	20-28	1.96
456936.7	810554.4	40-GW1	31.30	---	27.67	1999	5	20-28	25.4
417290.4	851599.2	40-GW10	12.10	7.61	7.65	1999	5	20-28	7.61
400648.4	853817.3	40-GW11	16.00	---	10.73	1999	5	20-28	9.36
402641.7	859377.9	40-GW12	6.30	---	5.21	1999	5	20-28	3.07
419350.8	859584.9	40-GW13	15.20	---	13.38	1999	5	20-28	10.43
449046.3	823257.3	40-GW2	25.70	---	23.29	1999	5	20-28	18.72
423361.6	817634.3	40-GW3	27.70	---	26.27	1999	5	20-28	23.84
422833	830665.6	40-GW5	24.40	20.28	22.8	1999	5	20-28	20.28
424260.7	842410.1	40-GW6	21.20	17.29	19.58	1999	5	20-28	18.34
405757.3	834457.8	40-GW7	21.20	---	20.95	1999	5	20-28	19.08
405550.5	845182.9	40-GW8	20.50	---	19.77	1999	5	20-28	17.81
417260.2	846328.3	40-GW9	14.30	---	8.91	1999	5	20-28	7.15
379182.3	834022.1	41-GW1	17.40	---	16.3	1999	5	20-28	14.21
384477.1	844347.9	41-GW3	10.10	---	9.29	1999	5	20-28	6.6
390119.2	850127.9	41-GW4	14.94	10.54	13.01	1999	5	20-28	10.54
390683.5	844366.1	41-GW6	19.70	15.5	18.71	1999	5	20-28	15.5
374735.6	812661.9	42-GW1	13.00	---	11.09	1999	5	20-28	8.92
372295	822493.6	42-GW2	13.00	---	11.65	1999	5	20-28	9.12
363112.2	810015.2	42-GW3	4.00	0.97	2.51	1999	5	20-28	0.97
355926.7	795888.4	43-GW1	4.65	---	3.48	1999	5	20-28	-1.14
350199.1	795264.6	43-GW2	5.20	---	3.65	1999	5	20-28	1.84
359413.5	803377.8	43-GW3	5.90	---	5.35	1999	5	20-28	1.58
356474.8	788374.1	43-GW4	6.00	---	3.37	1999	5	20-28	2.62
361970.5	787062.8	44-GW1	4.20	---	3.41	1999	5	20-28	1.97
348806.3	783703.6	44-GW2	5.10	---	2.9	1999	5	20-28	2.65
362314.6	781545.8	44-GW3	4.70	0.04	3.31	1999	5	20-28	0.35
366198.8	799211.5	45-GW1	5.20	1.96	2.69	1999	5	20-28	1.96
371457.3	803112.5	45-GW2	7.80	3.73	6.36	1999	5	20-28	3.73

Source- Lee County Public Works Environmental Services.

Table G-3. (Continued) Additional May 1999 Water Levels for the Water Table Aquifer.

NAD 83									
x (ft)	y (ft)	Station	Ground Elevation	Lower Detection Limit 1999	Mean Wet Season Water Table	Year	Month	Day	Water Level (NGVD)
375253.5	784063.8	45-GW4	5.20	---	2.24	1999	5	20-28	0.89
381445.6	797531.2	46A-GW1	13.30	8.54	12.94	1999	5	20-28	8.54
387982.4	805184.6	46A-GW10	17.70	---	16.99	1999	5	20-28	14.59
392580.3	800128	46A-GW11	18.80	---	18.48	1999	5	20-28	18.7
392667.4	796310.5	46A-GW12	18.60	---	19.03	1999	5	20-28	16
397902.5	805787.6	46A-GW13	21.30	---	21.18	1999	5	20-28	19.03
399029.5	812022.3	46A-GW14	21.00	18.99	21.46	1999	5	20-28	18.99
403483.7	800424.4	46A-GW15	22.60	---	22.74	1999	5	20-28	20.05
411544.3	808919.2	46A-GW16	26.30	23.15	25.68	1999	5	20-28	23.15
414901.3	815079.4	46A-GW18	27.20	---	24.73	1999	5	20-28	21.91
413900.7	820657.9	46A-GW19	24.54	---	23.14	1999	5	20-28	20.66
403025.7	824175.8	46A-GW20	22.70	---	22.42	1999	5	20-28	18.52
405570.3	830522	46A-GW21	22.20	18.3	21.34	1999	5	20-28	18.3
392979	837506.4	46A-GW22	20.30	17.02	19.92	1999	5	20-28	17.48
391242.6	829519.8	46A-GW23	19.40	15.61	18.06	1999	5	20-28	15.61
380083.3	797238.4	46A-GW25	13.60	8.72	12.74	1999	5	20-28	8.72
379411.8	794578.3	46A-GW26	11.00	6.35	10.63	1999	5	20-28	6.35
385412.4	786905.2	46A-GW3	14.20	7.57	12.76	1999	5	20-28	7.57
396430.1	788166.1	46A-GW4	20.60	---	20.08	1999	5	20-28	17.47
408793.4	785910.4	46A-GW5	20.60	17.17	20.3	1999	5	20-28	17.17
385868.3	781507.6	46B-GW1	12.90	---	10.19	1999	5	20-28	8.18
389353.8	772459.3	46B-GW2	14.90	10.42	12.97	1999	5	20-28	10.42
390392.1	832978.7	46C-GW1	18.60	16.35	18.02	1999	5	20-28	16.35
381284.1	822738.9	46C-GW2	18.03	14.33	16.69	1999	5	20-28	14.33
383625.2	813875.4	46C-GW3	15.60	---	15.74	1999	5	20-28	12.56
377641.7	798890.4	46C-GW6	11.70	7.48	11.6	1999	5	20-28	7.97
379187.3	818510.4	46C-GW7	16.00	11.29	14.91	1999	5	20-28	11.29
377643.4	823730	46C-GW8	15.50	11.43	15.3	1999	5	20-28	12.28
414096.4	769583.3	47A-GW1	18.20	---	18.43	1999	5	20-28	14.96
395483.4	784780.3	47A-GW10	19.50	---	18.27	1999	5	20-28	15.61
383159	767289.8	47A-GW11	9.10	4.04	6.42	1999	5	20-28	4.04
398219.7	768525.3	47A-GW2	14.30	13.78	10.57	1999	5	20-28	10.57
409095	763189.1	47A-GW3	18.00	16.68	14.45	1999	5	20-28	14.45
397721.7	776405.7	47A-GW4	18.86	12.86	16.48	1999	5	20-28	13.86
420567	785602.8	47A-GW5	24.90	---	23.5	1999	5	20-28	19.91

Source- Lee County Public Works Environmental Services.

Table G-3. (Continued) Additional May 1999 Water Levels for the Water Table Aquifer.

NAD 83									
x (ft)	y (ft)	Station	Ground Elevation	Lower Detection Limit 1999	Mean Wet Season Water Table	Year	Month	Day	Water Level (NGVD)
402778.5	756080.1	47A-GW6	15.96	12.19	15.6	1999	5	20-28	12.19
434706	799640.8	47A-GW8	28.70	23.97	27.98	1999	5	20-28	24.65
434659.2	811818.6	47A-GW9	29.20	27.12	23.59	1999	5	20-28	23.59
390474.7	751488.3	47B-GW1	14.30	10.85	13.25	1999	5	20-28	10.85
385703.3	747643.6	48-GW2	14.05	8.77	11.98	1999	5	20-28	8.77
397377.6	737937.4	48-GW3	10.33	6.01	9.51	1999	5	20-28	6.01
454702.2	799296.4	49-GW1	29.80	25.35	27.98	1999	5	20-28	26.04
424885.2	728446.8	49-GW10	14.20	---	14.24	1999	5	20-28	10.24
414254.8	730988.9	49-GW11	13.70	---	14.07	1999	5	20-28	8.9
411587.8	722887.3	49-GW12	12.80	---	11.72	1999	5	20-28	7.32
400757.3	737429.7	49-GW14	13.40	---	12.2	1999	5	20-28	8.79
392730.6	727907.8	49-GW15	9.90	---	8.25	1999	5	20-28	6.98
437065	792420.1	49-GW2	28.60	---	27.91	1999	5	20-28	26.07
434792.8	785100.1	49-GW3	28.10	23.9	26.39	1999	5	20-28	23.9
426774.9	784354.3	49-GW4	26.00	---	24.87	1999	5	20-28	21.41
438197.8	769331.6	49-GW5	24.70	---	24.01	1999	5	20-28	21.13
435332.1	753228.9	49-GW7	18.40	---	17.52	1999	5	20-28	15.38
435414.1	737597.9	49-GW8	16.92	---	17.26	1999	5	20-28	15.28
435366.3	728452.6	49-GW9	15.88	---	16.77	1999	5	20-28	13.54
410296.3	735133.9	49L-GW1	14.00	9.5	13.2	1999	5	20-28	9.5
405316.6	733163.9	49L-GW2	12.37	---	8.75	1999	5	20-28	6.77
321776	860254.2	5-GW1	7.80	2.46	4.29	1999	5	20-28	2.46
342933.4	865600.9	5-GW3	16.40	11.78	14.17	1999	5	20-28	11.68
343886.1	876380.1	5-GW4	17.50	---	17.05	1999	5	20-28	15.66
354391.2	869820.6	5-GW5	16.10	12.41	15.35	1999	5	20-28	12.41
356781	884344.9	5-GW8	21.68	---	20.75	1999	5	20-28	17.51

Source- Lee County Public Works Environmental Services.

Table G-4. May 1999 Water Levels for the Tamiami Aquifer.

State Planar (NAD83)				Well Construction										
x (ft)	y (ft)	Station	USGS ID	Case Diam. (in)	Case Depth (ft)	Total Depth (ft)	POR	Measuring Point Elevation (NGVD)	Year	Month	Day	Time	Water Level (NGVD)	Agency
457995	742253	C-0492	262228081361901	6	60	64	10/73 to current	21.54	1999	5	31	23:59	14.24	a
481884	778800	C-1076	262822081213202	4	65	85	4/86 to current	34.05	1999	5	17	13:58	25.21	a
533717	884434	HE-0516	26460108121302	2	270	273	1/77 to current	19.54	1999	5	19	8:55	8.95	b
633674	857402	HE-0629	264137081040701	2	133	144	9/77 to current	23.31	1999	5	18	13:15	16.96	b
577656	825664	HE-0853	263618081143001	4	17	61	9/77 to current	32.12	1999	5	19	11:29	26.12	b
614751	797643	HE-0855	263515081012001	4	70	90	1/78 to current	30.13	1999	5	18	11:54	21.87	b
630993	772792	HE-0859	262735081044602	4	58	59	9/77 to current	29.1	1999	5	18	10:40	16.7	b
632051	714837	HE-0884	261801081042501	4	62	67	9/77 to current	20.86	1999	5	18	10:03	14.39	b
633554	801667	HE-1037	263213081040802	2	70	120	10/87 to current	27.55	1999	5	18	12:13	21.92	b
593140	740422	HE-1042	26221408113001	2	40	80	10/87 to current	23.11	1999	5	18	11:16	18.54	b
621493	713431	HE-1063	261746081061804	2	78	123	10/87 to current	18.42	1999	5	18	10:10	14.42	b
642833	852349	HE-1068	264046081022801	6	60	160	10/87 to current	19.78	1999	5	18	13:05	15.83	b
680597	800255	HE-1075	263207080553101	2	135	155	10/87 to current	16.15	1999	5	19	12:08	11.39	b
543658	840080	HE-1076	263840081203901	6	300	340	1/88 to current	27.86	1999	5	19	10:35	17.72	b
396930	721480	L-2527	263955082083101	4	360	605	1/78 to current	10.74	1999	5	17	15:00	24.1	a

a. USGS
b. SFWMD (Howdi)

Table G-5. May 1999 Water Levels for the Lower Tamiami Aquifer.

State Planar (NAD83)				Well Construction									
x (ft)	y (ft)	Station	USGS ID	Case Diam. (in)	Case Depth (ft)	Total Depth (ft)	POR	Measuring Point Elevation (NGVD)	Year	Month	Day	Time	Water Level (NGVD)
391641	661130.8	C-0130	260902081480401	6	69	71.5	6/52 to current	7.96	1999	5	25	11:43	2.48
525801	758245.1	C-0298	262507081235201	3	254	303	7/59 to current	33.41	1999	5	17	14:53	10.56
458191	706306.7	C-0304	261630081360001	3	232	130	8/59 to current	17.59	1999	5	19	8:57	3.43
398845	692085.2	C-0460	261405081465501	2	64	66	8/73 to current	13.46	1999	5	24	23:59	2.45
513302	772118.3	C-0462	262724081260701	8.62	50	110	11/68 to current	37.11	1999	5	17	10:48	24.93
396454	688363.8	C-0489	261302081473901	8	63	83	5/70 to current	18.66	1999	5	25	12:56	-0.7
393896	686965.8	C-0490	261243081480301	2	70	71	10/71 to current	16.55	1999	5	25	12:34	2.2
391544	674863.7	C-0516	261156081475801	2	46	63	1973 to current	10.38	1999	5	25	12:09	3.23
390311	667096.5	C-0526	261018081484101	2	63	68	9/73 to current	5.71	1999	5	25	11:52	2.8
390311	667096.5	C-0528	261200081483001	2	63	80	9/73 to current	4.39	1999	5	25	12:01	1.98
413767	641916	C-0600	260549081441901	4	48	52	10/80 to current	8.76	1999	5	18	12:15	1.99
463760	689823.2	C-0951	261347081351202	6	120	170	10/84 to current	16.27	1999	5	19	23:59	1.03
444545	689611.6	C-0956	261343081384802	4	60	260	10/84 to current	17.42	1999	5	20	10:47	1
477836	658966.8	C-0973	260843081324201	6	90	150	10/84 to current	25.66	1999	5	20	13:37	3.88
444136	662352	C-0977	260915081385902	6	75	140	10/84 to current	15.94	1999	5	20	17:54	3.93
459784	735681.6	C-0979	262121081355503	6	ND	ND	10/84 to current	22.3	1999	5	19	10:14	10.64
500094	739249.3	C-0982	262158081283403	6	150	160	10/84 to current	20.25	1999	5	19	11:58	9.37
498358	712802.1	C-0985	261733081285503	6	80	160	10/84 to current	24.63	1999	5	19	12:31	8.69
410306	705648.6	C-0998	261620081450201	4	52	62	3/85 to current	17.84	1999	5	18	10:57	-2.74
400929	705603	C-1004	261620081464401	4	52	60	3/85 to current	12.52	1999	5	31	23:59	1.47
400929	705502	C-1058	261537081461202	4	62	80	4/86 to current	13.39	1999	5	25	9:08	-4.62
448469	616390.6	C-1064	260137081375902	4	84	120	4/86 to current	10.07	1999	5	18	15:29	-0.07
501995	585774.8	C-1065	255637081281401	4	27	50	4/86 to current	6.42	1999	5	17	23:59	0.46

Source- USGS.

Table G-5. (Continued) May 1999 Water Levels for the Lower Tamiami Aquifer.

State Planar (NAD83)				Well Construction									
x (ft)	y (ft)	Station	USGS ID	Case Diam. (in)	Case Depth (ft)	Total Depth (ft)	POR	Measuring Point Elevation (NGVD)	Year	Month	Day	Time	Water Level (NGVD)
478245	625747.4	C-1068	260314081323102	4	120	200	4/86 to current	9.02	1999	5	20	15:06	1.86
537441	661889.2	C-1070	260813081214302	4	100	205	4/86 to current	17.4	1999	6	3	17:14	10.51
526663	713110	C-1073	261740081235403	4	100	160	10/86 to current	23.48	1999	5	17	16:50	12.04
567168	759248	C-1074	262519081162102	4	100	130	10/85 to current	29.94	1999	5	17	15:06	21.97
397838	721171.6	C-1083	261805081473302	4	58	74	6/87 to current	15.81	1999	5	24	23:59	0.63
401440	729934.5	L-0738	262022081464201	4	61	75	11/68 to current	11.31	1999	5	31	23:59	-1.33
408457	731912.3	L-1691	262042081455001	4	58	69	6/73 to current	15.48	1999	5	25	15:17	1.49
401011	734178	L-5723	262102081464402	4	55	140	3/86 to current	13.1	1999	5	25	15:11	-0.86
388135	726482.6	L-5725	261946081490302	6	65	128	4/86 to current	14.96	1999	5	25	14:06	-0.42
406228	724150.5	L-5745	261900081454602	4	57	105	1/87 to current	13.6	1999	5	25	15:36	0.16
398261	745705.8	L-5747	262258081471802	4	59	105	7/87 to current	15.66	1999	5	31	23:59	-2.78

Source- USGS.

Table G-6. May 1999 Water Levels for the Sandstone Aquifer.

State Planar (NAD 83)				Well Construction							
x (ft)	y (ft)	Station	USGS ID	Case Diam. (in)	Case Depth (ft)	Total Depth (ft)	Year	Month	Day	Time	Water Level (NGVD)
529867	907692	MUSE+W1	---	---	---	---	1999	5	19	---	37.01
430214	705469	C-0303	261621081412302	3	232	300	1999	5	19	8:45	0.79
500066	763006	C-0687	262554081283801	4	290	310	1999	5	17	11:36	12.95
460756	715514	C-0688	261802081354801	4	220	242	1999	5	18	23:59	8.37
525728	713043	C-0689	261740081235402	4	230	265	1999	5	17	16:46	11.05
498331	712430	C-0989	261733081285502	6	240	270	1999	5	19	12:24	9.30
561687	717289	C-1072	261823081171902	4	140	260	1999	5	16	23:59	13.39
538832	777823	C-1077	262822081213203	4	170	246	1999	5	17	14:13	23.00
501251	739174	C-1079	262158081283404	4	298	390	1999	5	18	23:59	8.94
514056	840802	HE-0556	263845081260702	4	135	155	1999	5	31	23:59	15.61
494803	882976	FTDN-2	---	---	---	---	1999	5	19	---	0.40
455353	841548	L-0727	263850081365401	4	67	71	1999	5	31	23:59	12.69
439854	809819	L-0729	263335081394301	4	81	103	1999	5	16	23:59	10.20
470643	770092	L-0731	262703081340201	4	165	243	1999	5	31	23:59	10.29
449930	827438	L-1418	263630081375301	4	102	119	1999	5	18	9:13	8.99
416838	770667	L-1625	263329081394302	8	55	62	1999	5	17	15:17	9.67
471189	811487	L-1853	262706081435401	2	162	218	1999	5	25	17:01	1.21
421847	837381	L-1968	263807081430301	4	130	210	1999	5	17	17:12	11.20
390326	832622	L-1974	263718081485002	4	85	135	1999	5	18	14:43	16.47
423498	872914	L-1975	264359081424701	4	102	168	1999	5	17	10:19	8.97
455212	868811	L-1977	264320081365701	4	65	185	1999	5	17	10:28	7.74
408500	805550	L-1994	263251081452802	4	70	155	1999	5	25	23:59	8.69
419051	792363	L-1998	263041081433102	4	100	160	1999	5	31	23:59	-21.05
458564	810636	L-2186	263344081361703	4	133	160	1999	5	17	15:48	8.02
460825	847580	L-2187	263950081355401	4	136	154	1999	5	17	16:32	11.54
446737	769801	L-2192	262659081382501	4	155	184	1999	5	25	17:55	13.78
470903	869647	L-2200	264329081340401	4	122	163	1999	5	17	11:08	7.39
464040	796778	L-2215	263127081351602	4	99	149	1999	5	31	23:59	7.36
407799	886031	L-2216	264608081454101	4	130	150	1999	5	17	9:55	12.16
396148	805423	L-5648	263249081474401	4	118	123	1999	5	26	12:39	7.81
440412	759231	L-5664	262514081393402	4	180	300	1999	5	25	17:47	8.74
445996	748803	L-5673	262331082383202	4	130	135	1999	5	25	16:24	2.23

Source- USGS.

Table G-7. May 1999 Water Levels for the Mid-Hawthorn Aquifer.

State Planar (NAD 83)				Well Construction							
x (ft)	y (ft)	Station	USGS ID	Case Diam. (in)	Case Depth (ft)	Total Depth (ft)	Year	Month	Day	Time	Water Level (NGVD)
384871	757373	PW-8	---	6	195	235	1999	5	24	11:00	-9.50
534795	572683	C-0311	255430081221001	4	430	450	1999	5	18	17:05	39.40
523064	763028	C-0363	262555081242501	2	84	119	1999	5	17	14:38	21.78
525728	713043	C-0684	261740081235401	4	440	490	1999	5	17	16:41	33.60
463461	689756	C-0948	261347081351701	6	370	420	1999	5	19	13:43	34.00
460212	735609	C-0963	262121081355502	6	310	340	1999	5	19	10:09	26.30
543266	736820	C-0965	262136081204202	2	438	460	1999	5	17	18:11	13.80
477471	664858	C-0974	260941081324201	6	400	460	1999	5	20	13:12	36.40
500341	739178	C-0983	262158081283402	2	480	520	1999	5	19	11:40	30.00
458061	742384	C-1080	262228081361902	4	238	309	1999	5	19	10:51	25.30
380816	780278	L-0735	262839081503100	4	223	270	1999	5	24	10:07	-12.73
370742	809022	L-0742	263323081522401	8	138	225	1999	6	17	23:59	-60.72
324768	840765	L-0781	263834082005301	6	82	290	1999	5	17	16:15	-18.75
338480	865601	L-1110	264241081582401	2	147	238	1999	5	18	10:20	-2.76
349050	860068	L-1111	264147081562701	2	ND	165	1999	5	18	10:31	-18.57
316919	857591	L-1113	264120082022101	2	126	230	1999	5	18	9:32	3.38
376557	809387	L-1121	263327081512001	2	147	220	1999	5	18	15:38	-63.04
356267	804074	L-1598	263233081550301	2	137	176	1999	5	19	16:01	-45.20
390326	832622	L-1973	263718081485001	4	172	225	1999	5	18	15:03	-2.11
419051	792363	L-1983	263041081433101	4	321	345	1999	5	26	10:11	24.15
340099	779757	L-2212	262831081575901	4	135	236	1999	5	21	12:10	-5.27
343741	805075	L-2244	263242081572101	4	150	207	1999	5	17	10:38	-37.62
354245	838421	L-2640	263813081552801	4	128	180	1999	5	17	23:59	-35.02
335033	806655	L-2642	263257081585701	4	108	160	1999	5	17	10:58	-37.88
320045	806369	L-2643	263253082014201	4	141	200	1999	5	17	11:14	-19.00
316682	817201	L-2644	263440082022001	4	128	180	1999	5	30	23:59	-20.81
306667	835763	L-2645	263743082041201	4	160	210	1999	5	17	14:38	9.60
355114	883249	L-2646	264537081552202	4	170	220	1999	5	18	11:54	9.41
321664	849676	L-2700	264002082012801	4	165	205	1999	5	18	9:16	2.18
335192	839169	L-2701	263819081585801	4	175	206	1999	5	17	23:59	-30.97
283280	849295	L-2820	263955082083102	4	192	241	1999	5	17	15:20	11.70
301073	796831	L-2821	263117082051002	4	290	340	1999	5	17	15:43	8.80
343748	854655	L-4820	264057081572501	4	128	190	1999	5	26	11:15	-19.69

Source- USGS.

Potentiometric maps are used to display the elevation of the imaginary surface representing the static head of ground water in tightly cased wells that tap an aquifer; or in the case of unconfined aquifers, the water table. May 1999 potentiometric maps for the following aquifers are displayed in **Figures G-1** through **G-5** water table (LWC Planning Area and Lee County), lower Tamiami, Sandstone, and mid-Hawthorn.

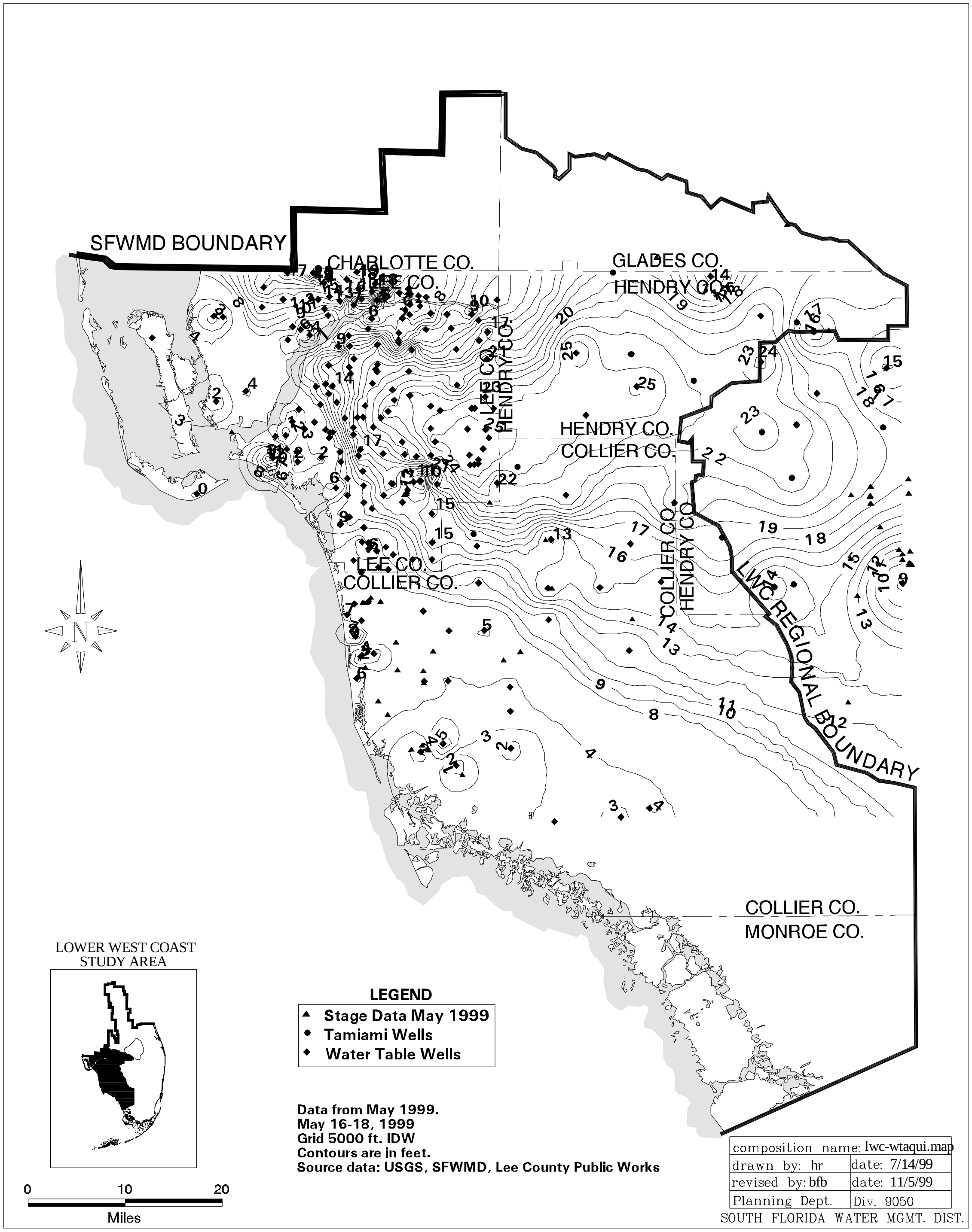

Figure G-1. Potentiometric Map of the Water Table Aquifer, May 1999.

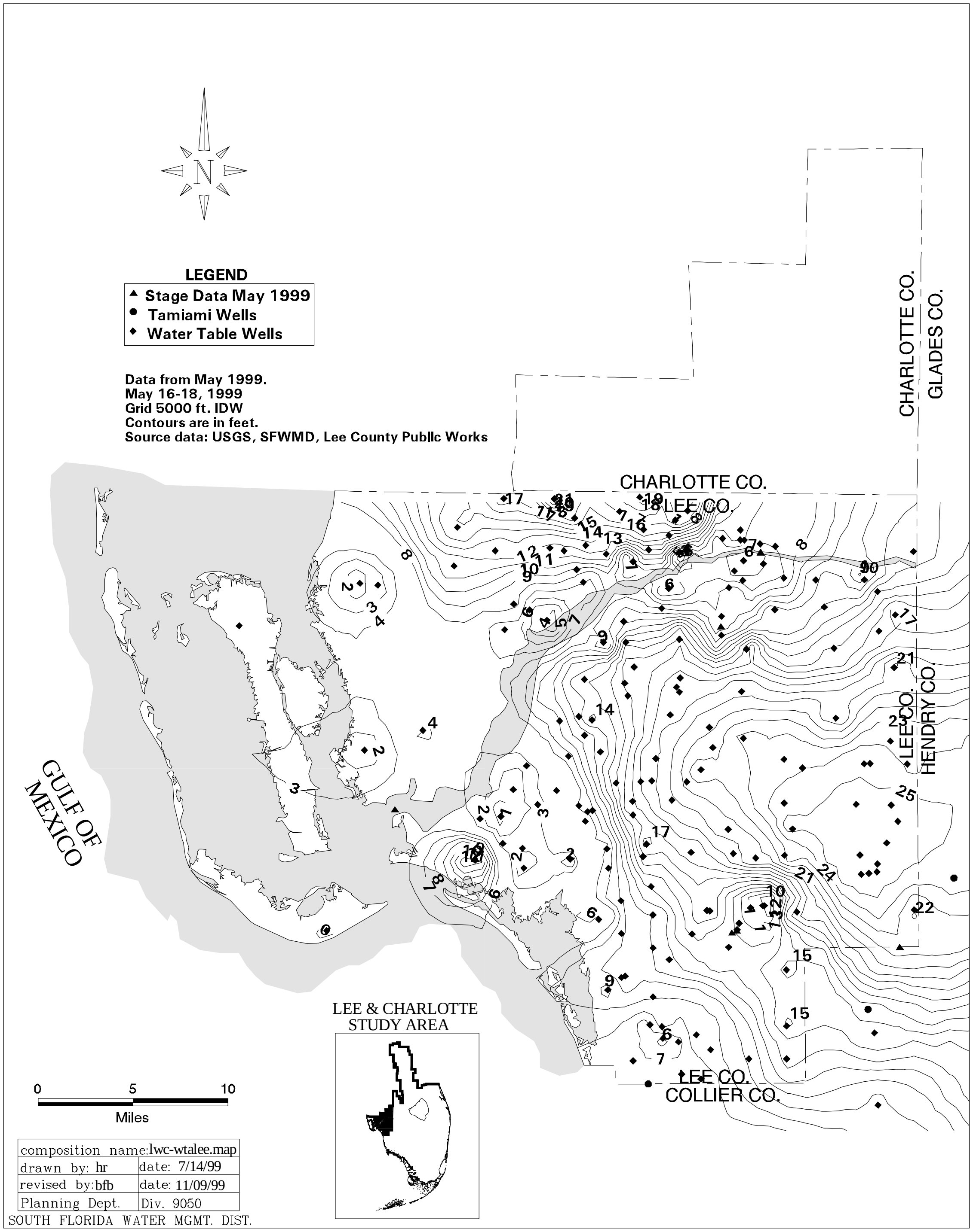

Figure G-2. Potentiometric Map of the Water Table Aquifer, in Lee County, May 1999.

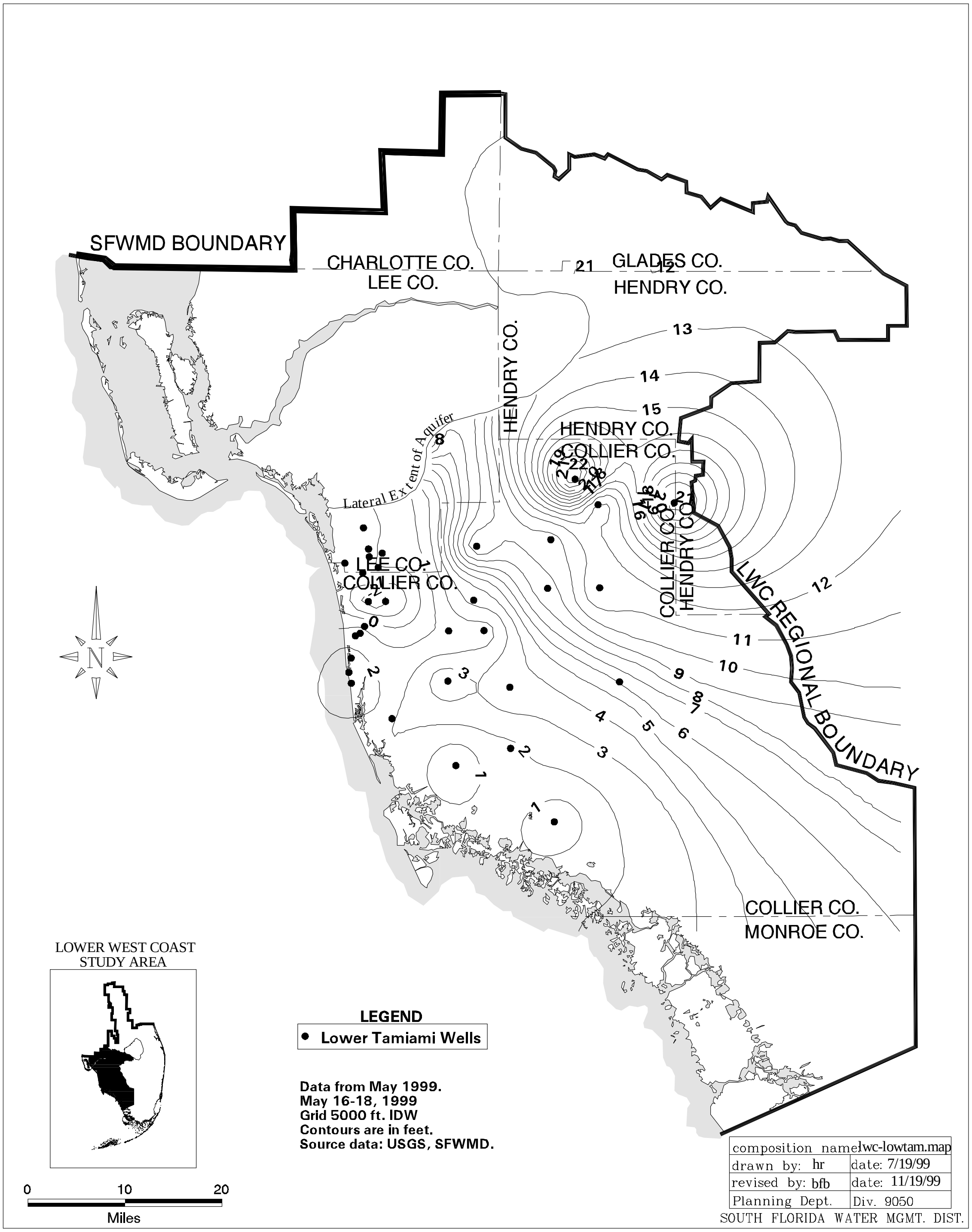

Figure G-3. Potentiometric Map of the Lower Tamiami Aquifer, May 1999.

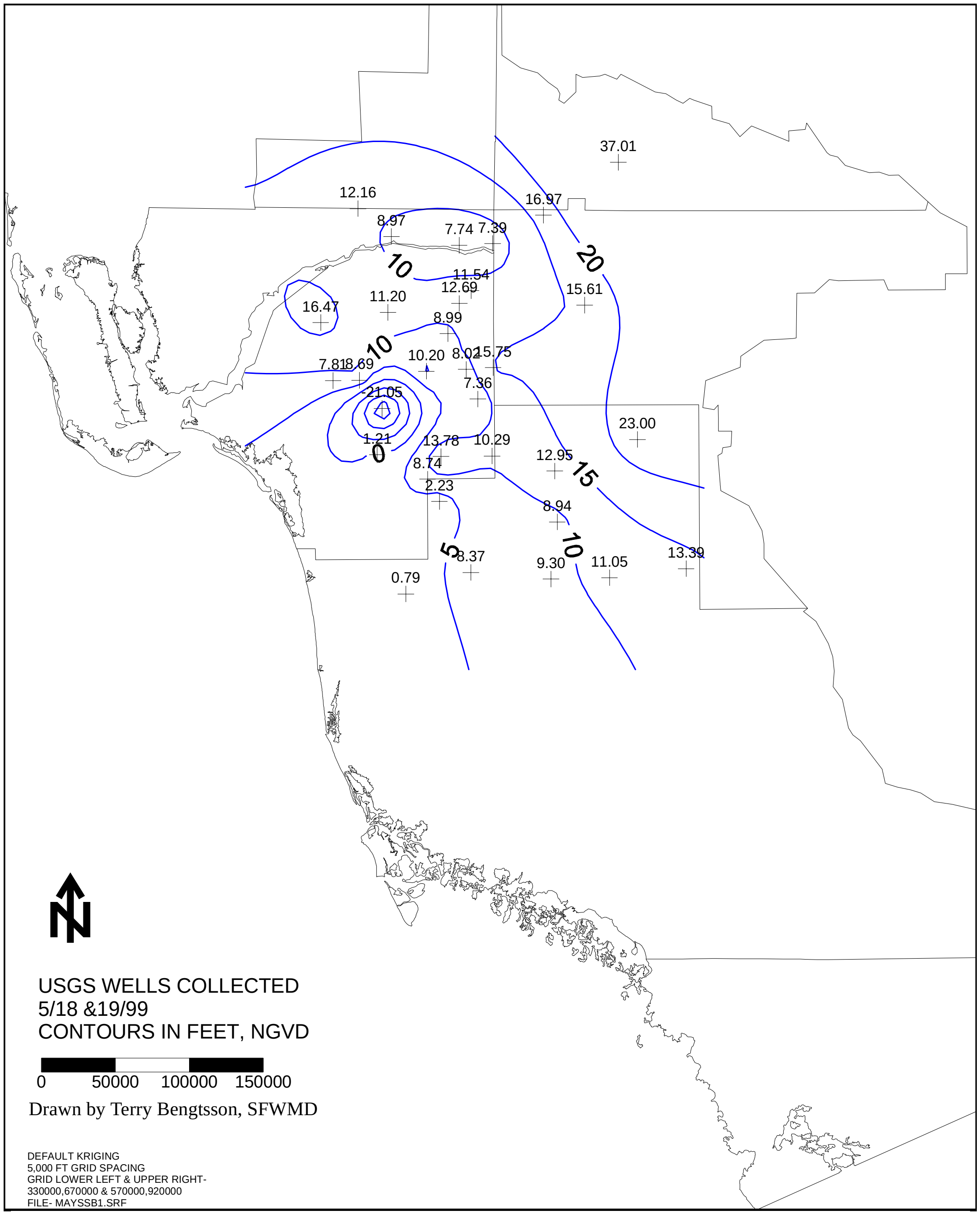

Figure G-4. Potentiometric Map of the Sandstone Aquifer, May 1999.

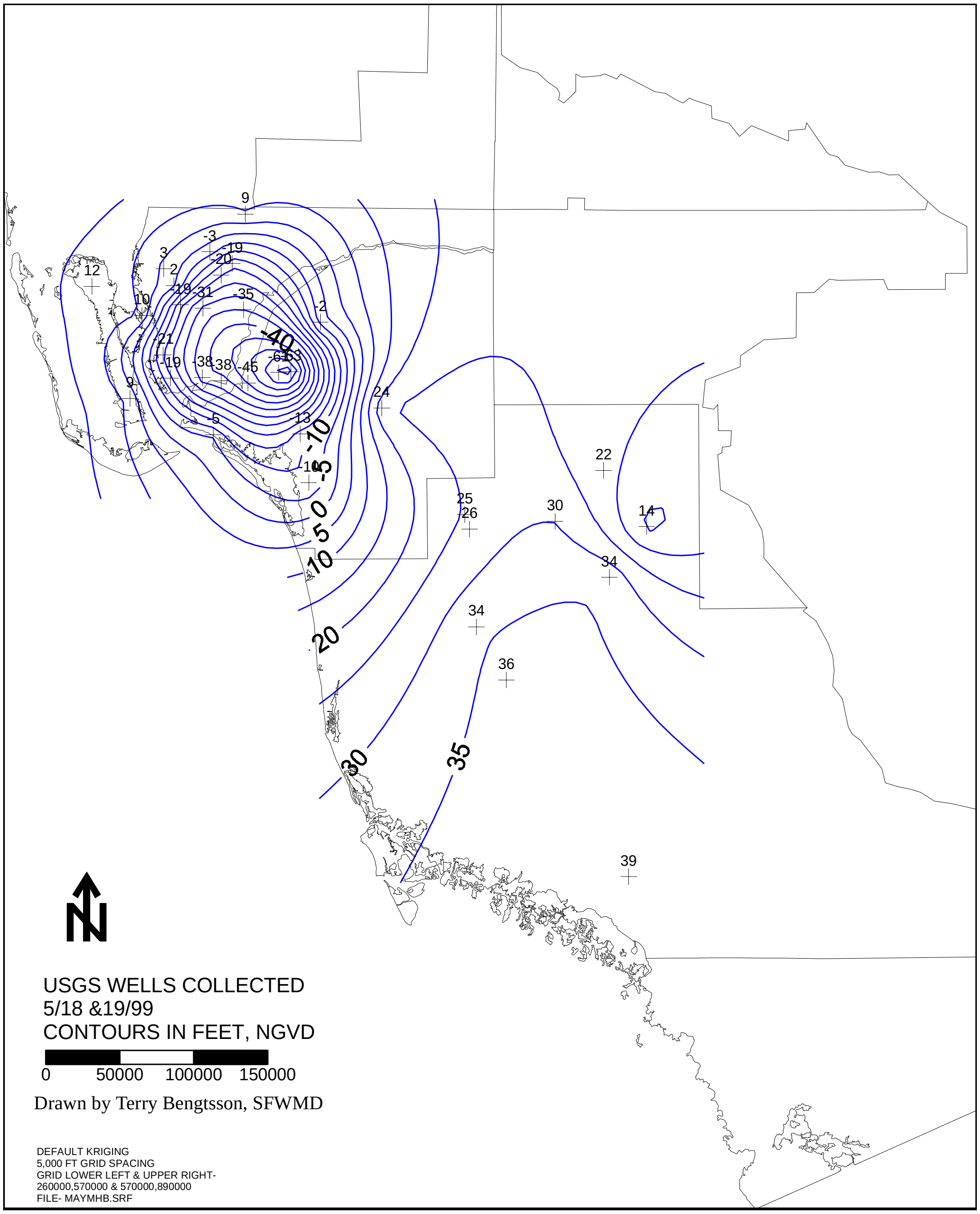

Figure G-5. Potentiometric Map of the Mid-Hawthorn Aquifer, May 1999.

Tables G-8 through **G-10** present the ambient water quality data retrieved from the AGWQMN database for the SAS, IAS, and FAS. Well construction information (casing and total depths) and well locations in latitude / longitude coordinates are included.

Table G-8. Water Quality Data for Surficial Aquifer Wells (data averaged over periods).

Station ID	Station	Latitude	Longitude	Case Depth	Total Depth	County	Chloride (mg/L)			Sulfate (mg/L)			Total Dissolved Soilds (mg/L)		
							1984-1989	1990-1998	Difference	1984-1989	1990-1998	Difference	1984-1989	1990-1998	Difference
261000080520001	C-00054	261020.1	805300.5	7	8	Collier	23	16	-7	5	7	2	337	---	---
260640081204301	C-00296	260644.2	812041.9	8	45	Collier	458	607	150	118	207	89	1,178	1,831	652
261630081360001	C-00304	261636.2	813614.7	125	130	Collier	43	39	-4	37	17	-20	380	358	-23
260919081160001	C-00307	260919	811559	11	56	Collier	---	21	---	---	---	---	---	---	---
261620081450701	C-00384	261620	814505	10	10	Collier	23	11	-12	12	26	14	340	---	---
261243081480301	C-00490	261313	814802	70	71	Collier	13	7	-6	5	2	-3	208	185	-22
262228081361901	C-00492	262228.9	813619.1	60	64	Collier	55	75	20	8	4	-4	432	---	---
255748081181801	C-00495	255754.5	811842.5	8	70	Collier	25	18	-7	5	2	-3	245	283	39
260111081243901	C-00496	260025.9	812440.0	8	60	Collier	44	29	-15	7	0.5	-6	284	---	---
261741081235401	C-00503	261742.1	812345.2	8	23	Collier	45	77	32	6	13	6	372	892	520
262859081273002	C-00532	262931.5	812735.3	3	13	Collier	25	21	-4	18	14	-4	319	---	---
260630081411401	C-00599	260626.4	814114.2	40	50	Collier	188	139	-49	95	78	-17	647	---	---
260843081324202	C-00972	260843.6	813237.2	25	44	Collier	8	7	-2	37	40	3	353	372	19
260843081324201	C-00973	260843.6	813237.4	90	150	Collier	---	598	---	---	---	---	---	---	---
262121081355501	C-00978	262119.2	813600.5	15	40	Collier	---	203	---	---	---	---	---	---	---
261343081384801	C-00980	261345.6	813843.5	15	30	Collier	---	8	---	---	---	---	---	---	---
261733081285501	C-00984	261737.4	812854.4	30	42	Collier	39	43	4	8	0.5	-8	449	---	---
261733081285502	C-00985	261737.5	812854.2	80	160	Collier	---	---	---	13	---	---	---	---	---
261436081480301	C-01003	261436	814803	51	61	Collier	---	13	---	---	---	---	---	---	---
261211081441301	C-01055	261240.9	814414.4	10	25	Collier	---	6	---	---	---	---	---	---	---
261537081461201	C-01057	261537	814612	8	11	Collier	---	16	---	---	---	---	---	---	---
265641081363301	CHWQ-01	265641.08	813632.40	50	60	Charlotte	47	43	-5	36	---	---	540	484	-56
264754081460201	CHWQ-02	264754	814602	18	33	Charlotte	30	29	-1	31	---	---	361	---	---
265404081202901	GLWQ-01	265407.02	812027.59	39	54	Glades	11	5	-6	10	18	8	100	---	---
265043081082001	GLWQ-03	265045.18	810820.84	44	49	Glades	64	72	8	47	25	-23	709	---	---
270427081064401	GLWQ-04	270425.51	810640.38	60	75	Glades	133	137	4	14	10	-4	806	765	-40
270143081001001	GLWQ-06	270144.04	810009.76	31	46	Glades	301	326	24	100	109	9	1,016	1,141	125
264939081332001	GLWQ-07	264939.44	813317.71	35	50	Glades	165	107	-58	21	12	-9	595	---	---
265640081292001	GLWQ-08	265640	812920	70	85	Glades	111	114	2	170	170	1	895	982	87
270137081203501	GLWQ-09	270136.07	812034.91	18	33	Glades	13	14	1	3	1	-2	88	94	6
263310081250902	HE-0554	263309.88	812509.84	5	15	Hendry	34	---	---	10	3	-7	261	---	---
264235081310602	HE-0558	264237.07	813105.92	3	14	Hendry	826	376	-451	189	240	51	1966	---	---
264133081040801	HE-0630	264133.28	810408.15	70	75	Hendry	---	145	---	41	42	1	634	---	---
263845081260703	HE-0851	263844.89	812609.79	5	13	Hendry	45	47	2	8	0	-7	546	---	---

a. Difference in averages of constituent ((1990-1998) - (1984-1989)), mg/l.

Table G-8. (Continued) Water Quality Data for Surficial Aquifer Wells (data averaged over periods).

Station ID	Station	Latitude	Longitude	Case Depth	Total Depth	County	Chloride (mg/L)			Sulfate (mg/L)			Total Dissolved Soilds (mg/L)		
							1984-1989	1990-1998	Difference	1984-1989	1990-1998	Difference	1984-1989	1990-1998	Difference
263548081200601	HE-0852	263545.94	812006.37	9	14	Hendry	28	18	-10	18	1	-17	463	457	-6
263515081012001	HE-0854	263509.98	810207.24	3	14	Hendry	19	21	2	9	11	2	383	---	---
263035081073501	HE-0855	263140.96	810735.51	70	77	Hendry	97	91	-6	7	8	1	525	---	---
263035081073502	HE-0856	263141.08	810735.55	4	11	Hendry	4	13	8	8	9	1	202	212	10
264535081130701	HE-0857	264540.84	811245.79	12	17	Hendry	---	37	---	---	---	---	507	483	-25
261735080534001	HE-0861	261735	805340	37	44	Hendry	68	63	-5	4	1	-2	303	---	---
261735080534002	HE-0862	261735	805340	7	11	Hendry	21	10	-11	5	2	-3	---	---	---
261746081061804	HE-1063	261747.24	810620.89	78	123	Hendry	---	230	---	---	---	---	---	---	---
264153082022301	L-00721	264152.49	820222.72	9	18	Lee	---	9	---	---	---	---	---	---	---
264425081454001	L-00726	264424.80	814539.79	14	19	Lee	---	6	---	---	---	---	---	---	---
263532081592202	L-01136	263531.96	815921.47	15	18	Lee	---	36	---	---	---	---	---	---	---
263950081355402	L-01137	263948.80	813552.98	15	20	Lee	15	55	40	26	25	-1	342	---	---
262549082035301	L-01403	262552.10	820355.67	2	11	Lee	490	80	-410	52	32	-20	1,138	---	---
263344081361702	L-01964	263343.88	813617.14	14	24	Lee	41	82	42	19	35	16	407	364	-43
264320081365702	L-01978	264317.71	813657.00	7	17	Lee	39	18	-21	11	8	-3	324	---	---
263041081433103	L-01999	263041.73	814332.64	16	26	Lee	19	29	10	14	26	12	410	---	---
264144081520302	L-02191	264200	815201	15	25	Lee	93	---	---	---	---	---	---	---	---
264329081340402	L-02202	264330.07	813406.77	7	19	Lee	56	40	-16	8	5	-3	464	---	---
262552081485703	L-02308	262551.07	814854.71	12	13	Lee	21	20	-1	6	3	-3	314	331	17
263955082083103	L-02549	263953.06	820830.63	58	80	Lee	104	105	1	2	2	0	545	566	21
262934081495802	L-05721	262933.90	814714.79		30	Lee	42	---	---	25	3	-22	384	---	---
264910081280401	RTA-007S	264911.47	812801.64	60	80	Glades	110	110	0	91	91	0	513	---	---

a. Difference in averages of constituent ((1990-1998) - (1984-1989)), mg/l.

Table G-9. Water Quality Data for Intermediate Aquifer Wells (data averaged over periods).

Station Id	Station	Latitude	Longitude	Case Depth	Total Depth	County	Chloride (mg/L)			Sulfate (mg/L)			Total Dissolved Solids (mg/L)		
							1984-1989	1990-1998	Difference	1984-1989	1990-1998	Difference	1984-1989	1990-1998	Difference
254858081231601	C-00039	254851.8	812145.2	436	484	Collier	1,928	1,850	-78	504	375	-129	2,986	---	---
255700081274501	C-00269	255625	812812	300	392	Collier	571	535	-36	97	113	16	1,140	1,299	159
262507081235201	C-00298	262507.7	812354.8	254	303	Collier	63	57	-6	4	2	-1	308	---	---
261621081412302	C-00303	261622.9	814122.9	232	300	Collier	676	645	-31	100	91	-9	1,533	---	---
260919081155901	C-00308	260919	811600	312	485	Collier	37	33	-4	6	5	-1	428	410	-18
255430081221001	C-00311	262228.9	813619.6	430	450	Collier	441	450	10	196	197	1	1,015	---	---
262859081273001	C-00531	262930.24	812736.00	210	237	Collier	47	34	-13	14	13	-1	423	---	---
261740081235401	C-00684	261740	812354	440	490	Collier	166	143	-23	1,587	1,450	-137	3,071	---	---
262554081283801	C-00687	262555.8	812837.6	290	560	Collier	99	91	-8	18	16	-2	458	---	---
261802081354801	C-00688	261802	813548	220	405	Collier	46	42	-4	54	53	-1	417	---	---
261740081235402	C-00689	261740	812354	230	265	Collier	81	74	-7	---	---	---	430	---	---
261733081285503	C-00989	261737.6	812853.0	240	270	Collier	205	197	-7	87	82	-5	797	---	---
262228081361902	C-01080	262228.9	813619.6	238	309	Collier	26	20	-6	14	18	4	258	---	---
264754081460202	CHWQ-03	264753.37	814611.00	175	240	Charlotte	462	400	-62	50	125	75	977	---	---
265404081202902	GLWQ-02	265407.02	812027.59	360	460	Glades	28	22	-7	18	16	-2	263	---	---
264623081213601	HE-0517	264612	812229	128	138	Glades	30	19	-11	4	0.4	-4	369	---	---
263310081250901	HE-0529	263309.88	812509.84	135	155	Hendry	45	37	-9	11	15	4	417	---	---
263845081260702	HE-0556	263845	812607	135	175	Hendry	199	160	-39	64	38	-26	689	---	---
264235081310601	HE-0557	264237.07	813105.92	80	100	Hendry	1,222	1,183	-39	363	363	0	2,566	---	---
262552081485701	L-00741	262550.93	814854.98	102	119	Lee	162	150	-12	8	4	-3	478	---	---
263344081361701	L-01963	263343.96	813617.35	65	74	Lee	185	135	-50	64	51	-13	---	---	---
263807081430301	L-01968	263759.46	814304.03	70	165	Lee	75	63	-12	17	18	1	559	---	---
264320081365701	L-01977	264317.52	813657.11	65	185	Lee	1,029	945	-84	286	280	-6	2,155	---	---
263251081452801	L-01993	263251	814528	190	242	Lee	---	---	---	---	12	---	---	---	---
263950081355403	L-02187	263949.06	813552.81	136	154	Lee	350	360	10	150	150	0	1,016	---	---
264144081520301	L-02190	264200	815201	71	109	Lee	249	---	---	---	---	---	---	---	---
262659081382501	L-02192	262700.50	813828.46	155	180	Lee	77	63	-14	30	25	-5	502	455	-47
264329081340401	L-02200	264330.11	813406.87	122	163	Lee	880	800	-80	292	260	-32	1,888	---	---
264537081552202	L-02646	264537.55	815521.45	170	220	Lee	80	77	-4	15	14	-1	370	---	---
263955082083102	L-02820	263953.01	820830.62	192	250	Lee	844	805	-39	47	58	11	1,591	---	---
263117082051002	L-02821	263116.77	820509.45	290	340	Lee	601	634	33	193	185	-7	1,608	---	---
263330081260701	RTA-005	263332.41	812610.82	165	200	Hendry	62	57	-5	7	4	-3	450	---	---
264910081280402	RTA-007	264911.47	812801.64	395	410	Glades	110	111	1	87	89	2	514	382	-132

a. Difference in averages of constituent ((1990-1998) - (1984-1989)), mg/l.

Table G-10. Water Quality Data for Floridan Aquifer Wells (data averaged over periods).

Station Id	Station	Latitude	Longitude	Case Depth	Total Depth	County	Chloride (mg/L)			Sulfate (mg/L)			Total Dissolved Soilds (mg/L)		
							1984-1989	1990-1998	Difference	1984-1989	1990-1998	Difference	1984-1989	1990-1998	Difference
261438081481001	C-00575	261318	814807	352	652	Collier	145	795	-250	365	416	51	2,552	1,795	-757
262538082045701	L-00588	262539.37	820455.00	43	557	Lee	1,631	---	---	---	---	---	3,429	---	---
264101081443001	L-00652A	264056.19	814430.78	188	598	Lee	720	720	0	380	370	-10	1,823	---	---
262552081485702	L-02295	262551.09	814854.98	300	610	Lee	493	426	-67	295	285	-10	1,398	1,046	-352
263344081361704	L-02311	263344.13	813617.42	300	625	Lee	1,232	1,171	-61	516	543	27	2,969	2,956	-13
263307081555901	L-02435	263405.93	815600.65	352	704	Lee	3,408	3,200	-208	558	500	-58	6,102	---	---
263117082051001	L-02525	263116.56	820509.59	405	645	Lee	461	445	-16	198	175	-23	1,128	---	---
263955082083101	L-02527	263953.10	820826.65	360	605	Lee	1,891	1,891	0	282	276	-6	3,632	3,900	269
263907081592701	L-02528	263906.78	815926.60	420	625	Lee	917	1,200	283	300	245	-55	1,948	---	---
264427081362601	L-02531	264432.01	813626.39	345	605	Lee	757	700	-57	400	390	-10	1,853	---	---
262713081414402	L-02319	262711.60	814140.17	492	750	Lee	396	---	---	---	---	---	---	---	---

a. Difference in averages of constituent ((1990-1998) - (1984-1989)), mg/l.

Figures G-6 through **G-8** are location maps depicting the wells within each aquifer in the LWC Planning Area.

Figures G-9 through **G-35** contain water quality maps for the selected water quality parameters and differences between water quality parameter concentrations for the period 1984 through 1989 and the period 1990 through 1998.

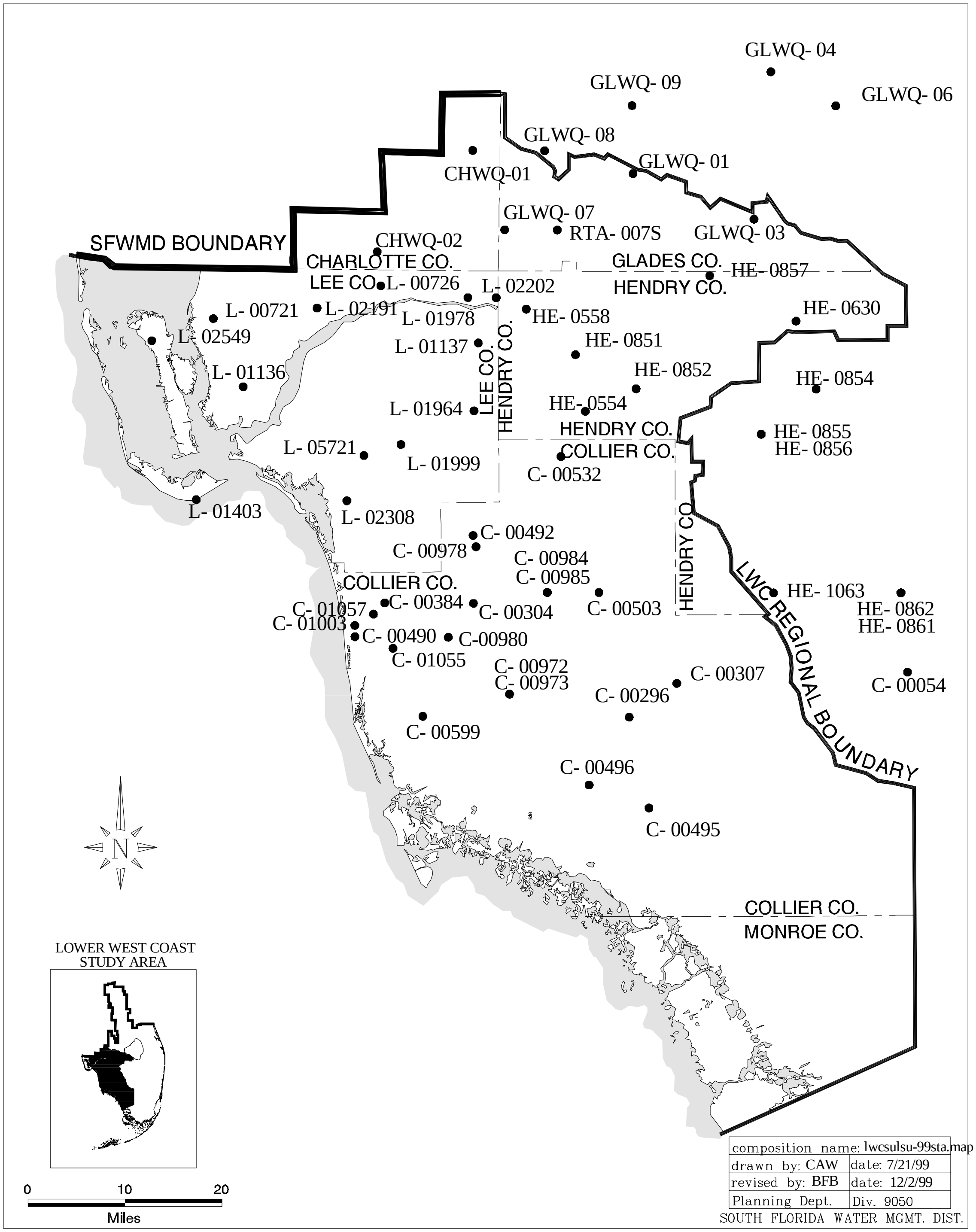

Figure G-6. Surficial Aquifer System Ambient Ground Water Quality Monitor Wells.

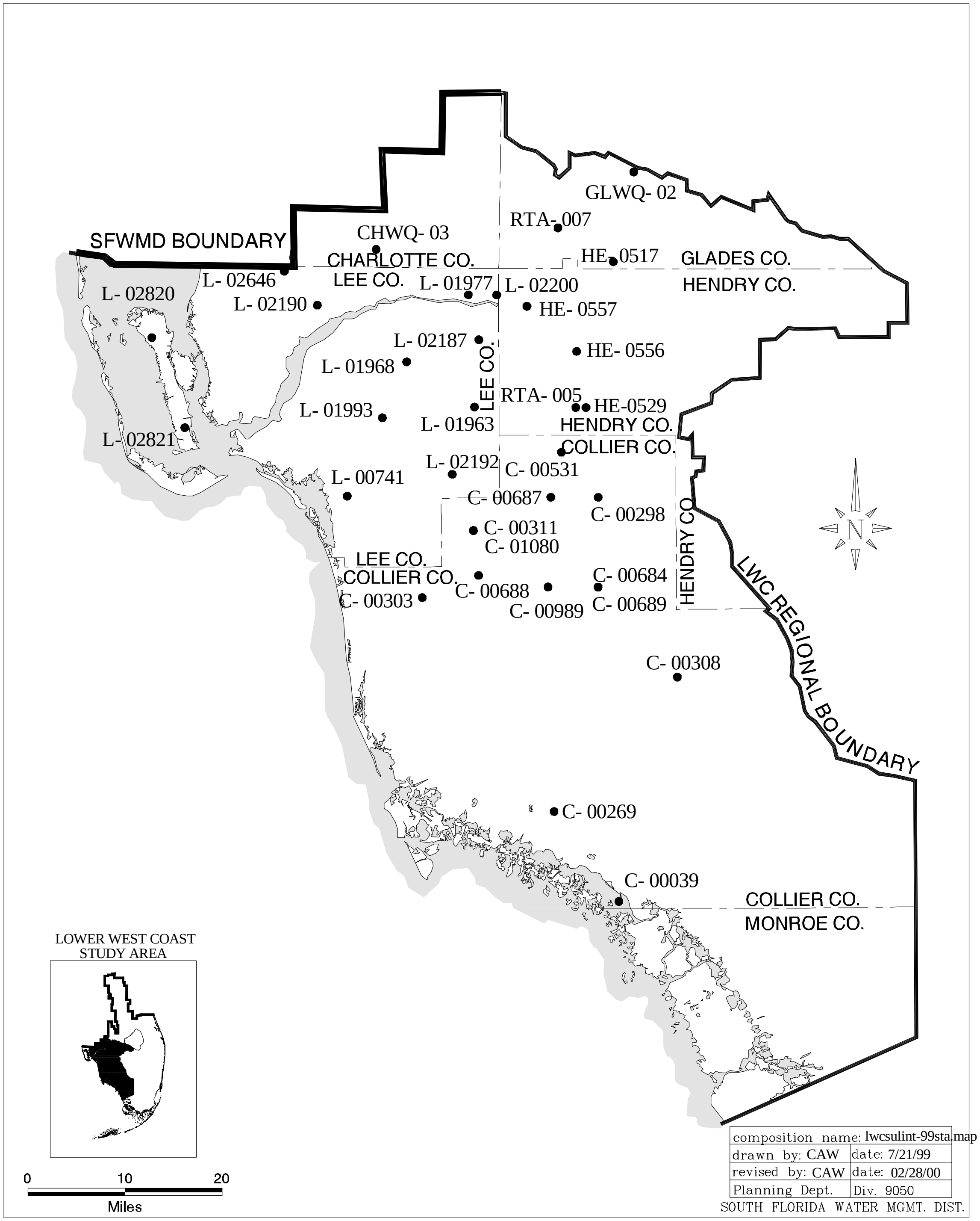

Figure G-7. Intermediate Aquifer System Ambient Ground Water Quality Monitor Wells.

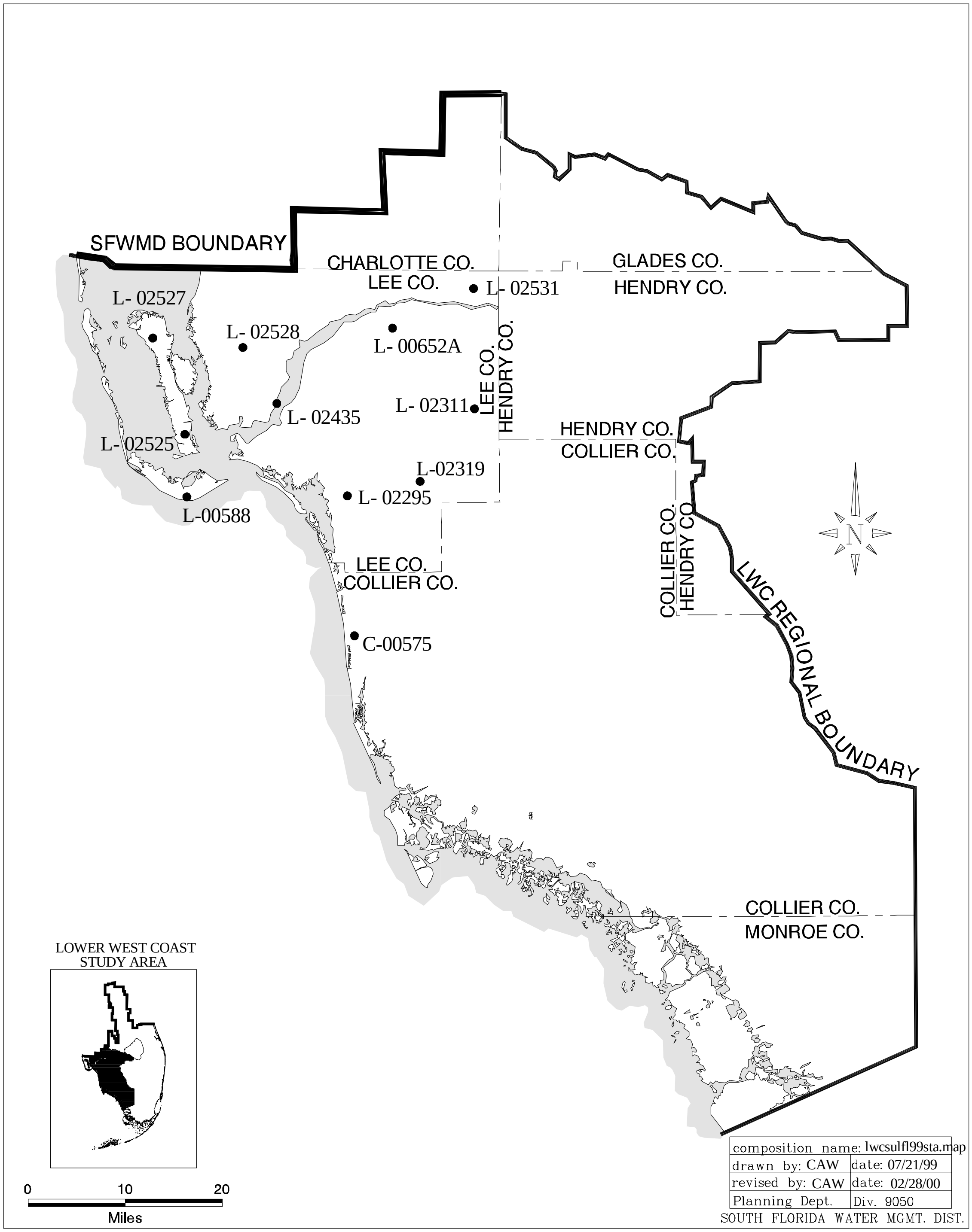

Figure G-8. Floridan Aquifer System Ambient Ground Water Quality Monitor Wells.

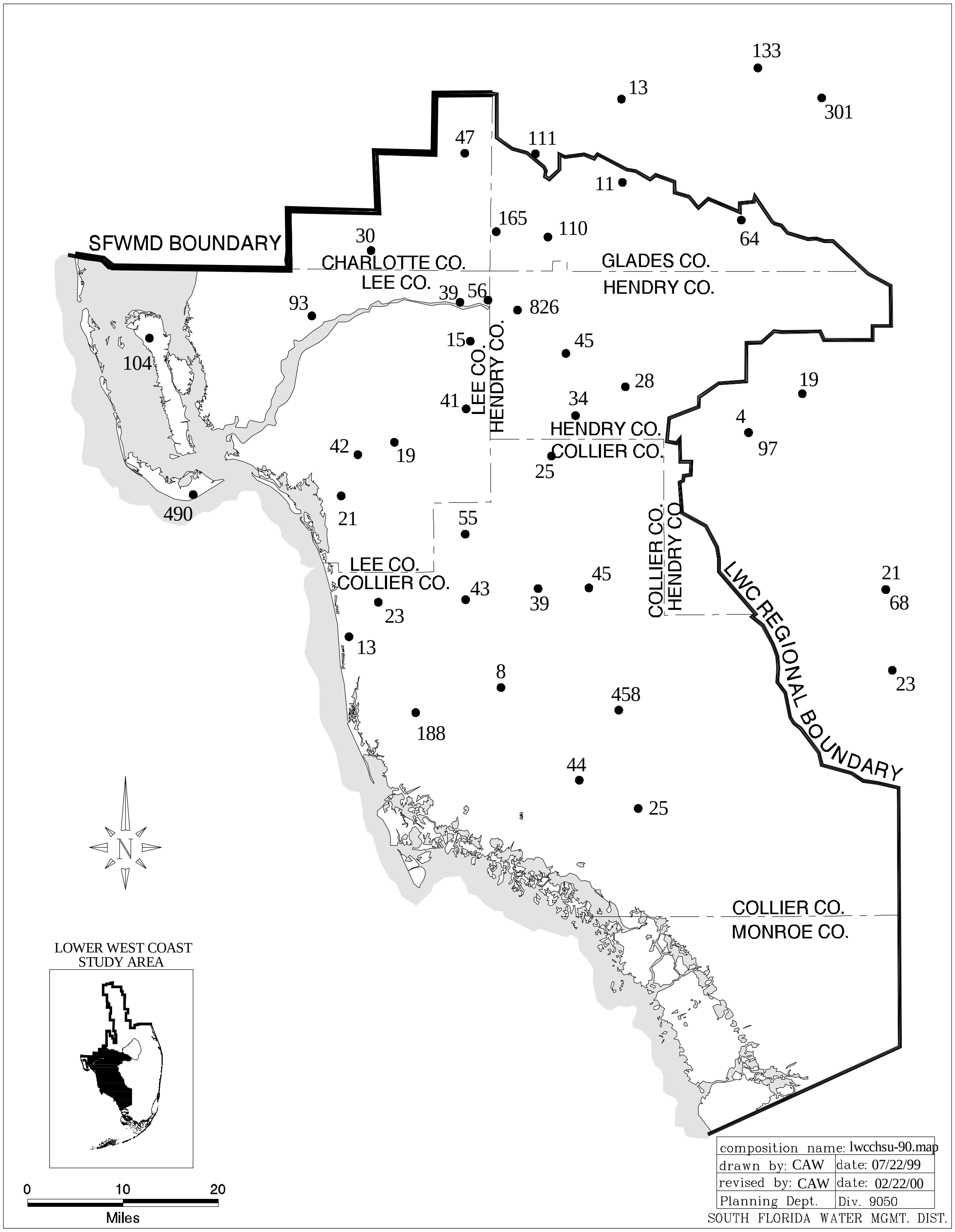

Figure G-9. Average Chloride Concentrations (mg/L) of the Surficial Aquifer System Ambient Ground Water Quality Monitor Wells (1984-1989).

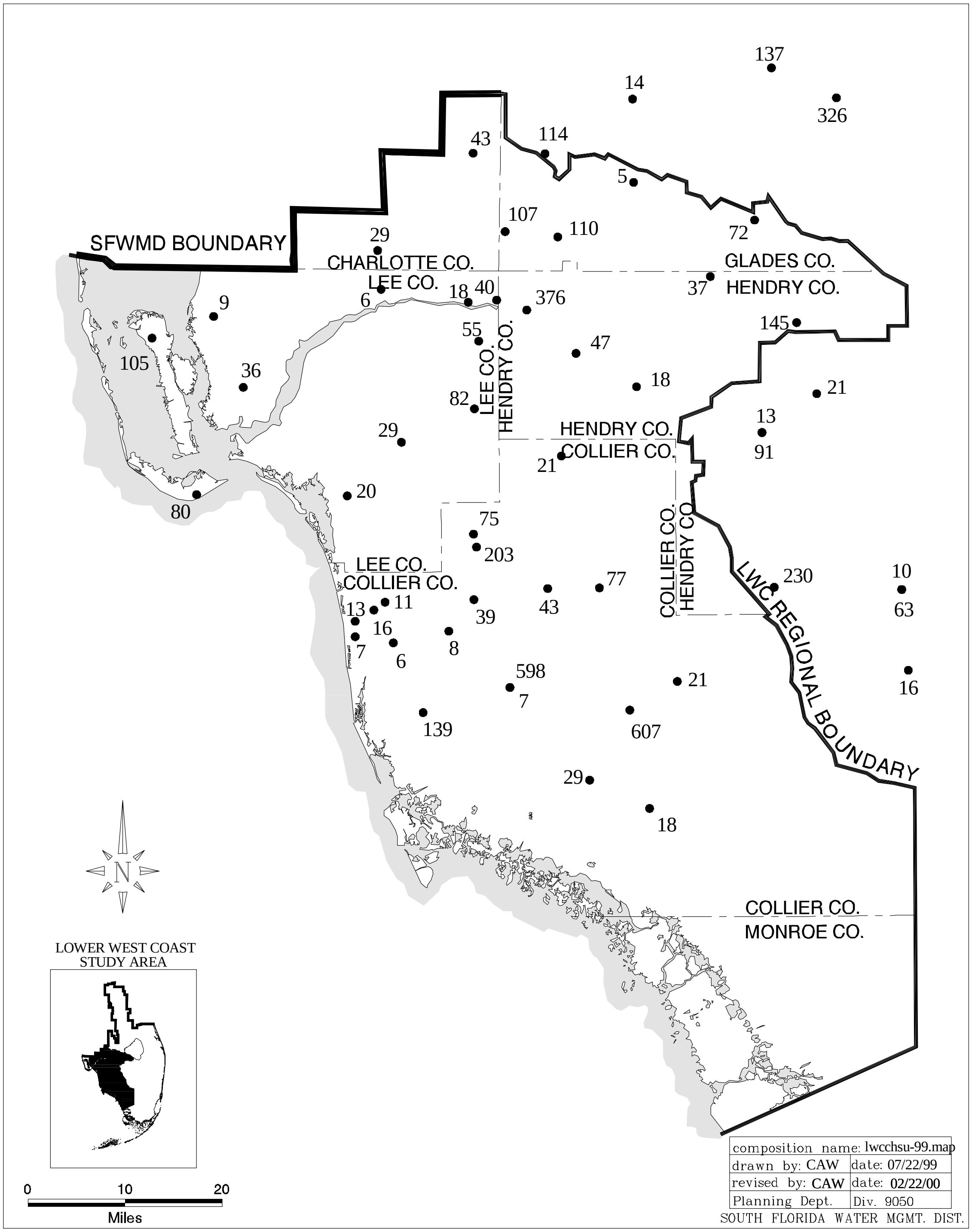

Figure G-10. Average Chloride Concentrations (mg/L) of the Surficial Aquifer System Ambient Ground Water Quality Monitor Wells (1990-1998).

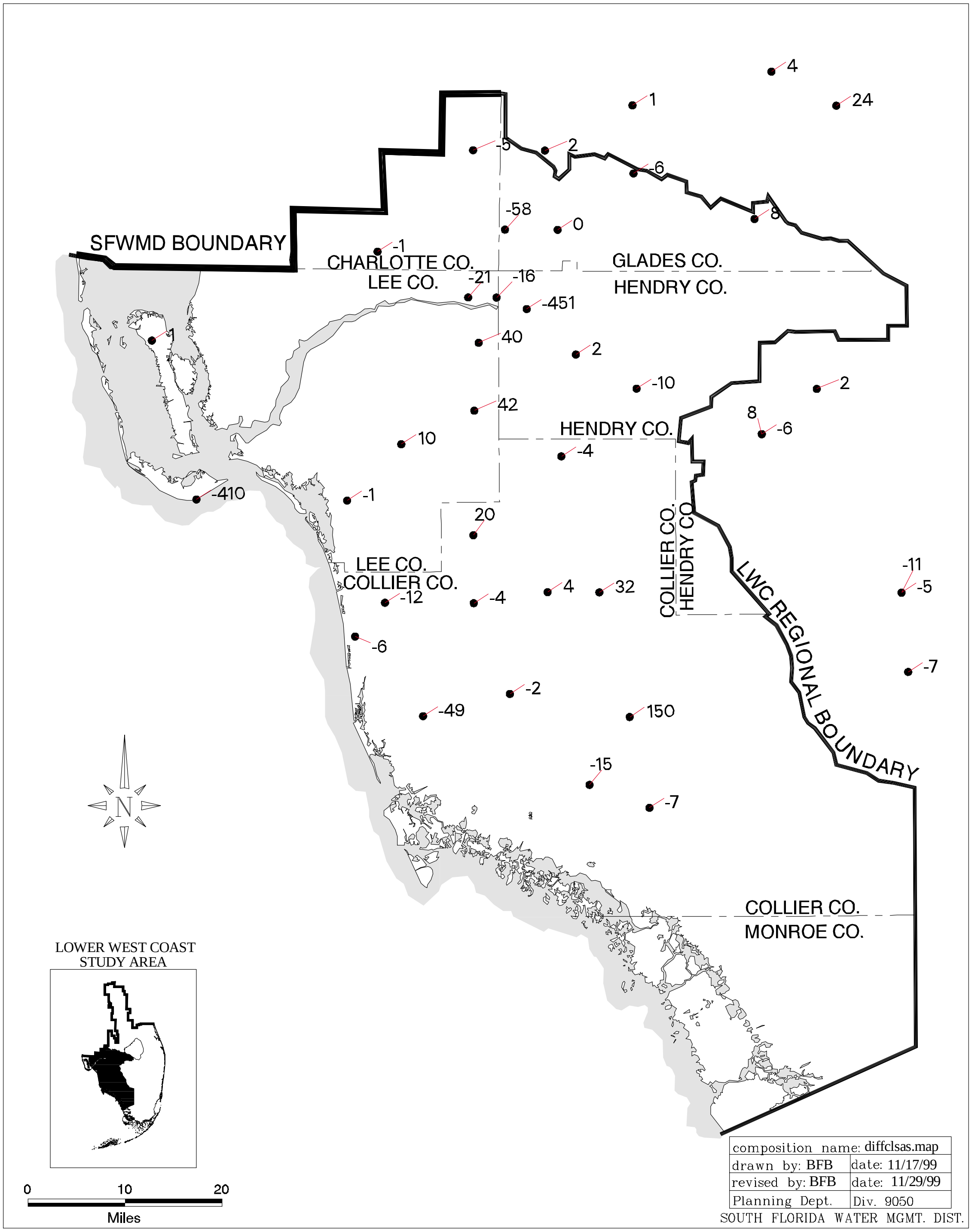

Figure G-11. Differences in Average Chloride Concentrations (mg/L) of the Surficial Aquifer System Ambient Ground Water Quality Monitor Wells (1984-1989 and 1990-1998).

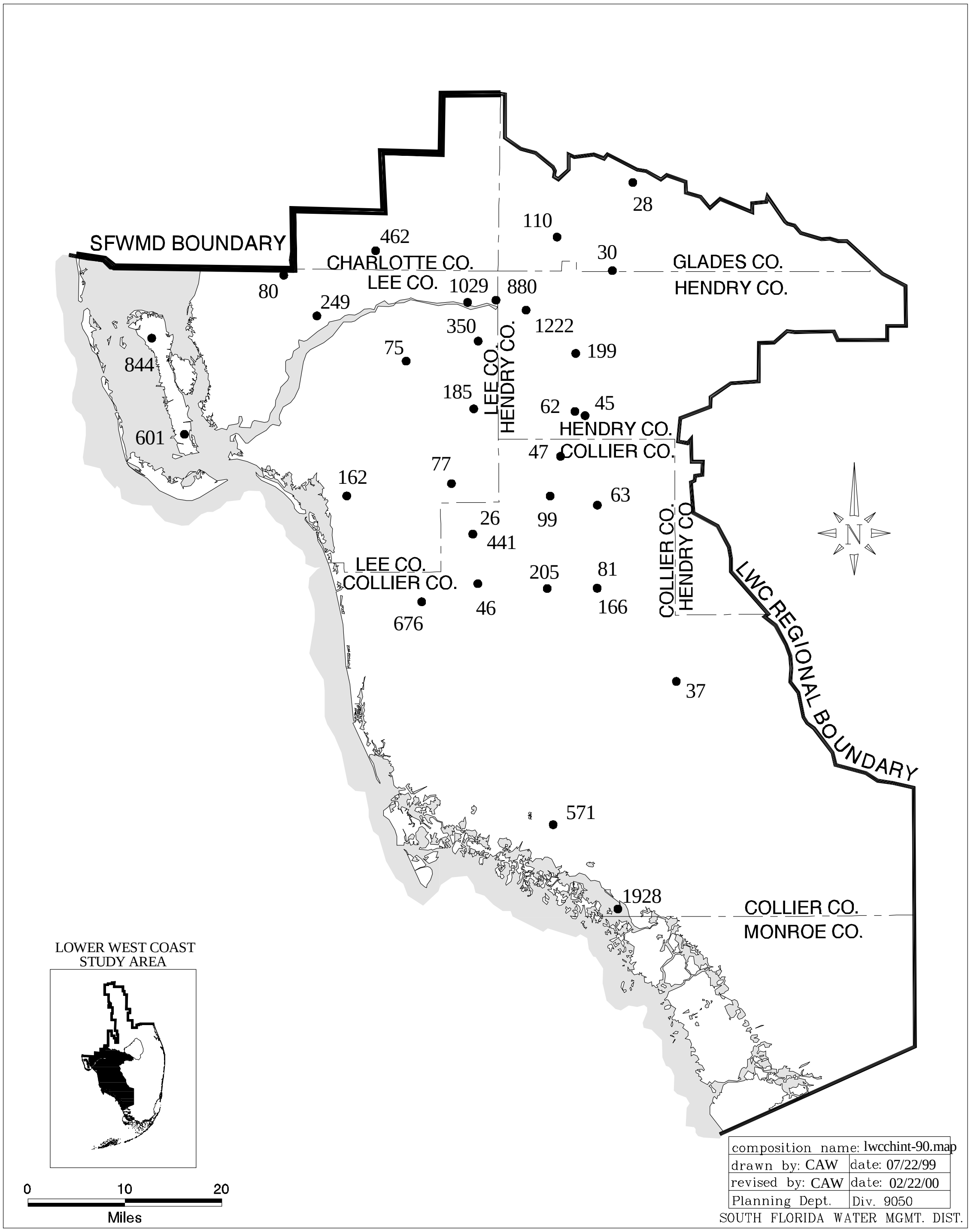

Figure G-12. Average Chloride Concentrations (mg/L) of the Intermediate Aquifer System Ambient Ground Water Quality Monitor Wells (1984-1989).

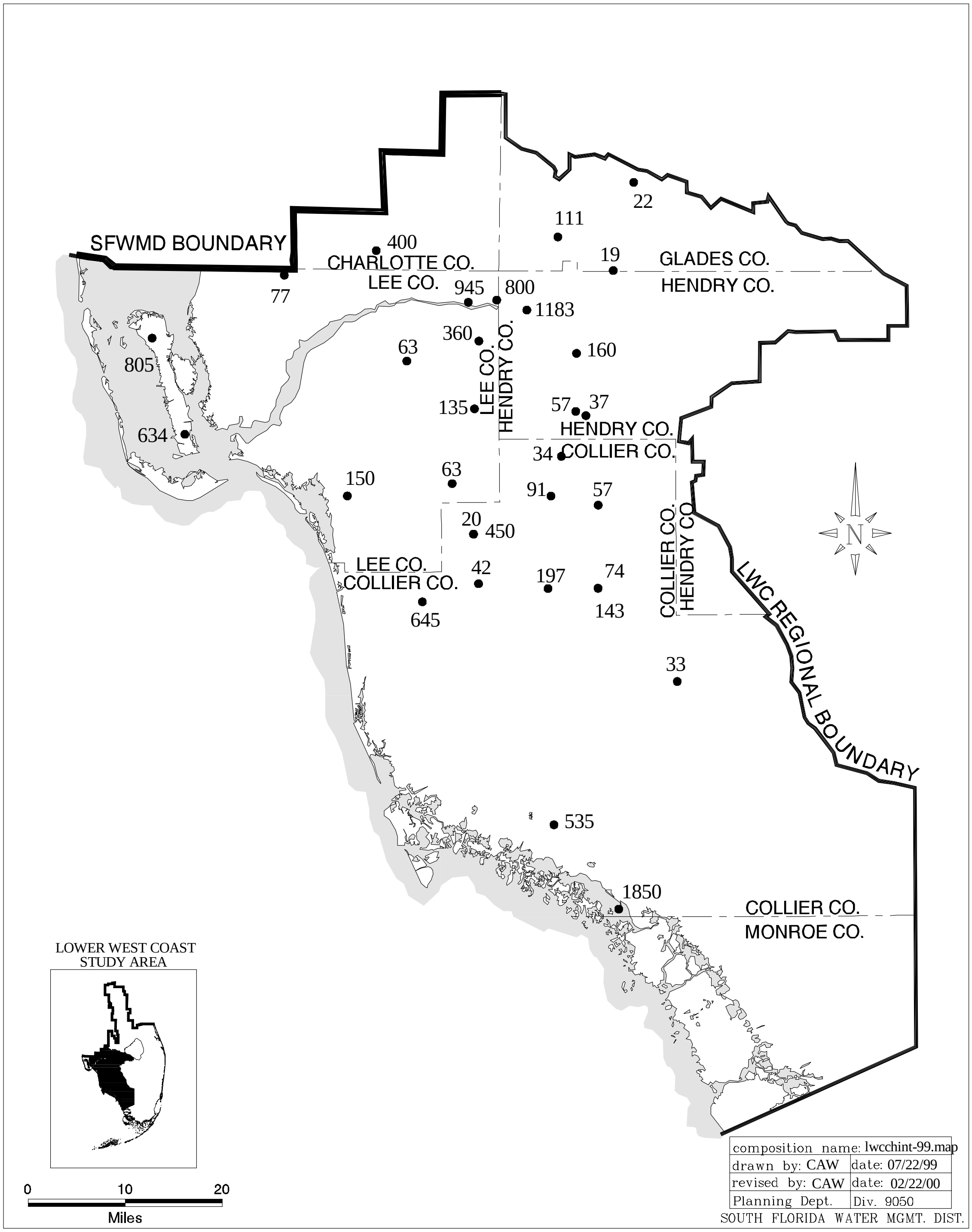

Figure G-13. Average Chloride Concentrations (mg/L) of the Intermediate Aquifer System Ambient Ground Water Quality Monitor Wells (1990-1998).

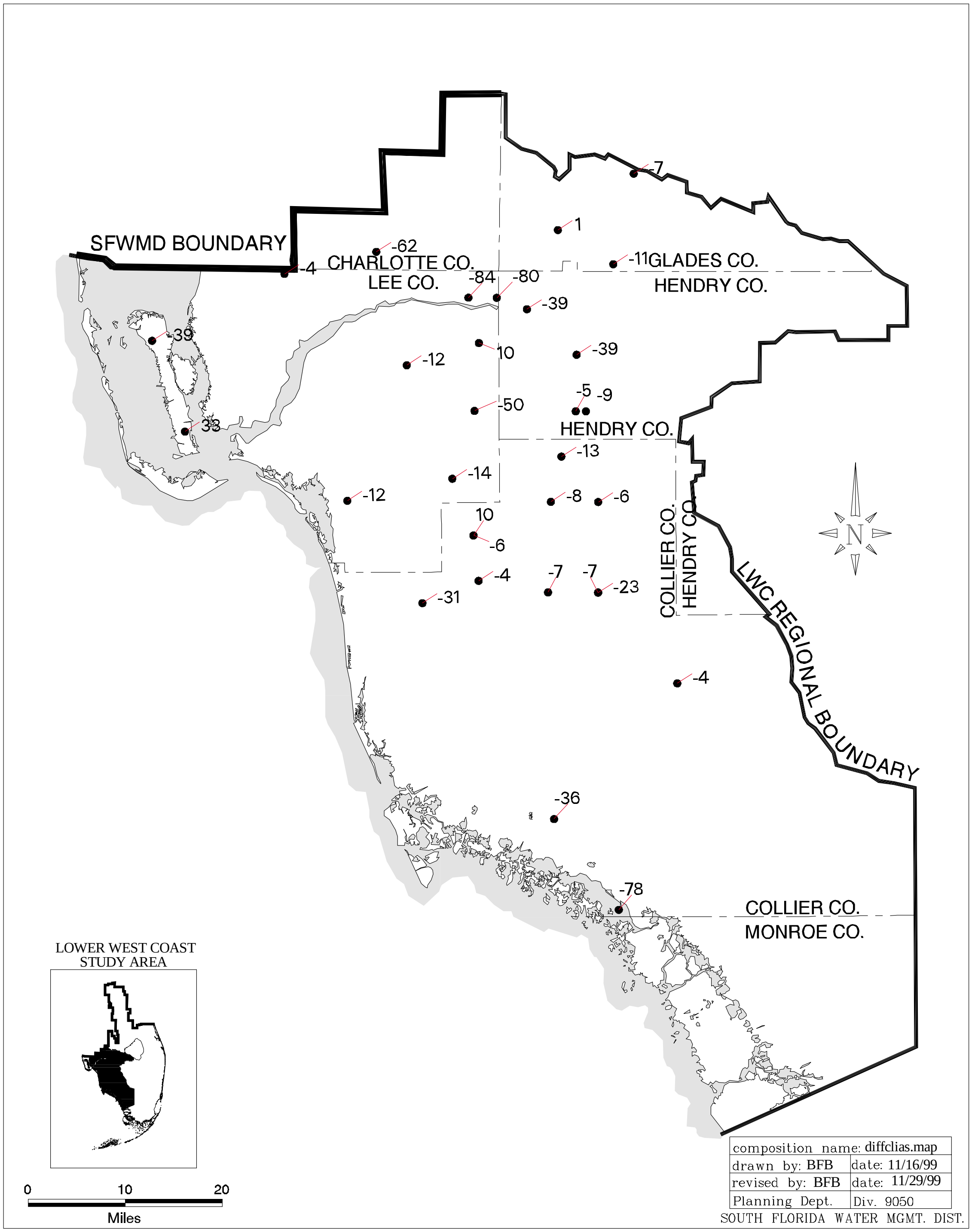

Figure G-14. Differences in Average Chloride Concentrations (mg/L) of the Intermediate Aquifer System Ambient Ground Water Quality Monitor Wells (1984-1989 and 1990-1998).

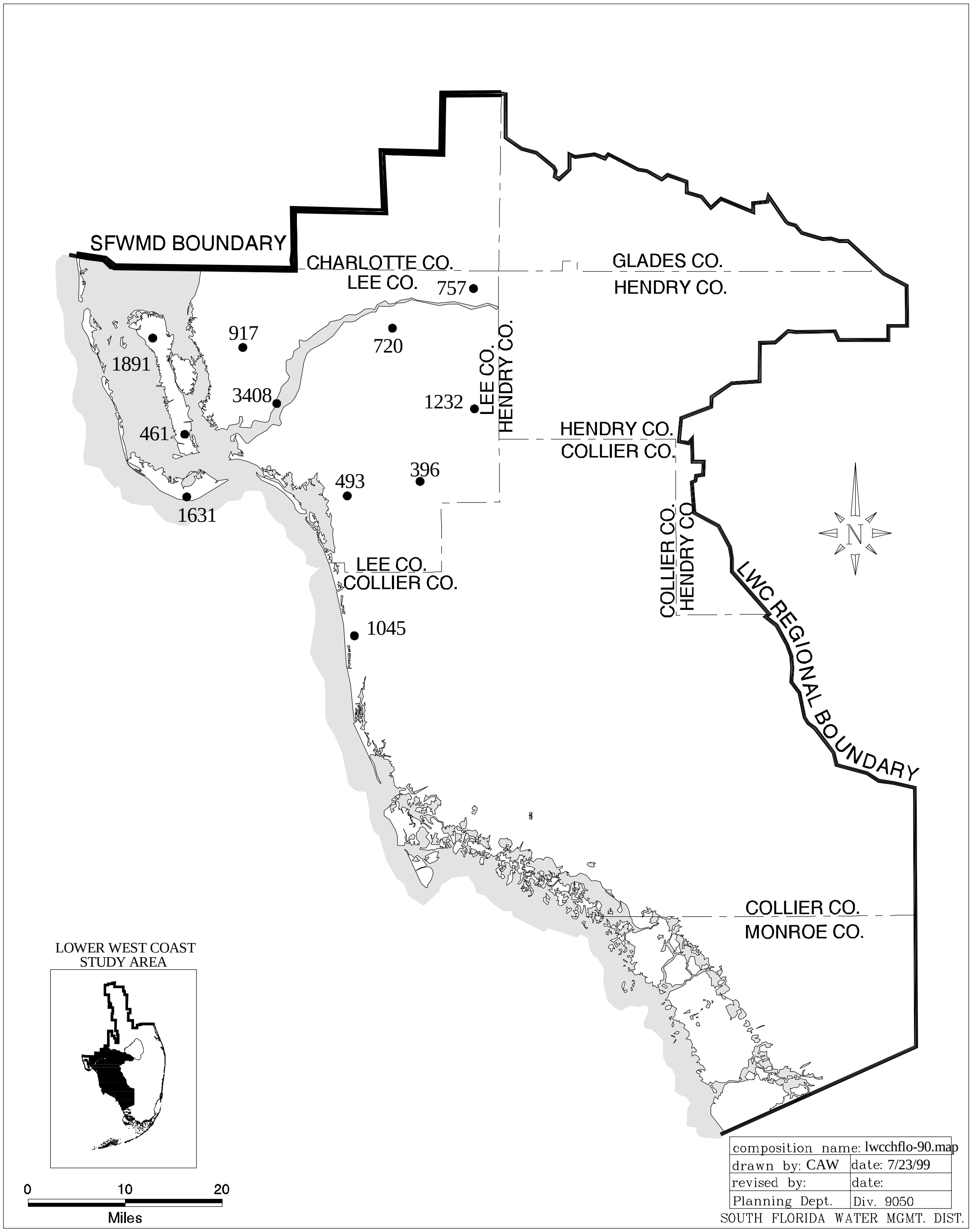

Figure G-15. Average Chloride Concentrations (mg/L) of the Floridan Aquifer System Ambient Ground Water Quality Monitor Wells (1984-1989).

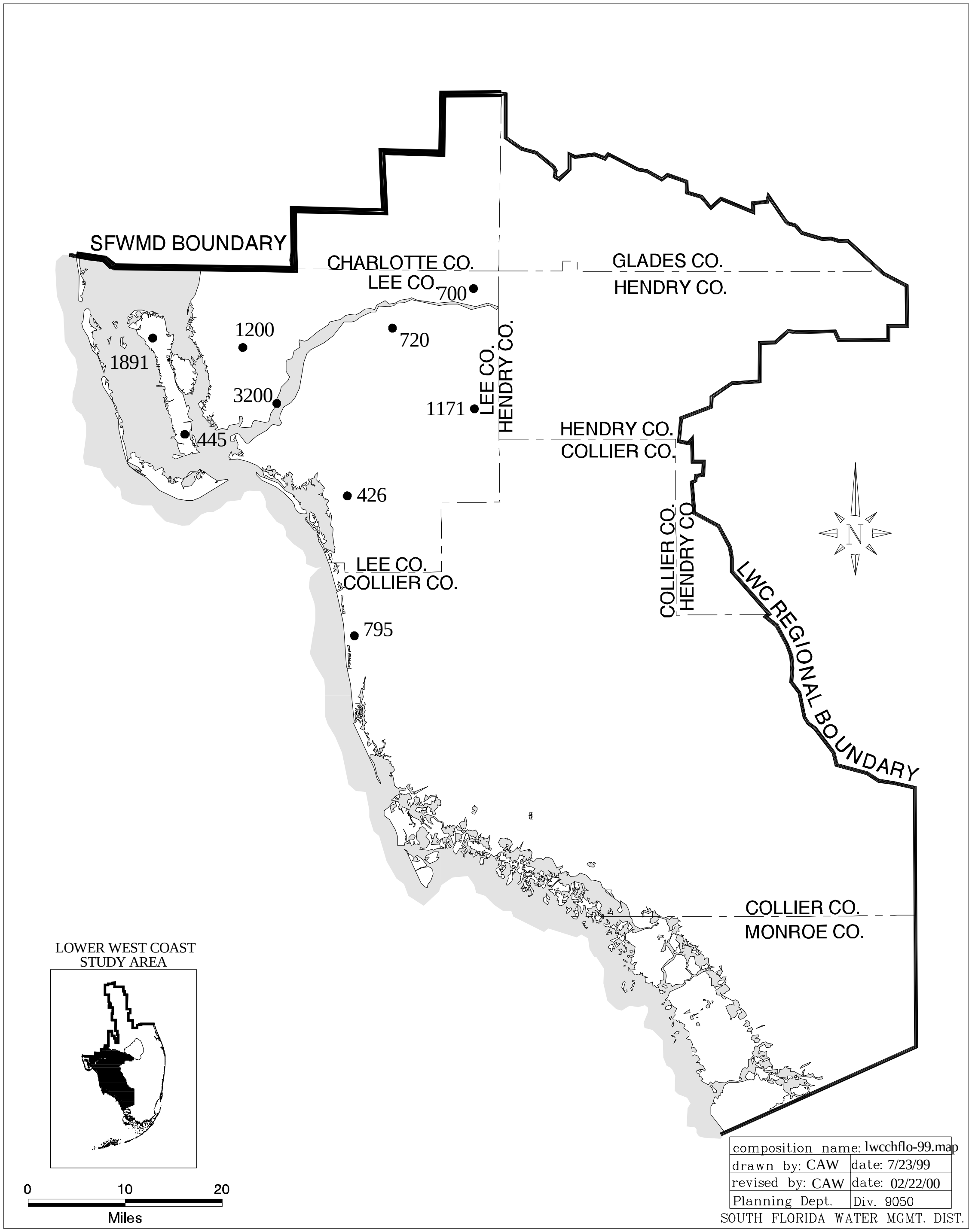

Figure G-16. Average Chloride Concentrations (mg/L) of the Floridan Aquifer System Ambient Ground Water Quality Monitor Wells (1990-1998).

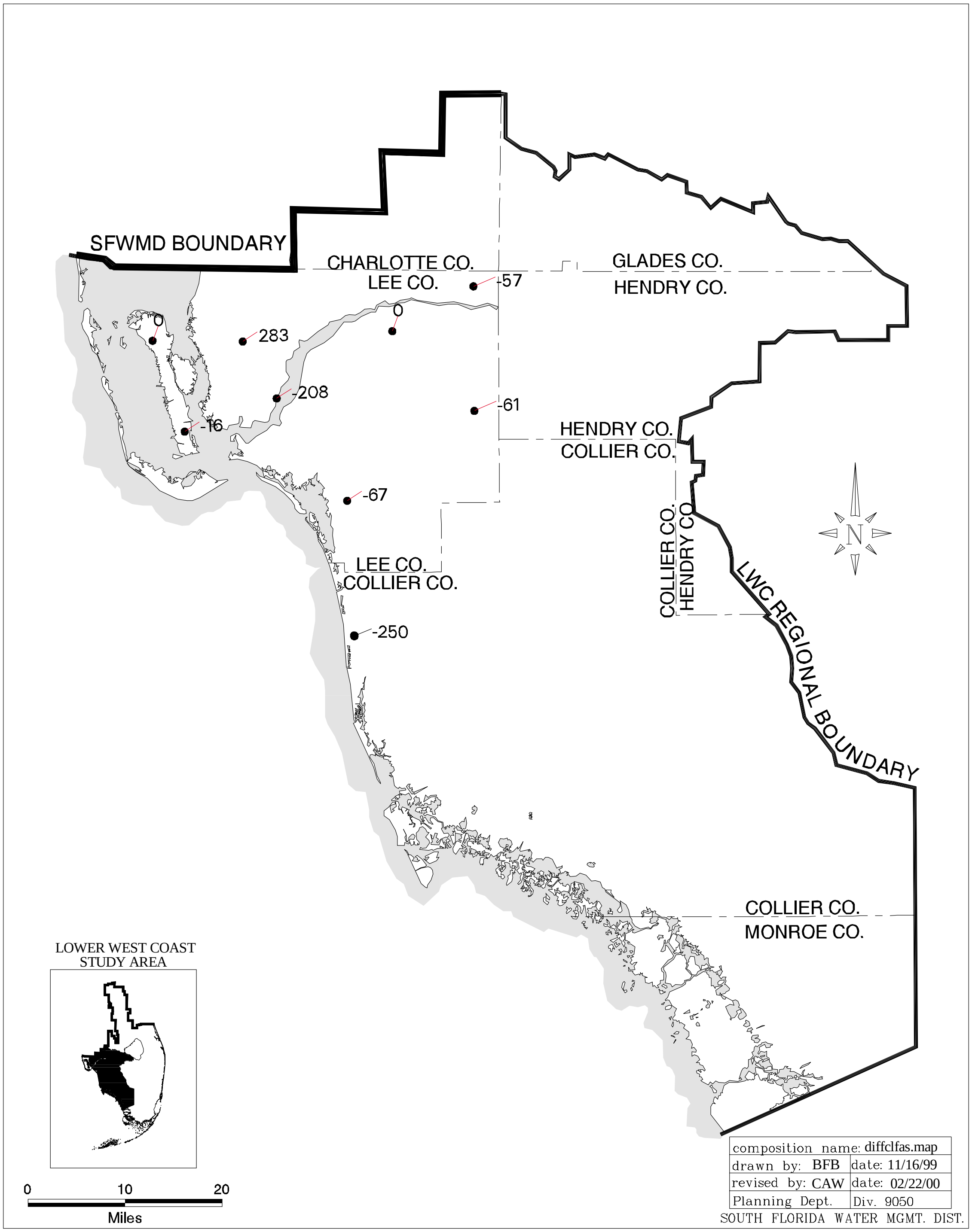

Figure G-17. Differences in Average Chloride Concentrations (mg/L) of the Floridan Aquifer System Ambient Ground Water Quality Monitor Wells (1984-1989 and 1990-1998).

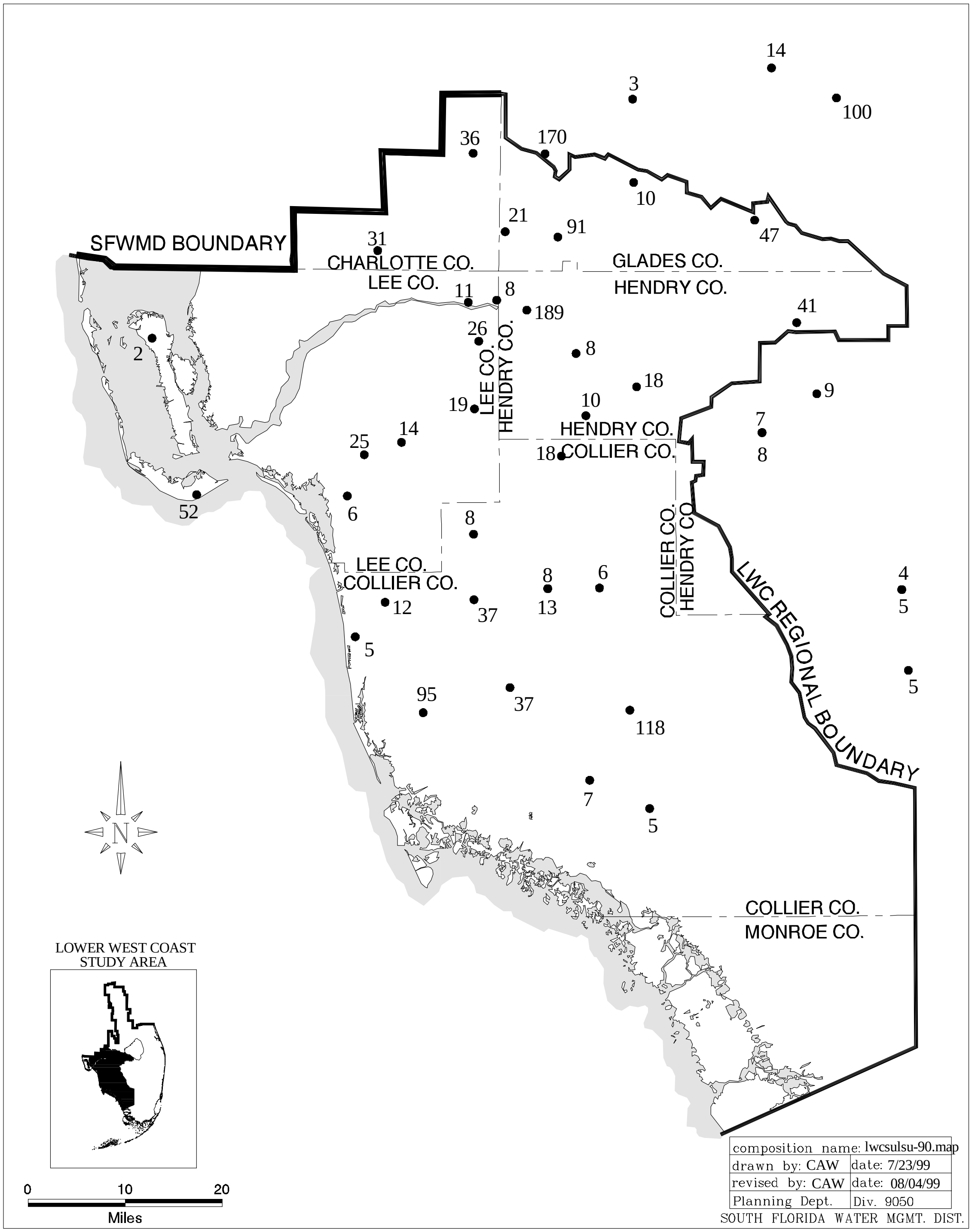

Figure G-18. Average Sulfate Concentrations (mg/L) of the Surficial Aquifer System Ambient Ground Water Quality Monitor Wells (1984-1989).

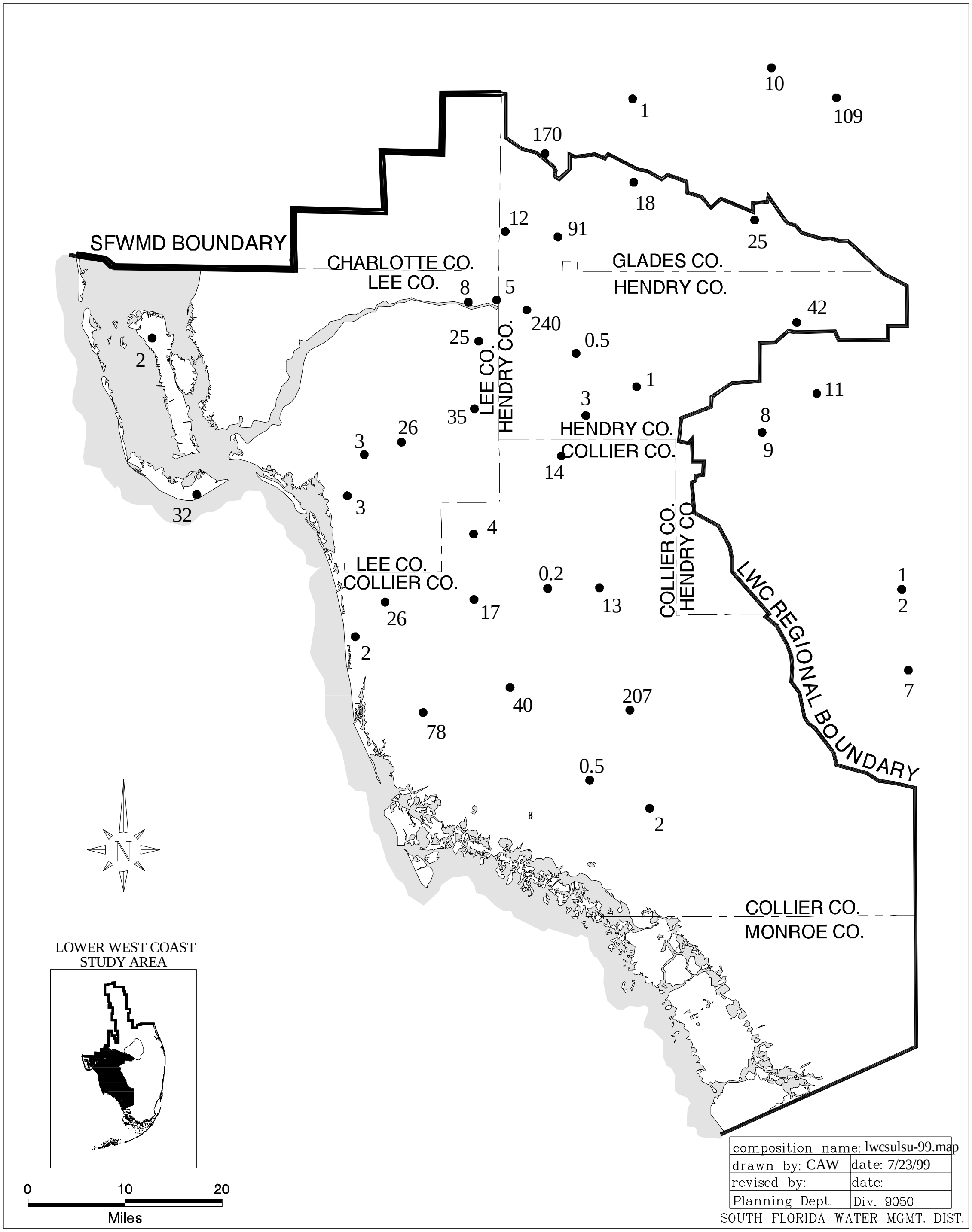

Figure G-19. Average Sulfate Concentrations (mg/L) of the Surficial Aquifer System Ambient Ground Water Quality Monitor Wells (1990-1998).

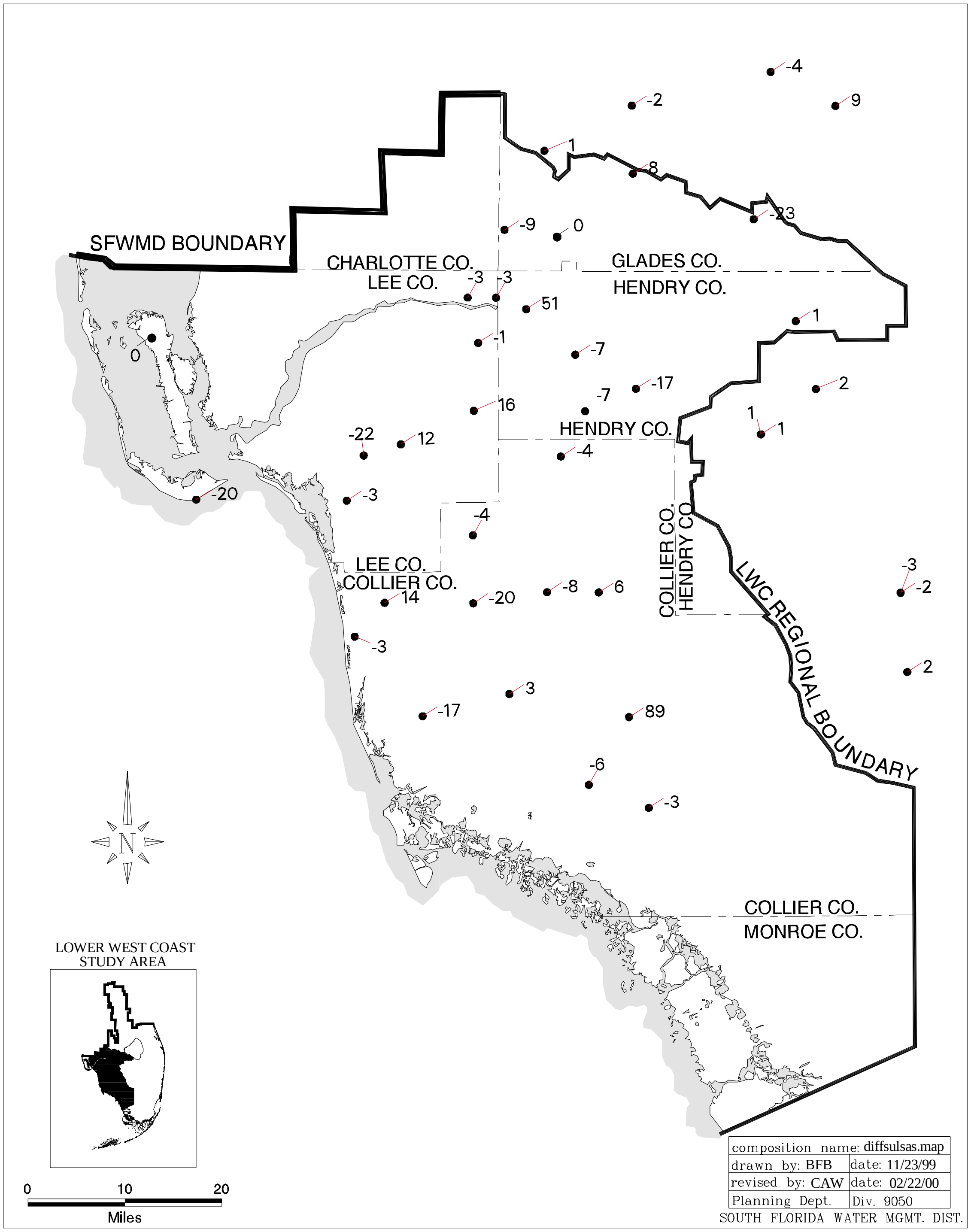

Figure G-20. Differences in Average Sulfate Concentrations (mg/L) of the Surficial Aquifer System Ambient Ground Water Quality Monitor Wells (1984-1989 and 1990-1998).

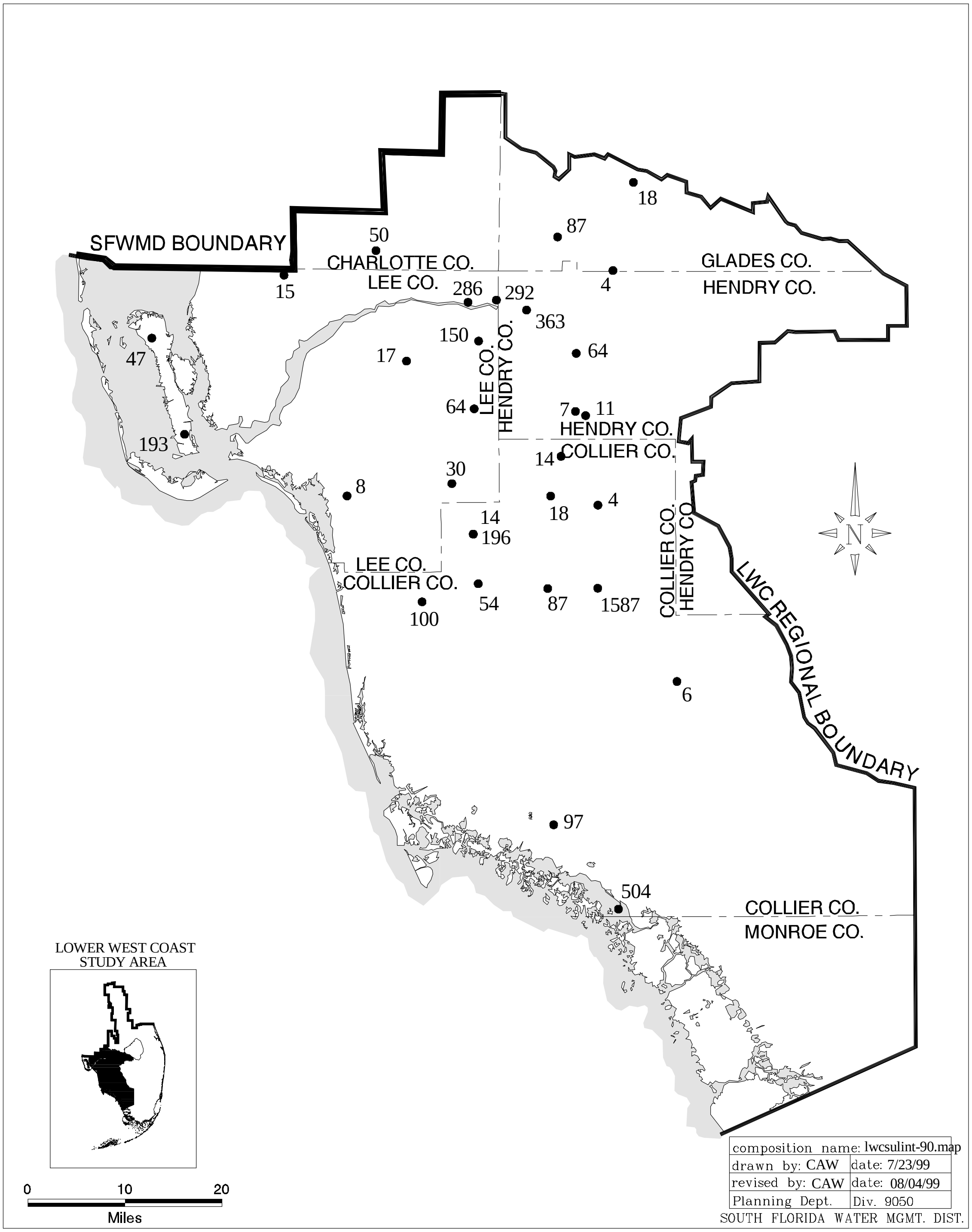

Figure G-21. Average Sulfate Concentrations (mg/L) of the Intermediate Aquifer System Ambient Ground Water Quality Monitor Wells (1984-1989).

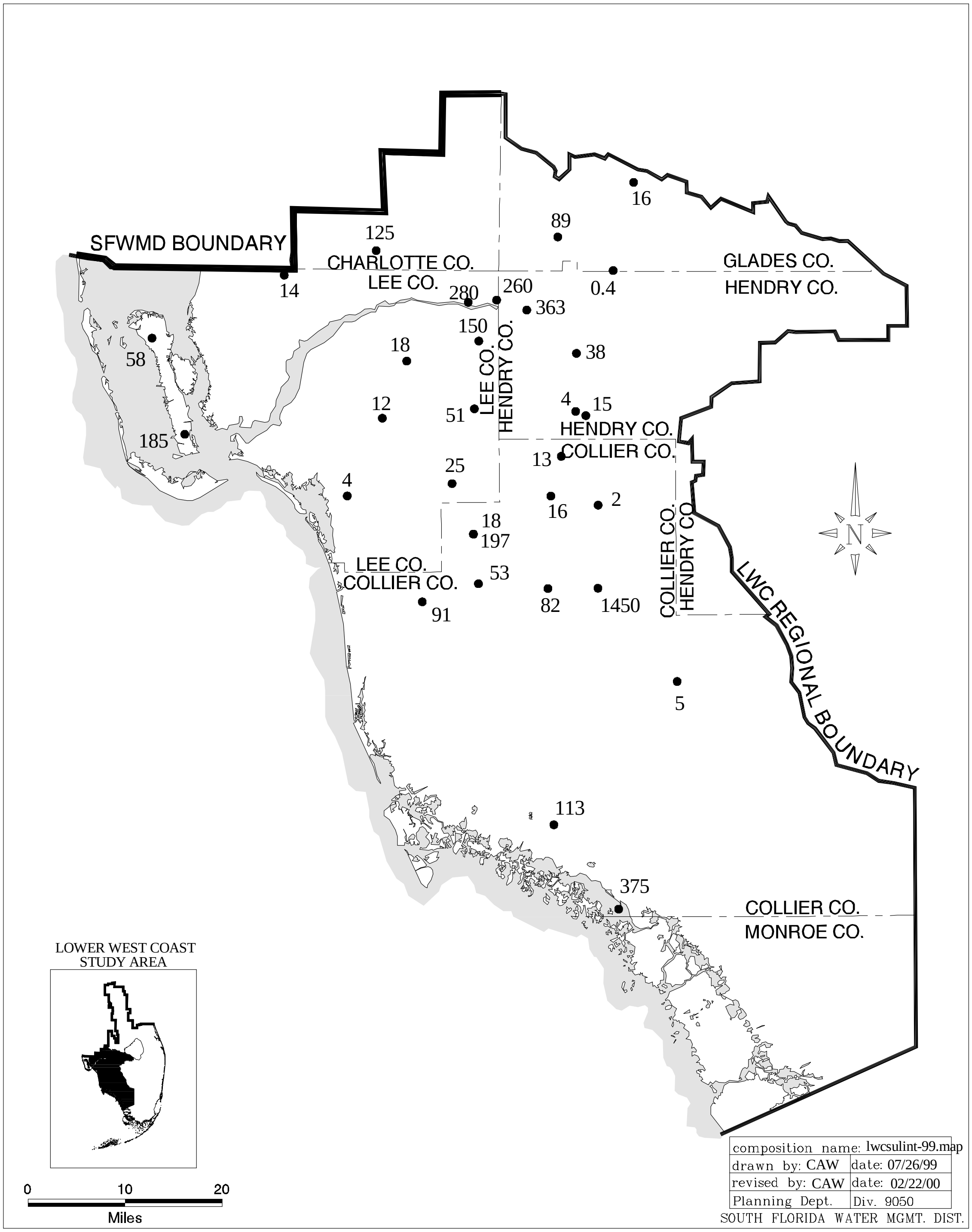

Figure G-22. Average Sulfate Concentrations (mg/L) of the Intermediate Aquifer System Ambient Ground Water Quality Monitor Wells (1990-1998).

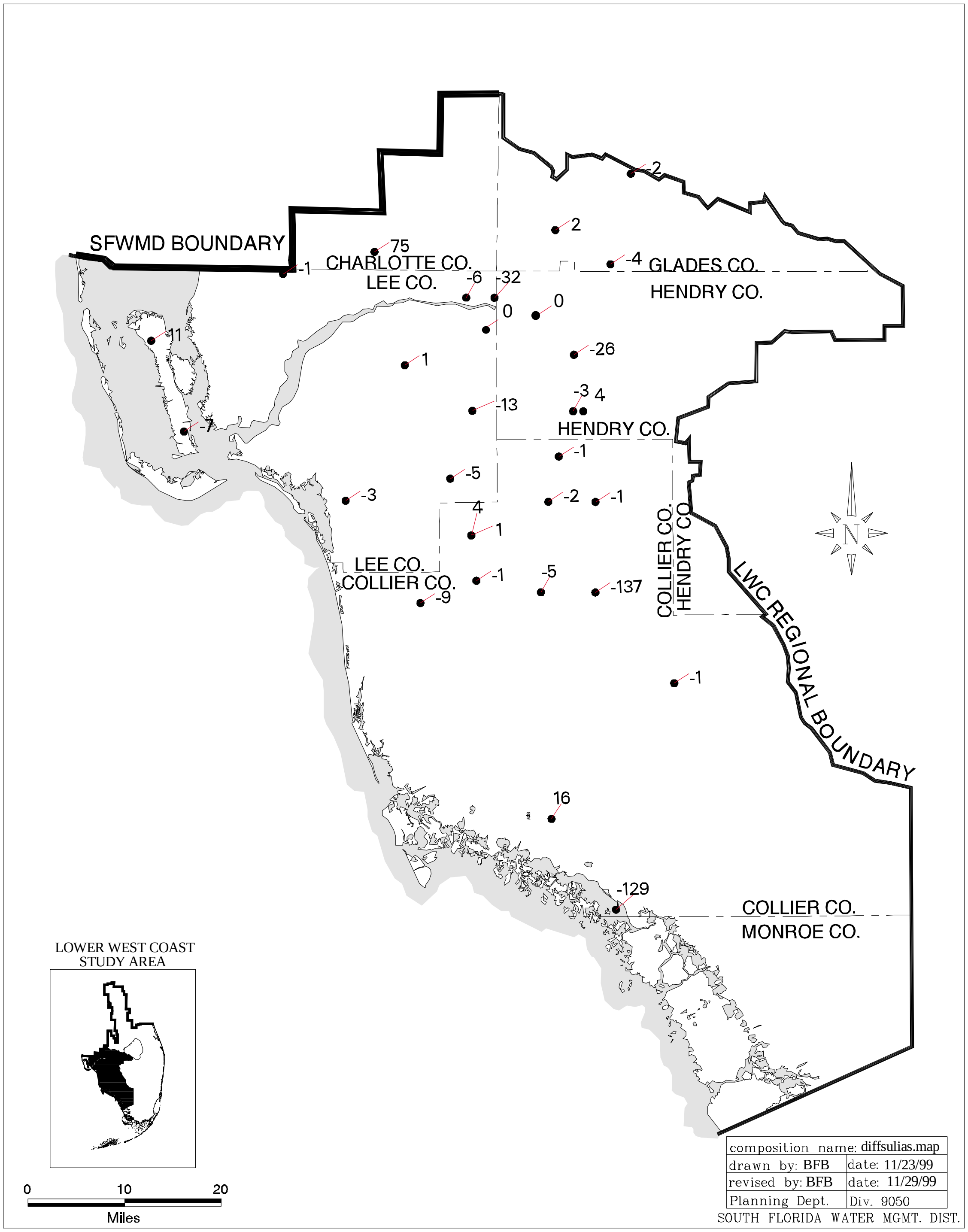

Figure G-23. Differences in Average Sulfate Concentrations (mg/L) of the Intermediate Aquifer System Ambient Ground Water Quality Monitor Wells (1984-1989 and 1990-1998).

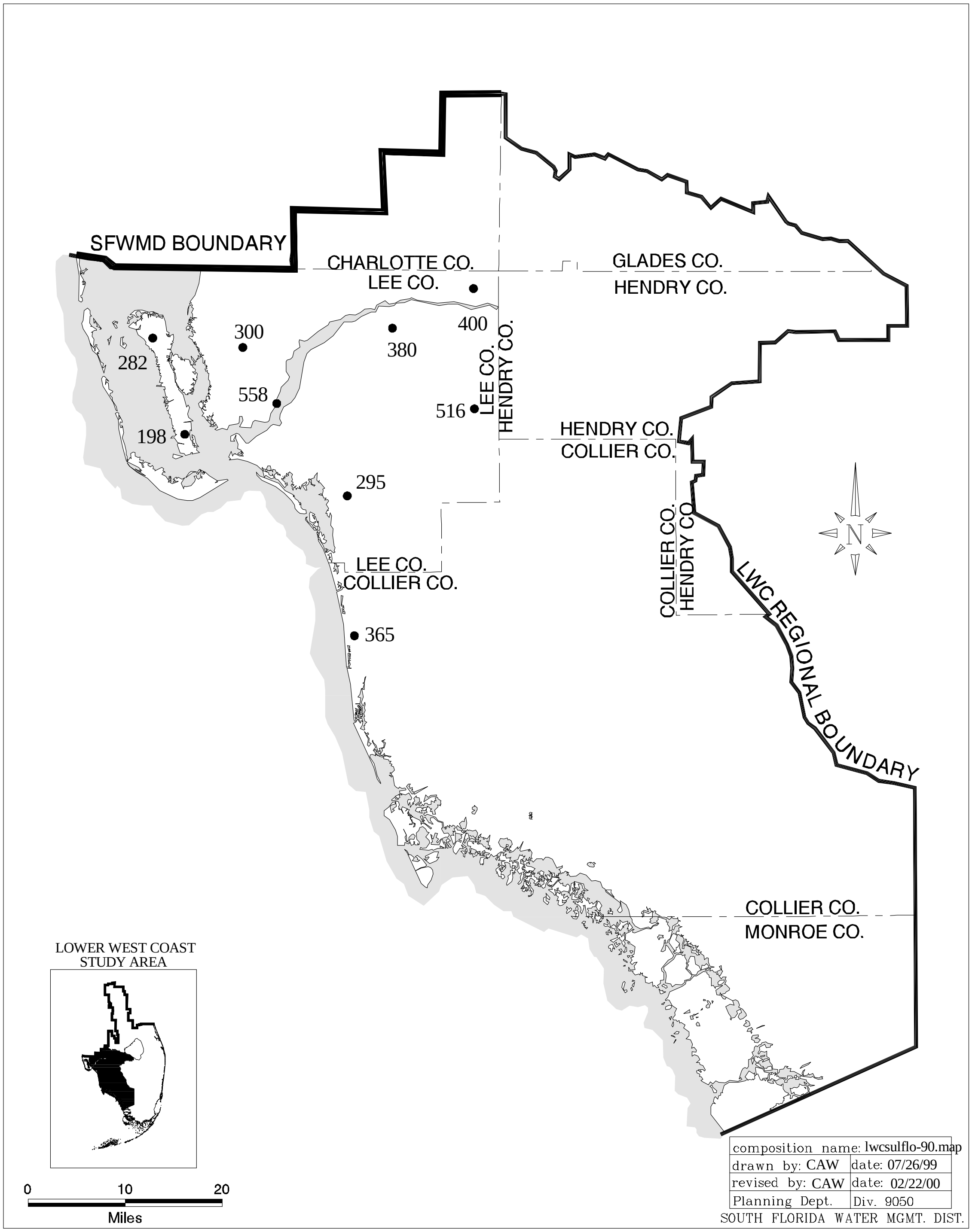

Figure G-24. Average Sulfate Concentrations (mg/L) of the Floridan Aquifer System Ambient Ground Water Quality Monitor Wells (1984-1989).

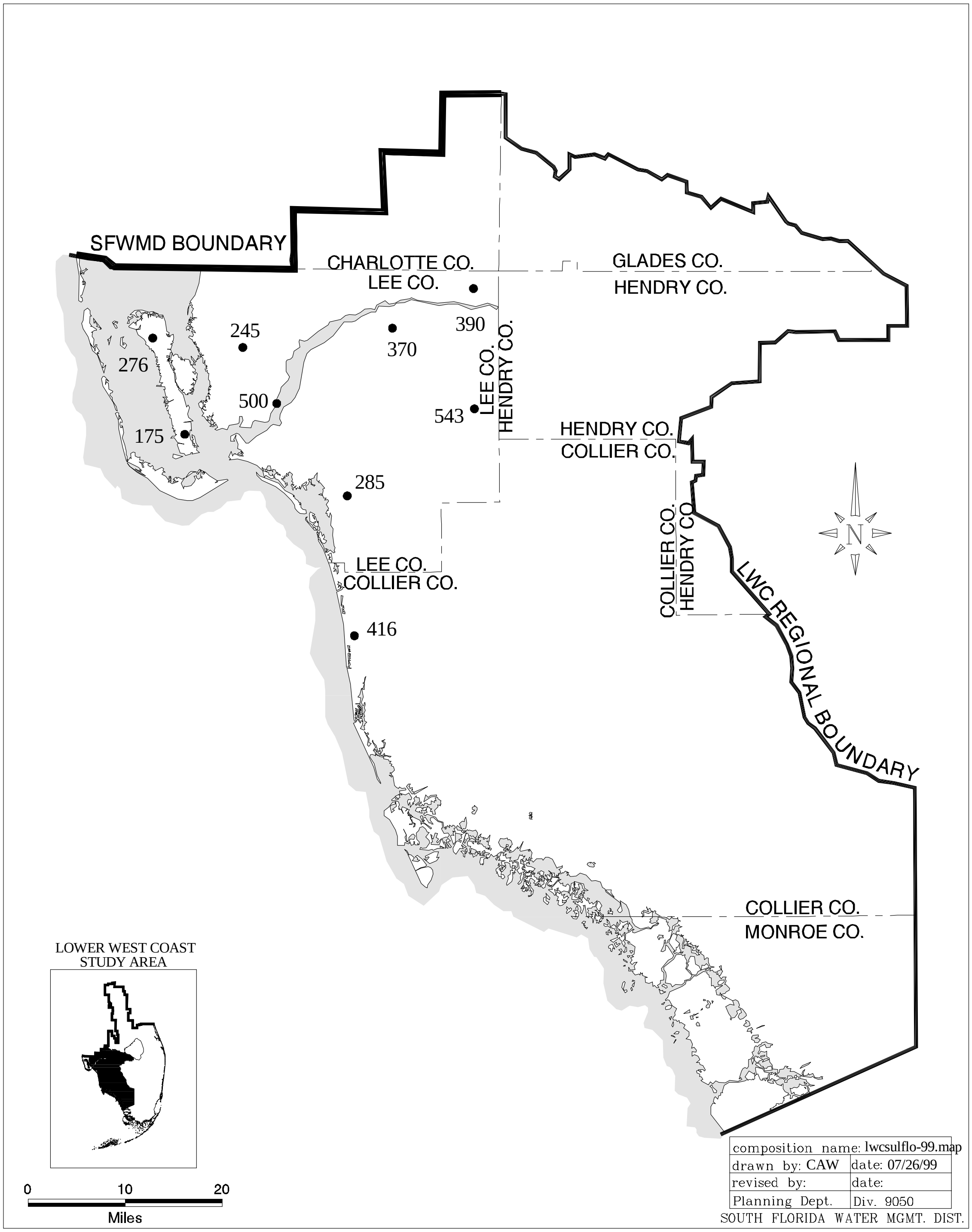

Figure G-25. Average Sulfate Concentrations (mg/L) of the Floridan Aquifer System Ambient Ground Water Quality Monitor Wells (1990-1998).

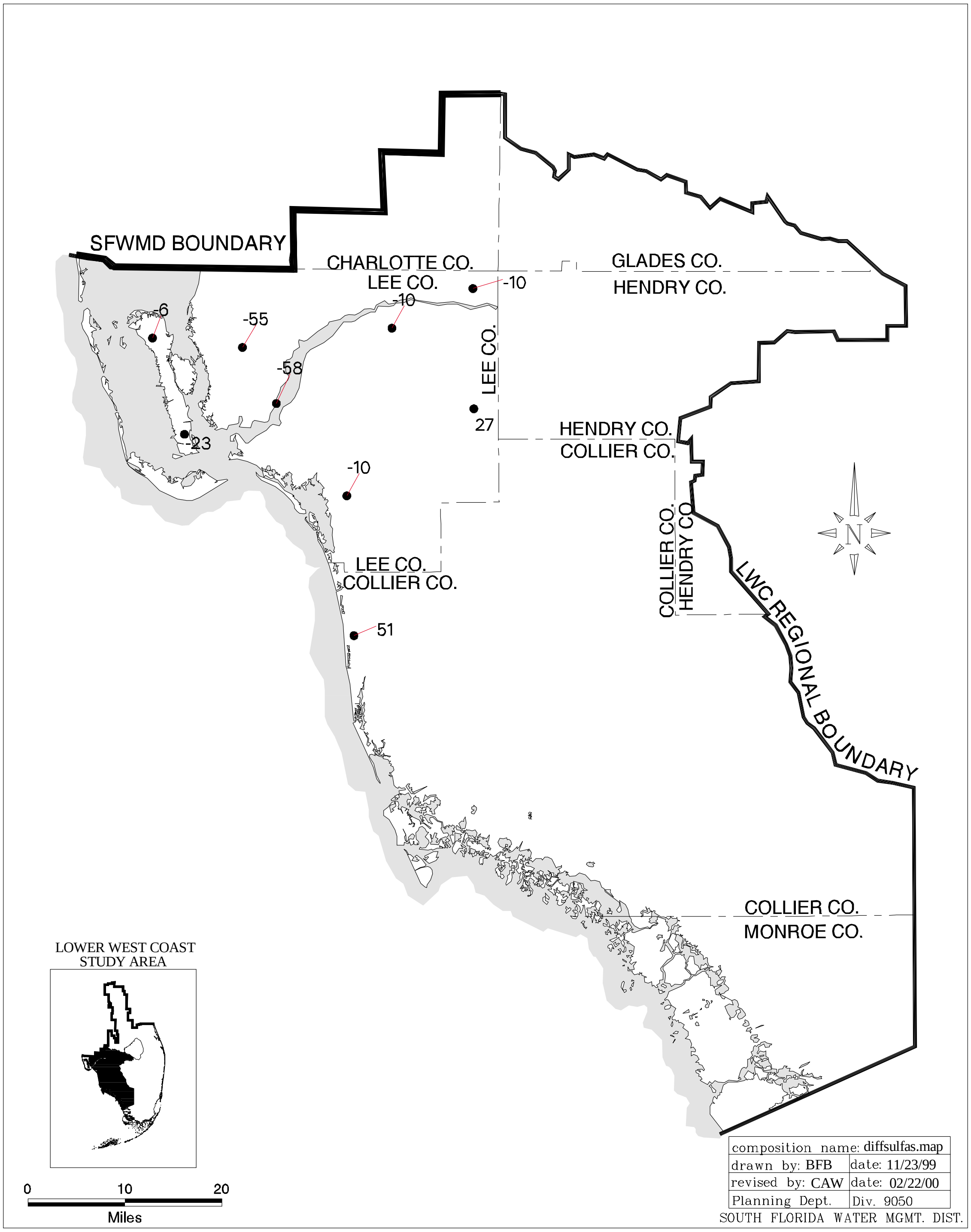

Figure G-26. Differences in Average Sulfate Concentrations (mg/L) of the Floridan Aquifer System Ambient Ground Water Quality Monitor Wells (1984-1989 and 1990-1998).

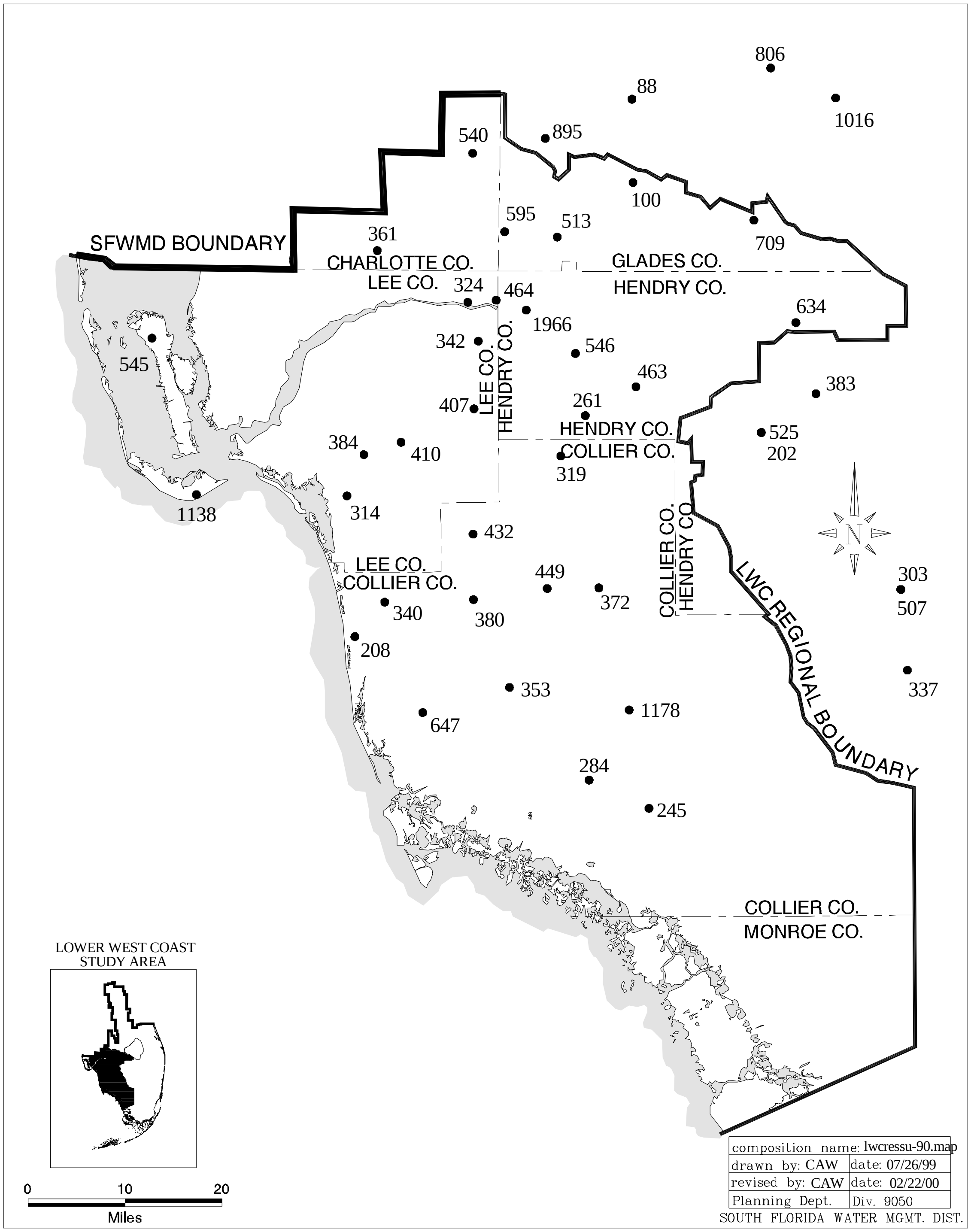

Figure G-27. Average Total Dissolved Solids (mg/L) of the Surficial Aquifer System Ambient Ground Water Quality Monitor Wells (1984-1989).

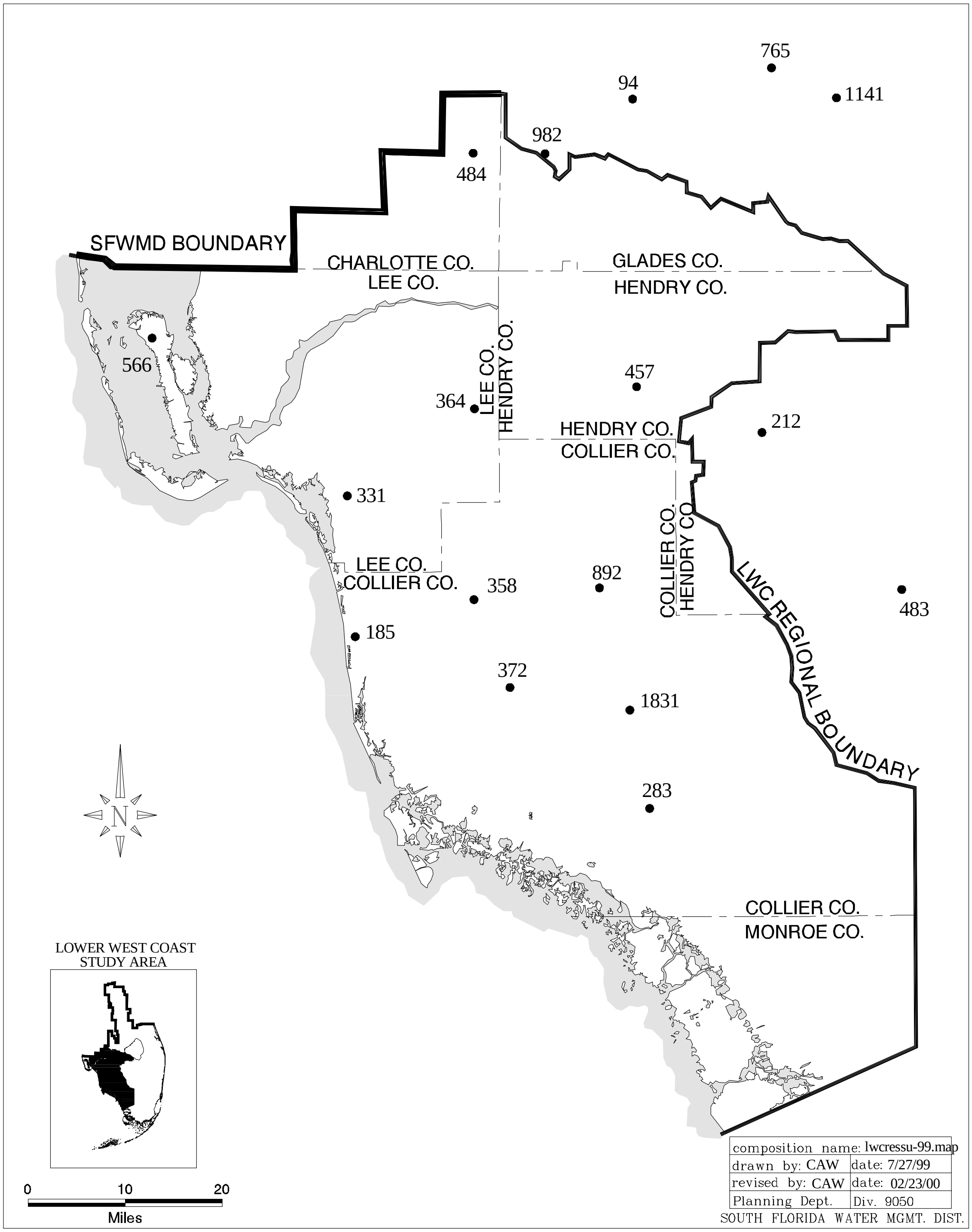

Figure G-28. Average Total Dissolved Solids (mg/L) of the Surficial Aquifer System Ambient Ground Water Quality Monitor Wells (1990-1998).

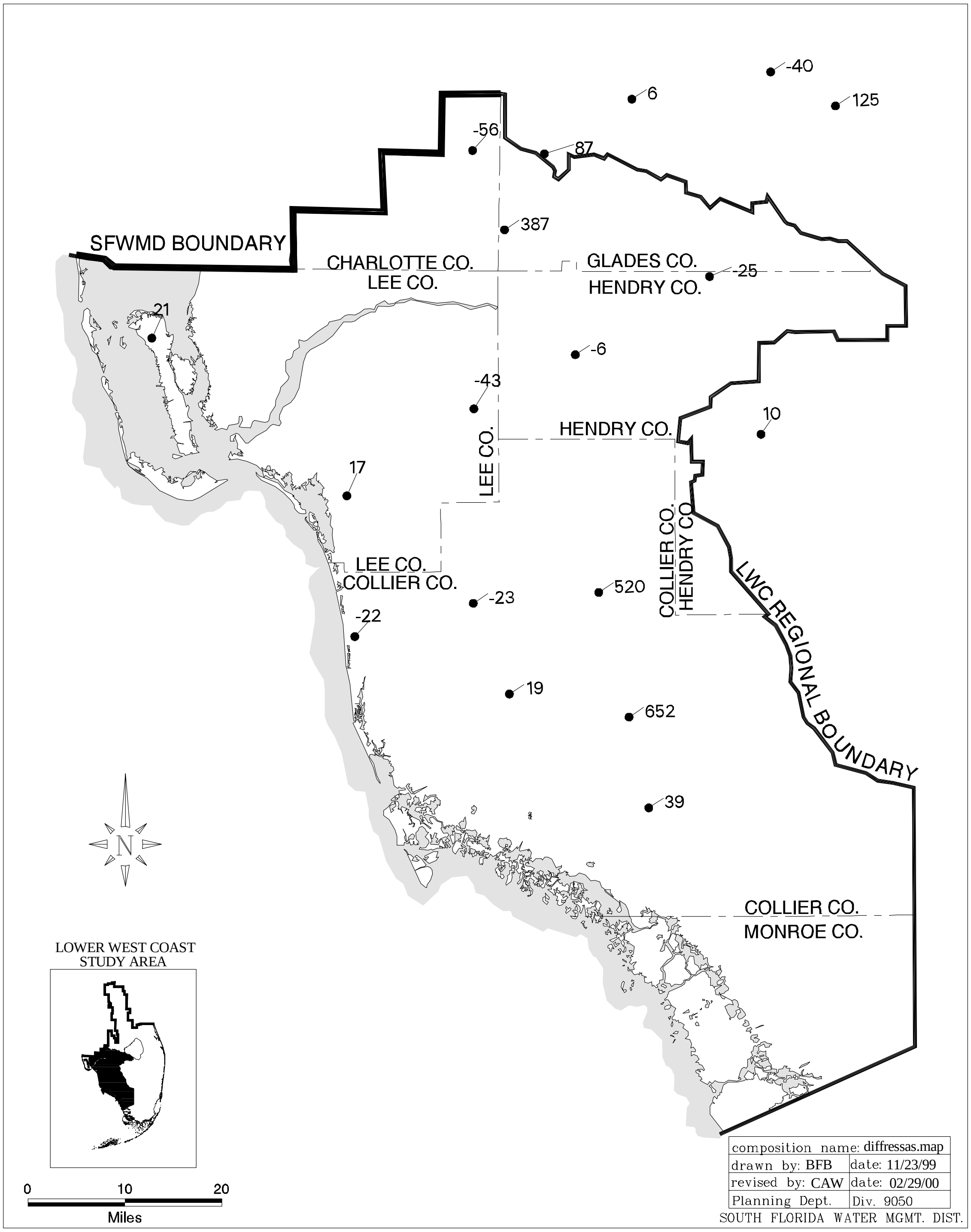

Figure G-29. Differences in Average Total Dissolved Solids (mg/L) of the Surficial Aquifer System Ambient Ground Water Quality Monitor Wells (1984-1989 and 1990-1998).

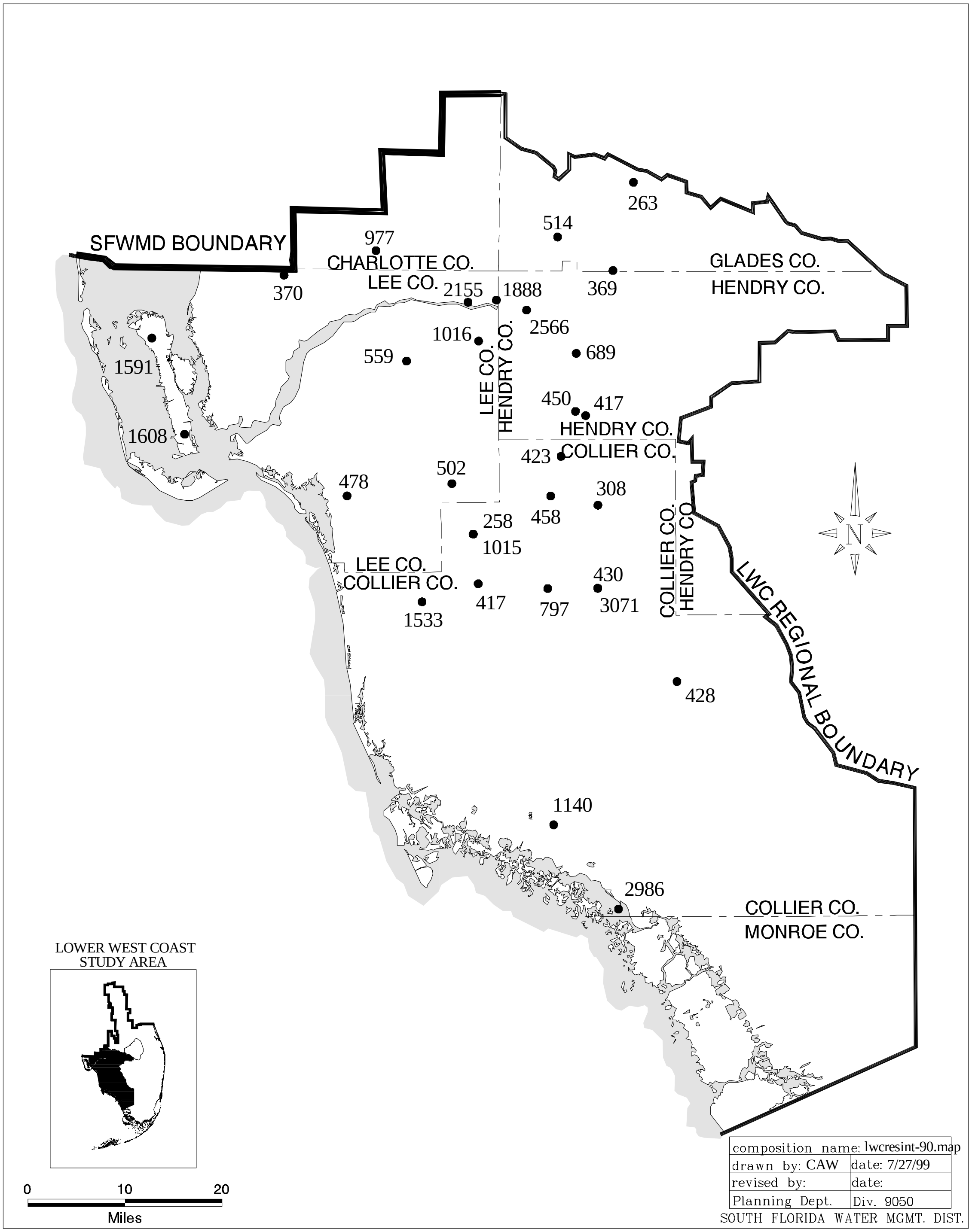

Figure G-30. Average Total Dissolved Solids (mg/L) of the Intermediate Aquifer System Ambient Ground Water Quality Monitor Wells (1984-1989).

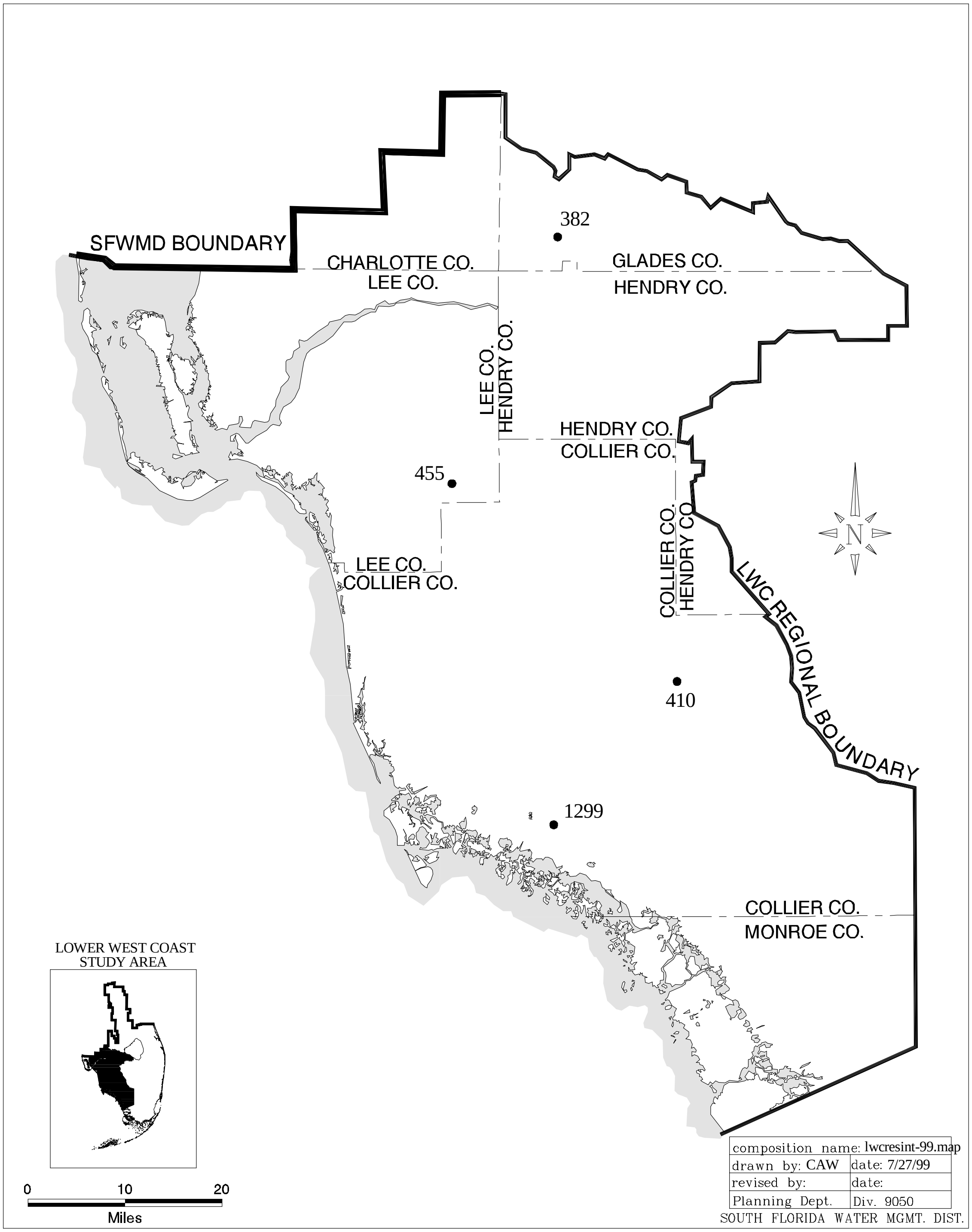

Figure G-31. Average Total Dissolved Solids (mg/L) of the Intermediate Aquifer System Ambient Ground Water Quality Monitor Wells (1990-1998).

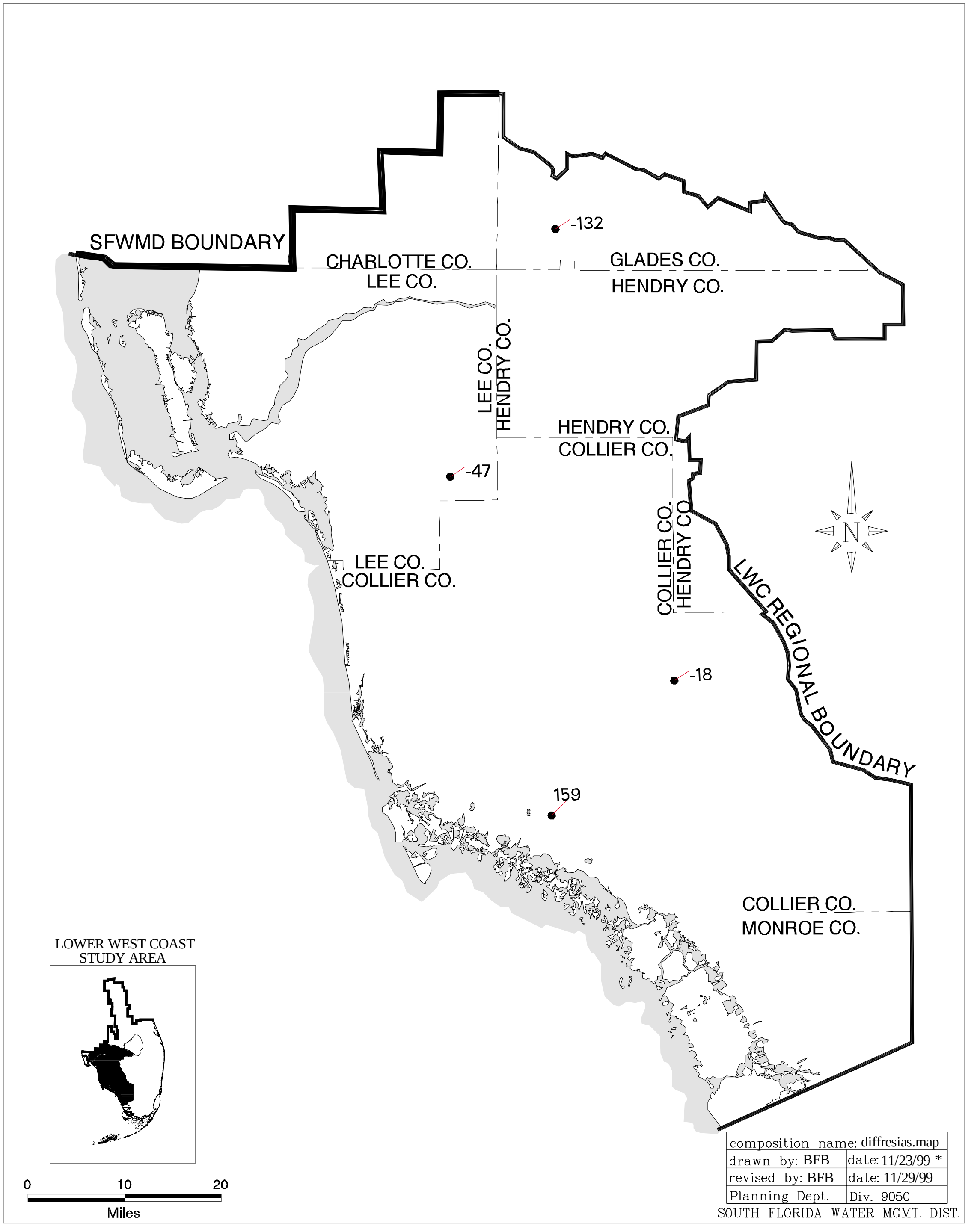

Figure G-32. Differences in Average Total Dissolved Solids (mg/L) of the Intermediate Aquifer System Ambient Ground Water Quality Monitor Wells (1984-1989 and 1990-1998).

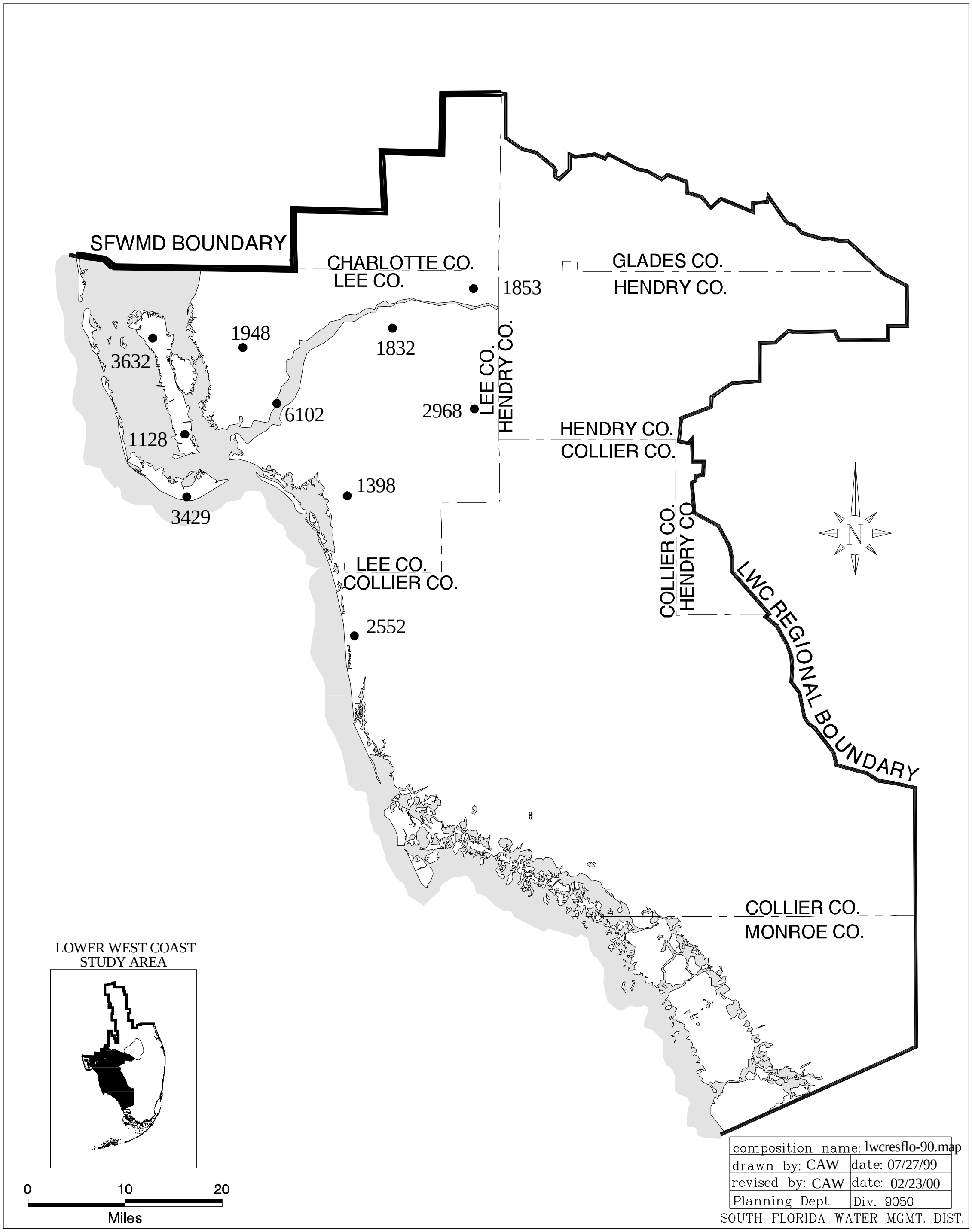

Figure G-33. Average Total Dissolved Solids (mg/L) of the Floridan Aquifer System Ambient Ground Water Quality Monitor Wells (1984-1989).

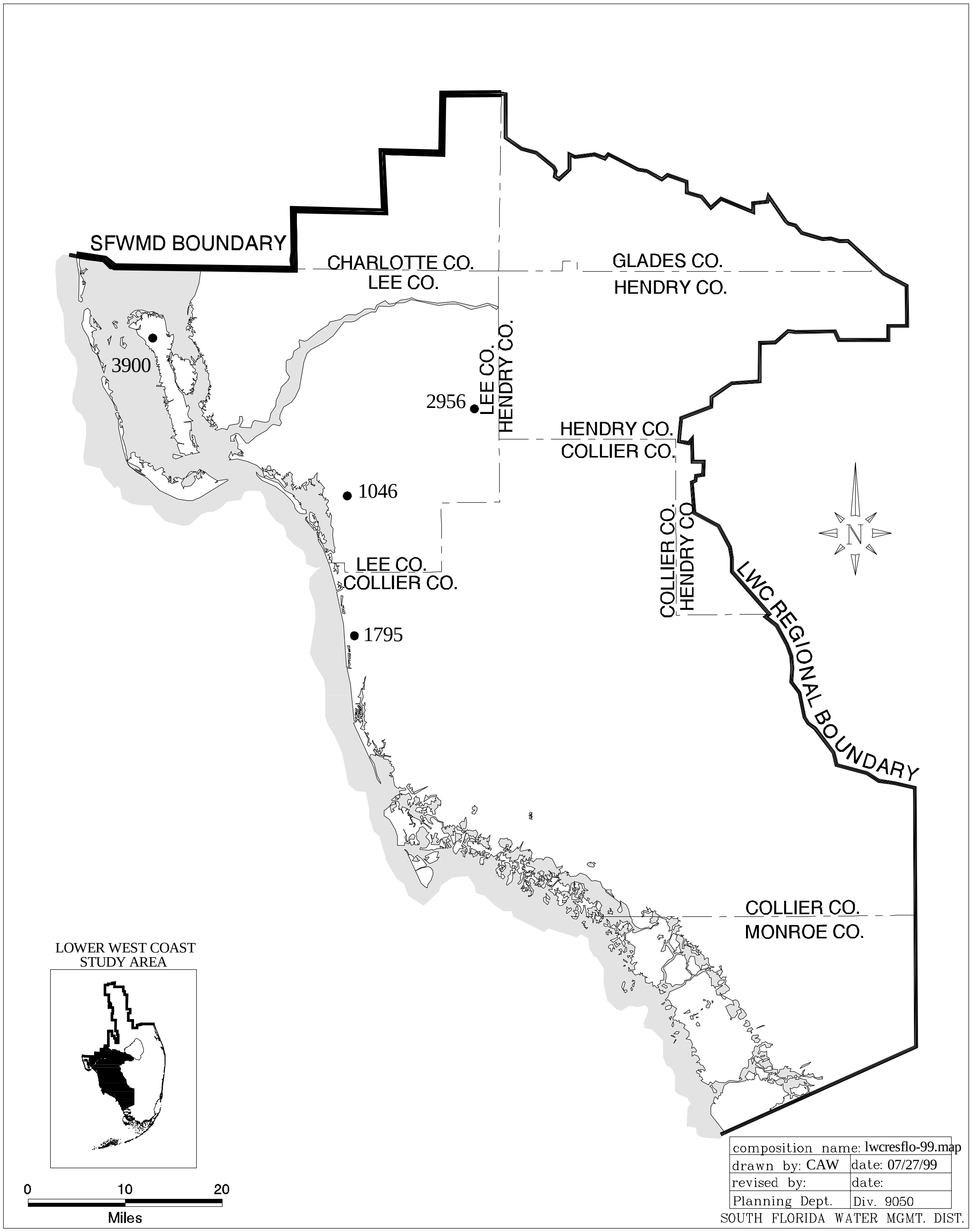

Figure G-34. Average Total Dissolved Solids (mg/L) of the Floridan Aquifer System Ambient Ground Water Quality Monitor Wells (1990-1998).

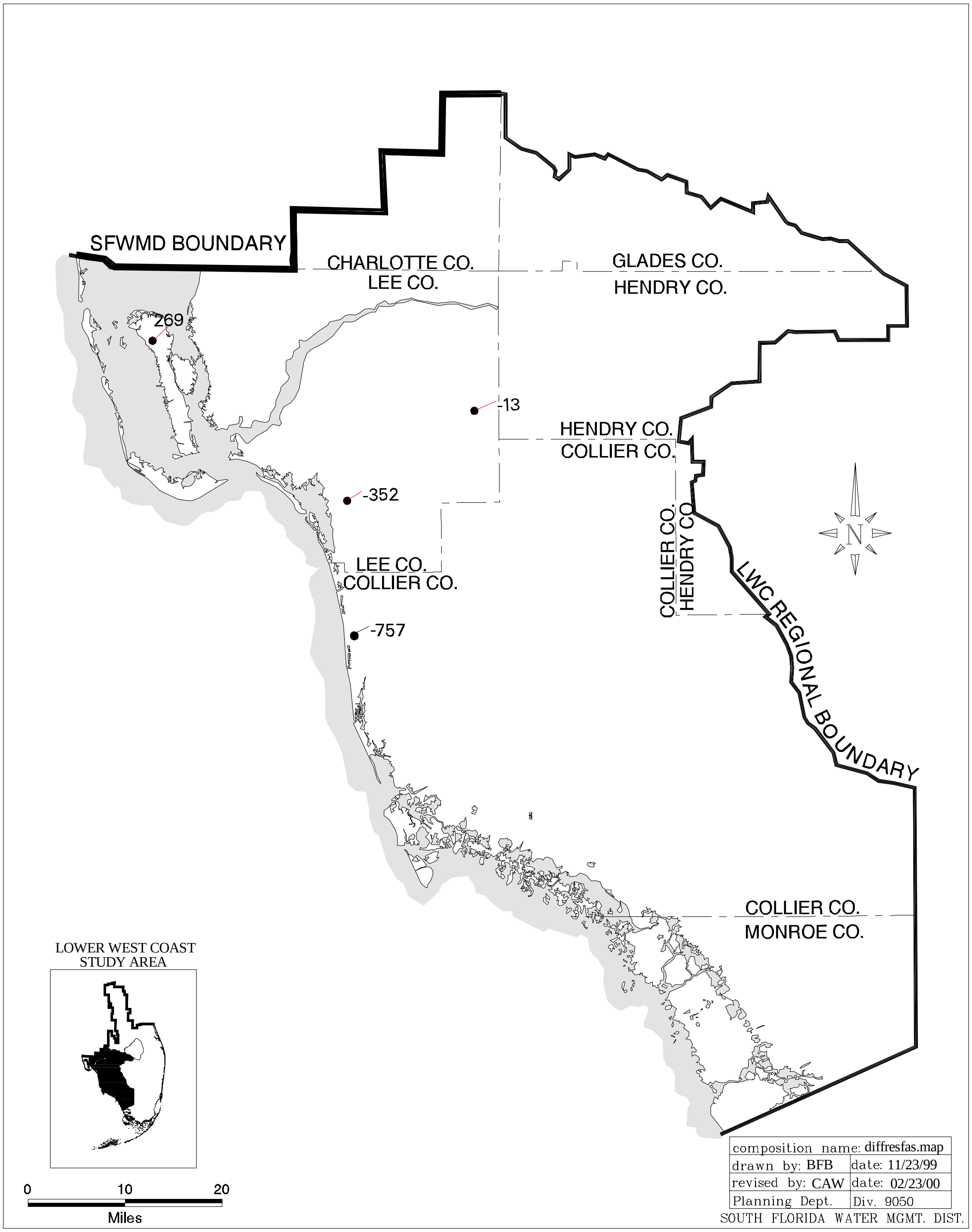

Figure G-35. Differences in Average Total Dissolved Solids (mg/L) of the Floridan Aquifer System Ambient Ground Water Quality Monitor Wells (1984-1989 and 1990-1998).

Landfills

There are 23 Class I and II landfills, as well as other unknown disposal sites, in the LWC Planning Area. These facilities, classified as either active or closed, were compiled from several sources listed in **Table G-11**. The accompanying landfill location map is included as **Figure G-36** .

Table G-11. Class I and II Landfill Facilities in the Lower West Coast Planning Area.

Map Number	Facility Name	Class	Status	Source
Collier County				
1	Goodlette Road	---	Closed	6, 8
2	Immokalee #1	I	Closed	1, 3, 4, 6, 8
3	Immokalee #2	I	Active	1, 3, 4, 5, 6, 7, 8
4	Naples	I	Active	1, 3, 4, 5, 6, 7, 8
5	Naples Airport	I	Closed	3, 4, 5, 6, 8
6	Temple Drive	---	Closed	6
Glades County				
7	Glades County #2	II	Active	4, 7
Hendry County				
8	Airglades	I	Closed	1, 6
9	County Landfill (Pioneer)	I	Closed	1, 4, 5, 6, 8
10	LaBelle	I	Closed	6
11	Lee/Hendry	I	Active	5, 7
Lee County				
12	Alva School Dump	---	Closed	6
13	Alva-Spanish River Dump	---	Closed	6
14	Billy's Creek Dump	---	Closed	6
15	Buckingham	I	Closed	2, 4, 5, 6, 8
16	Corkscrew Road	II	Closed	4
17	Detar Lane	II	Closed	4
18	Fort Myers, City of	---	Closed	2, 5
19	Gulf Coast	I	Active	1, 2, 4, 5, 6, 7, 8
20	Harlem Heights (Kelly Road)	II	Closed	2, 4, 5, 6, 8
21	Lake Kennedy	II	Closed	4
22	Old Lehigh Dump	I	Closed	6
23	Pine Island Dump	---	Closed	6

Source codes:
1. Miller et al. (1987)
2. Phone conversation January 3, 1991 with Mr. Van Horn, Lee County Solid Waste, Fort Myers, FL
3. Letter dated December 31, 1990 from Robert Fahey, Solid Waste Management Director, Collier County Government, Naples, FL
4. Letter dated January 17, 1991 from Philip Edwards, FDER South District Deputy Assistant Secretary, Fort Myers, FL
5. South Florida Water Management District. 1989. Solid Waste Disposal Site Surface Water Management System Inventory. SFWMD, West Palm Beach, FL
6. Shaw, J.E. 1985. Water Quality Assurance Act Program Progress Report December 1983 to March 1985. SFWMD, West Palm Beach, FL
7. Florida Department of Environmental Protection, 1998. Solid Waste Management in Florida annual report 1998. Appendix C
8. Letter Dated February 17, 1998 from Bill Krumbholz, FDEP, South District, Fort Myers, FL

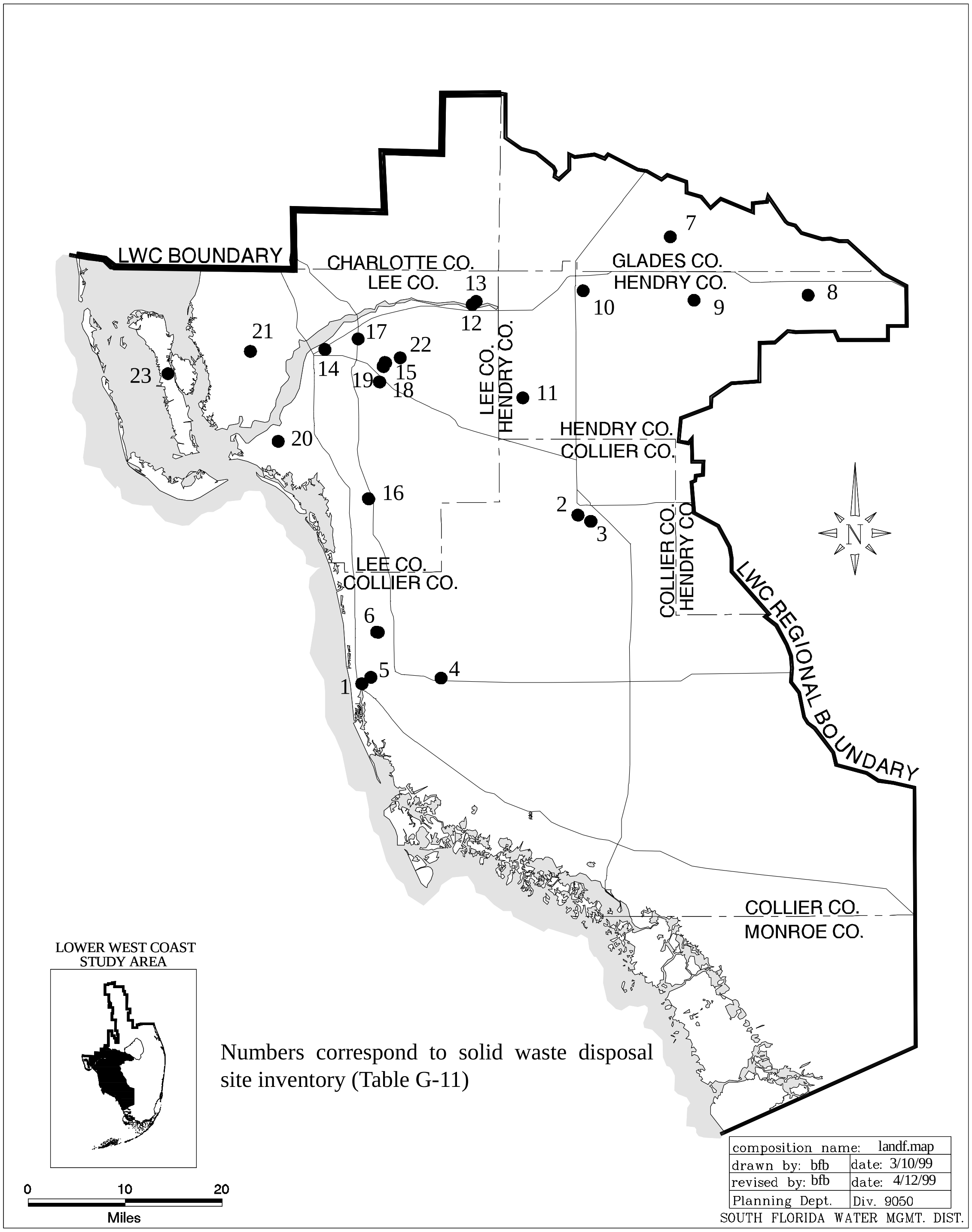

Figure G-36. Locations of Landfills in the Lower West Coast Planning Area.

WATER QUALITY STANDARDS

Drinking Water Standards

Current FDEP primary and secondary drinking water standards are shown in **Tables G-12**, **G-13**, and **G-14**. Primary drinking water standards include contaminants which can pose health hazards when present in excess of the maximum contaminant level (MCL). Secondary drinking water standards, commonly referred to as aesthetic standards, are those parameters that may impart an objectionable appearance, odor or taste to water, but are not necessarily health hazards.

Table G-12. FDEP Primary Drinking Water Standards (Ch. 62-550, F.A.C., revised November 1999).

ORGANICS	MCL* (mg/L)
Volatile Organics	
Vinyl chloride	0.001
Benzene	0.001
Carbon tetrachloride	0.003
1,2-Dichloroethane	0.003
Trichloroethylene	0.003
para-Dichlorobenzene	0.075
1,1-Dichloroethylene	0.007
1,1,1-Trichloroethane	0.2
cis-1,2- Dichloroethylene	0.07
1,2-Dichloropropane	0.005
Ethylbenzene	0.7
Monochlorobenzene	0.1
o-Dichlorobenzene	0.6
Styrene	0.1
Tetrachloroethylene	0.003
Toluene	1
trans-1,2-Dichloroethylene	0.1
Xylenes (total)	10
Dichloromethane	0.005
1,2,4-Trichlorobenzene	0.07
1,1,2-Trichloroethane	0.005

Total Trihalomethanes

The sum of concentrations of bromodichlormethane, dibromochloromethane, tribromomethane (bromoform) and trichloromethane (chloroform)

PESTICIDES & PCBS	MCL* (mg/L)
2,3,7,8- TCDD (Dioxin)	3×10^{-8}
Alachlor	0.002
Atrazine	0.003
Carbofuran	0.04
Chlordane	0.002
Dibromochloropropane (DBCP)	0.0002
2,4-D	0.07
Endrin	0.002
Ethylene dibromide (EDB)	0.00002
Heptachlor	0.0004
Heptachlor epoxide	0.0002
Lindane	0.0002
Methoxychlor	0.04
Polychlorinated biphenyl (PCB)	0.0005
Pentachlorophenol	0.001
Toxaphene	0.003
2,4,5-TP (Silvex)	0.05
Dalapon	0.2
Di(2-ethylhexyl)phthalate	0.006
Di(2-ethylhexyl)adipate	0.4
Dinoseb	0.007
Diquat	0.02
Endothall	0.1
Glyphosate	0.7
Hexachlorobenzene	0.001
Hexachlorocyclopentadiene	0.05
Oxamyl (vydate)	0.2
Benzo(a)pyrene	0.0002
Picloram	0.5
Simazine	0.004

INORGANICS	MCL* (mg/L)
Contaminant	
Antimony	0.006
Arsenic	0.05
Asbestos	7 MFL**
Barium	2
Beryllium	0.004
Cadmium	0.005
Chromium	0.1
Cyanide	0.2
Fluoride	4.0***
Lead	0.015
Mercury	0.002
Nickel	0.1
Nitrate	10 (as N)
Total Nitrate and Nitrate	10 (as N)
Nitrite	1 (as N)
Selenium	0.05
Sodium	160
Thallium	0.002

TURBIDITY

Surface Water

- 1 turbidity unit (NTU) when based on a monthly average
- 5 NTU when based on an average for two consecutive days.

Ground Water

- 1 NTU

MICROBIOLOGICAL

Coliform Bacteria

- Presence/Absence

Escherichia coli

- Presence/Absence

Giardia lamblia

- Presence/Absence

Cryptosporidium

- Presence/Absence

RADIONUCLIDES	MCL*
- Combined radium-226 and radium-228	5 pCi/L
- Gross alpha activity, including radium-226, but excluding radon and uranium	15 pCi/L
- Manmade radionuclides	4 millirem/yr
- Tritium/total body	20,000 pCi/L
- Strontium-90/bone marrow	8 pCi/L

*MCL = maximum contaminant level

**MFL = million fibers per liter >10 micrometers

***Fluoride also has a secondary standard

Table G-13. FDEP Secondary Drinking Water Standards (Ch. 62-550, F.A.C., revised November 1999).

Contaminant	MCL (mg/L)[a]
Aluminum	0.2
Chloride	250
Color	15 color units
Copper	1
Fluoride	2.0
Foaming Agents	0.5
Iron	0.3
Manganese	0.05
Odor	3[b]
pH (at collection point)	6.5-8.5
Silver	0.1
Sulfate	250
Total Dissolved Solids	500[c]
Zinc	5
Total Trihalomethanes	0.10

a. Except color, odor, corrosivity, and pH.
b. Threshold odor number.
c. May be greater if no other MCL is exceeded.

Irrigation Water Quality Parameters

Chemical parameters of an irrigation water that affect plant growth, yield, and appearance, soil conditions, and the ground water quality governs the applicability of a water. The University of California Cooperative Extension Service has developed a useful and widely accepted guide to evaluate the suitability of an irrigation water and identifying potential areas of concern. Problems and related constituents include salinity, permeability, specific ion toxicity (sodium, chloride, boron), nitrogen, bicarbonate, and pH. These guidelines can be found in "Water Treatment Principles and Design" (J.M. Montgomery Consulting Engineers, 1985).

Table G-14. MCLGS and MCLS for Disinfection By-Products (Federal Register, 40 CFR, December 1998).

Disinfection By-products	MCLG (mg/L)	MCL (mg/L)
Total Trihalomethanes (TTHM)[a]	N/A[b]	0.080
Chloroform	0	
Bromodichloromethane	0	
Dibromochloromethane	0.06	
Bromoform	0	
Haloacetic acids (five) (HAA5)[c]	N/A[b]	0.060
Dichloroacetic acid	0	
Trichloroacetic acid	0.3	
Chlorite	0.8	1
Bromate	0	0.010

a. Total Trihalomethanes is the sum of the concentrations of chloroform, bromodichloromethane, dibromchloromethane, and bromoform.

b. Not available because there are no individual MCLGs for TTHMs or HAAs.

c. Haloacetic acids (five) is the sum of the concentrations of mono-, di-, and trichloroacetic acids and mono- and dibromoacetic acids.

In addition to these guidelines, recommended maximum concentration for trace elements have been developed and can be found in J.M. Montgomery Consulting Engineers, 1985.

Salinity

Salinity is a measure of the soluble salts, or the ionic activity of a solution in terms of its capacity to transmit current, in a water and is determined by measuring the water's electrical conductivity (EC) or specific conductance. Water salinity is the most important parameter in determining the suitability of water for irrigation. As salinity increases in irrigation water, the probability for certain soil, water, and cropping problems increases. There are several dissolved salts found in water, the principal salts being the chloride and sulfate salts of sodium, calcium, and magnesium (Augustin et al., 1986). Many salts, such as nitrogen, phosphorus, calcium, and potassium are necessary for normal plant growth.

Salt is added continuously via the irrigation water to the soil. Over time, a salinity problem to the plant may occur if the accumulated soil salt concentration increases to where it is harmful to the plant. The accumulation is dependent on the quantity of salt applied and the rate at which salt is removed by leaching. Leaching is essential to successfully irrigate with highly saline water. To assure that salt leaching occurs, additional irrigation water could be applied. Establishment of a net downward movement of water and salts is the only practical way to manage a salinity problem. In addition, under these circumstances, good drainage and/or percolation is essential in allowing movement of the water and salt below the root zone. The climate in an area also affects soil salt accumulation. Evaporation and transpiration remove water and leave the salts behind. Climate also influences the salt tolerance of plants, which will be discussed later.

Ground water salt content increases due to upconing or saline water intrusion. For reclaimed water, salts enter the wastewater stream in many different ways. Salts are contained in drinking water, are introduced through domestic and industrial activities, through water softeners, and through infiltration and inflow (I/I) into the wastewater collection system. Infiltration is where ground water enters the collection system through defective joints, cracked and broken pipes and manholes, whereas inflow is where storm water enters the collection system through combined sewers, manhole covers, foundation drains and roof drains. In coastal areas, I/I of seawater can be major source of salts in the reclaimed water. The advanced secondary wastewater treatment process has little effect on removal of salts from the wastewater stream.

Knox and Black (n.d.) provide a table indicating the degree of salt tolerance of many of the landscape plants adapted to South Florida, including trees, palms, shrubs, ground covers, and vines. Many of the salts are necessary for healthy plant growth; however, excessive concentrations of these salts can have a negative impact on the plant. Salts affect plant growth by: (1) osmotic effects, (2) specific ion toxicity, and (3) soil particle dispersion.

Osmotic Effects

Osmosis is the attraction of dissolved salts which causes water to move from areas of low salt concentration to areas of high salt concentration. Roots selectively absorb compounds that the plant needs to grow. The normal osmotic flow causes water to move from the soil, which is usually an area of low salt concentration, into the roots which is an area of higher salt concentration. Excessive salts in the soil can reverse the normal osmotic flow of water into the plant by reversing the salt concentration gradient, thus causing dehydration of the plant. Increased plant energy is also needed to acquire water and make biochemical adjustments necessary to survive, which will decrease plant growth and crop production. In addition, osmotic effects indirectly create plant nutrient deficiencies by decreasing the nutrient absorption. The salt tolerance of common turf grass species in South Florida can be found in "Saline Irrigation of Florida Turfgrasses" (Augustin et al., 1986).

Deposition of salts on foliage through spray irrigation may also cause problems, especially to sensitive ornamental plants. Much work has been devoted to quantify the tolerance of many of the plants. Many researchers have identified the salt tolerance of plants through field observation and have categorized them as having poor, moderate, or good salt tolerance. Several of their publications are available from the Florida Cooperative Extension Service Institute of Food and Agricultural Sciences (IFAS).

Specific Ion Toxicity. Ion toxicity is due to excessive accumulations of specific ions in a plant that result in damage or reduced yield. Toxicity problems may or may not occur in the presence of a salinity problem. Specific ions of concern include boron, chloride, sodium, and bicarbonate. Ion toxicity potential is increased in hot climates. The ions can be absorbed by the plant through the roots or the foliage, but with sprinkler irrigation, sodium and chloride frequently accumulates by direct adsorption through the leaves. Such toxicity occurs at concentrations that are much lower than toxicity caused by surface irrigation. Toxicity associated with overhead sprinkling is sometimes eliminated with night irrigation when lower temperatures and higher humidity exists. Tolerances of these ions vary from plant to plant.

Sodium. Sodium is not considered essential for most plants; however, it has been determined that sodium does positively affect some plants lower than the salt tolerance threshold. The amount of sodium is of concern because it is usually found in the largest amount. Sodium directly and indirectly affects plants. Direct affects of sodium toxicity involves the accumulation of this ion to toxic levels, which is generally limited to woody species (Maas, 1990). Indirect effects resulting from sodium toxicity include nutritional imbalance and impairment of the physical conditions of the soil. Sodium can affect the plant's uptake of potassium. Ornamental sodium toxicity is characterized by burning of the outer leaf edges of older leaves and progresses inward between the veins as severity increases. Sodium is usually introduced into the wastewater stream by I/I. With adequate care, sodium toxicity should not be a problem.

Chloride. Chloride is an essential micronutrient for plants and is relatively nontoxic. Most nonwoody crops, such as turf grass, are not specifically sensitive to chloride. However, many woody, perennial shrubs and fruit tree species are susceptible to chloride toxicity. In addition, chloride contributes to osmotic stress. Ornamentals express chloride toxicity by leafburn starting at the tip of older leave and progressing back along the edges with increasing severity. Chloride is usually introduced into the wastewater stream by I/I. With adequate care, chloride toxicity should not be a problem except possibly for irrigation of salt sensitive plants.

The City of St. Petersburg investigated the effect of reclaimed irrigation water on the growth and maturation of commonly used ornamental plants and trees in the St. Petersburg area. The study, called "Project Greenleaf" was also used to determine the chloride tolerance of those plants and trees (Parnell, 1987). The study suggested a chloride threshold of 400 mg/L be established for reclaimed water that is utilized for green space irrigation. This threshold protects salt sensitive ornamentals from the effects of chlorides, which generally have a lower salt tolerance than turf grasses.

Boron. Boron is an essential element to plants but can become toxic when concentrations of soil water slightly exceed the amount required for optimum growth. Boron is usually not a problem to turf grasses because boron accumulates in the leaf tips, which are removed by mowing; however, other landscape plants may be more sensitive to boron levels. Boron toxicity may be expressed by leaf tip burn or marginal burn accompanied by chlorosis of the interveinal tissue. Boron is commonly introduced to the wastewater stream from household detergents or from industrial discharges.

Water Infiltration Rate

In addition to other concerns with high sodium content, it can lead to deterioration of the physical condition of the soil by formation of crusts, water logging and reducing the soil permeability and nutritional problems induced by the sodium. An excess of sodium in the soil could displace nutrients such as calcium, iron, phosphorus, and magnesium from the soil particles and thereby creating a nutritional deficiency that the plant requires in addition to creating soil permeability problems (Knox, n.d.). Infiltration problems occur within the top few inches of the soil and is mainly related to the structural stability of the surface soil and is related to a relatively high sodium or very low calcium content in this zone or in the irrigation water. Reclaimed water usually contains sufficient amounts of both salt and calcium, such that dissolving and leaching of calcium from the surface soil is minimized.

Salt Levels in Soil

Good drainage is essential to leach soluble salts through the soil profile. To maintain a certain soil salt level, irrigation rates exceeding evapotranspiration are required to leach excess salts through the soil.

Salt Tolerance of Plants

Research has found that salt tolerance of plants usually relates to its ability to: (1) prevent absorption of chloride and sodium ions, (2) tolerate the accumulation of chloride or sodium ions in plant tissue, or (3) tolerate osmotic stress caused by soil or foliar salts. Plant tolerance to salts can be influenced differently based on the age of the plant, the stage of growth, irrigation management, and soil fertility. In addition, some plants are tolerant to soil salts but intolerant to salt deposits on the foliage, or vice versa.

The salt tolerance of plants varies greatly. Some plants avoid salt stress by either excluding salt absorption, extruding excess salts, or diluting absorbed salts. Other plants adjust their metabolism to withstand direct or indirect injury. Most plants utilize a combination of these. Turf grass salt stress is indicated by faster wilting than normal due to the osmotic stress, shoot and root growths are reduced to direct and indirect salt injury, leaf burn, general thinning of the turf and ultimately turf death. Landscape plant salt stress could be expressed by burning of the margins or tips of leaves followed by defoliation and death of salt sensitive plants.

Salt tolerance depends on many factors, conditions, and limits including type of salt, crop growing conditions, and the age and species of the plant. The type and purpose of the plant needs to be considered when evaluating salt tolerance. For example, for edible crops, yield is of primary importance and salt tolerance would be based on growth and yield. However, to establish permissible levels of salinity for ornamental plant species, the aesthetic characteristic of the plant is more important than its yield. The loss or injury of leaves due to salt stress is unacceptable for ornamentals, even if growth is unaffected. Accordingly, landscape plants can tolerate relatively higher levels of salts, since reduced growth and yield are the initial effects of excess salts and appearance of plants is not immediately affected (Knox and Black, n.d.).

Climate is a major factor affecting salt tolerance. Most crops can tolerate greater salt stress if the weather is cool and humid rather than hot and dry. Rainfall also reduces salinity problems by diluting salt concentration and enhancing leaching by adding additional water. Nighttime irrigation reduces foliar absorption and injury. In addition, some plants may be tolerant to soil salinity but are not tolerant to salt deposition on the leaves and vice versa. Use of an irrigation technique that applies water directly to the soil surface rather than on the leaf surfaces is preferred when using irrigation water which contains excessive salts.

Nutrients

Reclaimed water contains nutrients that provide a fertilizer value to the crop or landscape, which when accounted for, can reduce the amount of fertilizer applied, thus reducing fertilizer costs. The nutrients found in reclaimed water occurring in quantities important to agriculture and landscape management include nitrogen and phosphorus, and occasionally potassium, zinc, born, and sulfur.

Municipal wastewaters usually contain sufficient amounts of micronutrients to prevent deficiencies. The trace elements of boron (B), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo), zinc (Zn), sodium (Na), and chlorine (Cl) are essential for plant growth; however, intake of excessive concentration of these elements can be toxic and detrimental to some plants.

REFERENCES CITED

Augustin, B.J., A.E. Dudeck, and C.H. Peacock. 1986. *Saline Irrigation of Florida Turfgrasses*. Circular 701. Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL.

South Florida Aquifer Storage and Recovery Work Group. 1993. *Guidance for Development of Class V Aquifer Storage and Recovery Injection Well Systems in South Florida – November 1993*. USEPA, FDEP, and SFWMD, n. pag.

Camp Dresser & McKee. 1989. *Wastewater Reuse System Engineering Cost Model. Documentation, User's Guide and Computer Program*. Prepared for the South Florida Water Management District, West Palm Beach, FL. vari. pag.

Camp, Dresser & McKee. 1990. City of Boca Raton, Florida, Reclaimed Water System Master Plan. CD&M, Fort Lauderdale, FL.

Eingold, J.C. and W.C. Johnson. n.d. *St. Petersburg's Wastewater Reclamation and Reuse Project -- Eight Years Later.* City of St. Petersburg, FL. 7 pp.

ENR Engineering News Record. 1994. Construction Cost Index. *The McGraw-Hill Construction Weekly,* 232(13):49.

ENR Engineering News Record. 1994. Construction Cost Index. *The McGraw-Hill Construction Weekly*, 232(18):114.

Florida Geological Survey. 1992. *Florida's Ground Water Quality Monitoring Program: Background Hydrogeochemistry.* Publication No. 34. FGS, Tallahassee, FL. 364 pp.

Hunter, R.G. 1990. *State of the Environment Reuse of Reclaimed Water.* Florida Department of Environmental Regulation, Tallahassee, FL. 8 pp.

J.M. Montgomery Consulting Engineers. 1985. *Water Treatment Principles and Design*. New York: John Wiley & Sons.

KPMG Peat Marwick. 1992. *Reclaimed Water User Cost Study.* Final report submitted to the South Florida Water Management District, SJRWMD, and SWFWMD. KPMG Peat Marwick, Vienna, VA.

Knox, G.W. n.d. *Management of Saline Irrigation Water in the Nursery.* Circular 718. Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL.

Knox, G.W. and R.J. Black. n.d. *Salt Tolerance of Landscape Plants in South Florida*. Circular 756. Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL.

Maas, E.V. 1990. Crop *Salt Tolerance in Agricultural Salinity Assessment and Management*. New York: ASCE.

Metcalf & Eddy, n.d. Project Log-Orange County and City of Orlando, Florida, water reclamation facilities. Metcalf & Eddy Services, Inc., Winter Garden, FL.

Parnell, R. 1987. Project Green Leaf - Executive Summary. St. Petersburg, FL.

Schnelle, J.F. and C.C. Ferraro. 1991. Integrated, created and natural wetland systems using wastewater. Presented at: Florida Association of Environmental Professionals Annual Seminar in Jupiter, FL. Environmental Management & Engineering, Palm Beach Gardens, FL. and FDER, Orlando, FL.

University of Florida. 1988. Population estimates for Florida cities and counties. Unpublished data. Bureau of Economic and Business Research, UF.

University of Florida. 1989. *Agricultural Commodity Report*. Cooperative Extension, Institute of Food and Agricultural Sciences, Naples, FL. 2 pp.

University of Florida. 1990. *IFAS Citrus/Wildlife Study Task-- Report Numbers 1.2.1, 1.2.2, 1.2.3, 1.3, And 1.4.* Institute of Food and Agricultural Sciences and the Florida Cooperative Research Unit, UF. Prepared for the South Florida Water Management District, West Palm Beach, FL. Multi-volumes.

Appendix H
WATER SOURCE OPTIONS: RECLAIMED WATER AND AQUIFER STORAGE AND RECOVERY

REGULATIONS AND SUPPLEMENTAL INFORMATION FOR WATER SOURCE OPTIONS

Reclaimed water and water storage via aquifer storage and recovery are two of the water source options being considered in the Lower West Coast (LWC) Water Supply Plan to meet the needs of this region. Both of these options are regulated by the Florida Department of Environmental Protection (FDEP).

Reclaimed Water

Reuse is the deliberate application of reclaimed water for a beneficial purpose in compliance with the FDEP and Water Management Districts rules. Reclaimed water is wastewater that has received at least secondary treatment and is reused after flowing out of a wastewater treatment plant (Chapter 62-610, F.A.C.). Reuse includes the following:

- Landscape irrigation (such as irrigation of golf courses, cemeteries, highway medians, parks, playgrounds, school yards, retail nurseries and residential properties)
- Agricultural irrigation (such as irrigation of food, fiber, fodder and seed crops, wholesale nurseries, sod farms, and pastures)
- Aesthetic uses (such as decorative ponds and fountains)
- Ground water recharge (such as slow rate and rapid rate land application systems)
- Industrial uses (such as cooling water, process water and wash waters)
- Environmental enhancement (such as wetlands restoration)
- Fire protection

The FDEP 1998 Reuse Inventory identified 451 wastewater treatment facilities ($\geq$.10 MGD) statewide that are reusing approximately 490 MGD of reclaimed water in Florida (FDEP, 1999). These facilities have a permitted design capacity for reuse of 1,009 MGD. There have been substantial increases in reuse over the past decade. The 1990 Reuse Inventory identified 199 wastewater treatment facilities that were reusing approximately 266 MGD of reclaimed water (FDEP, 1990). Among the many reasons for the increased utilization of reuse are: (1) it is an environmentally acceptable means of disposal; (2) state regulations have been adopted; (3) there is an increased public acceptance; and (4) the frequency of drought and water restrictions have increased. Treated wastewater, when properly treated to acceptable standards for the reuse, is no longer a waste but a valuable nonpotable water resource that enhances the regional water inventory. Reclaimed water is and will continue to have a substantial role in water supply in Florida.

Reuse in the LWC Planning Area

Nineteen of the regional wastewater facilities in the LWC Planning Area utilized reuse for reclaimed water disposal in 1998. The methods of reuse employed by these facilities included ground water recharge via percolation ponds, public access spray irrigation of golf courses, residential lots and other green space, restricted public access spray irrigation of hay fields, and industrial use. The facilities utilizing reuse for all or part of their disposal needs are listed in **Table H-1**.

Table H-1. Lower West Coast Planning Area 1998 Reuse Facilities.

Wastewater Treatment Facility	Public Access Spray Irrigation			Percolation Ponds	Spray Fields	Industrial
	Golf Course	Residential Lots	Green Space			
Collier County						
Collier County North	x					
Collier County Pelican Bay	x	x	x			
Collier County South	x			x		
Golden Gate				x		
Immokalee					x	
Marco Island Utilities	x	x		x		
Naples	x		x			
Hendry County						
Clewiston					x	
Lee County						
Bonita Springs East and West	x	x	x			
Cape Coral Everest Parkway		x	x			
Cape Coral Southwest		x	x			
Fiesta Villages	x					
Forest Utility	x					
Lee County (Fort Myers Beach)	x		x	x		
Fort Myers Central			x			x
Gateway				x		
Gulf Three Oaks	x					
Lehigh Acres	x			x		
North Fort Myers	x					
City of Sanibel	x			x		

Many of the treatment facilities utilized reclaimed water for plant process water and for irrigation of the plant site, which also could be considered reuse. Reuse of 40.93 MGD of reclaimed water in 1998, accounted for 61 percent of the total wastewater processed in 1998 in the LWC Planning Area. The remaining 25.68 MGD was disposed of by deep well injection or discharge to surface water and lost from the water supply inventory. This water, that was disposed of by deep well injection and discharge to surface water, could have been made available with the addition of regulatory mandated equipment including filtration and the associated chemical feed system, disinfection facilities and reclaimed water monitoring equipment. A required facility reliability of Class I, or an equivalent may exist via their existing method of disposal. In some cases, the existing method of disposal may also be utilized as an alternate means of disposal during periods of low demand or when the required reclaimed water quality is not met, which may negate the need for regulatory mandated storage.

Many of the facilities listed in **Table H-1** will continue to increase their amount of reuse when additional reclaimed water becomes available and/or when demand is created. Utility-specific information is provided in Appendix D.

Florida's Comprehensive Reuse Program

The State and District objectives include promoting and encouraging water conservation and reuse of reclaimed water. To achieve these objectives, several requirements and regulations have been implemented as part of a comprehensive reuse program. These are: (1) Chapter 62-40, F.A.C., (2) Section 403.064, F.S., (3) the FDEP's Antidegradation Policy, (4) guidelines for preparation of reuse feasibility studies, (5) SFWMD Basis of Review, and (6) State reuse regulations.

Chapter 62-40, F.A.C. This chapter, also referred to as the Water Resource Implementation Rule, requires the water management districts to designate areas that have existing water resource problems or areas in which water resource problems are projected to develop during the next 20 years. These were formerly referred to as critical water supply problem areas. This chapter further states that applicants in these areas must make use of a reclaimed water source unless the applicant demonstrates that it's use is not economically, environmentally, or technologically feasible. The SFWMD adopted the designated areas by rule (Chapter 40E-23, F.A.C.) in October of 1991. The LWC Planning Area is incorporated in this designation.

Section 403.064, Florida Statutes. This section of the statutes requires all applicants for domestic wastewater permits from the FDEP for facilities located in water resource caution areas (critical water supply problem area) to evaluate the feasibility of reuse of reclaimed water as part of their application for the permit.

FDEP Antidegradation Policy. This policy is contained in Chapter 62-4, F.A.C., "Permits," and Chapter 62-302, F.A.C., "Surface Water Quality Standards." Compliance with the state's antidegradation policy must be justified prior to issuance of a permit by FDEP for any new or expanded surface water discharge. The antidegradation policy requires a utility proposing to construct a new discharge or expand an existing discharge, to demonstrate that an alternative disposal method such as reuse is not feasible in lieu of a discharge to surface water, and that such a discharge is clearly in the public interest.

Reuse Feasibility Studies. There are several rules, statutes, or laws that require preparation of reuse feasibility studies. The FDEP, with assistance from the water management districts and the public service commission, have developed guidelines for preparation of reuse feasibility studies for applicants having responsibility for wastewater management to aid in coordination, consistency and completeness of these studies. A companion document has also been developed for water use applicants.

SFWMD Basis of Review. Revisions since 1993 to the District's Basis of Review required feasibility evaluations of reuse. For all potable public water supply utilities who control, directly or indirectly, a wastewater treatment facility, an analysis of the economic, environmental and technical feasibility of making reclaimed water available shall be incorporated into their water conservation plan at the time of permit application.

Applicants for permits for commercial/industrial uses, agricultural irrigation, and landscape and golf course irrigation uses that are located in water resource caution areas are required to use reclaimed water in place of higher quality water sources, unless it is demonstrated that its use is either not environmentally, economically or technically feasible. Reclaimed water also has to be readily available for facilities located outside a designated water resource caution areas.

State Reuse Regulations. The state adopted Chapter 62-610, F.A.C., "Reuse of Reclaimed Water and Land Application," in April of 1989. This Chapter contains the specific reuse and land application requirements of the FDEP and the Local Pollution Control programs where such authority has been delegated to those programs.

Reuse Benefits

Several benefits result from the use of reclaimed water for nonpotable water needs. When reclaimed water is utilized to replace a potable supply for nonpotable needs, the benefits include the following:

- Postponement or elimination of future water treatment plant expansions
- Postponement or elimination of construction of additional water supply wells
- Reduction in the size of the potable water distribution lines
- Reduction in monthly water bills

Additional benefits to the above and with respect to other ground water users include the following:

- Guaranteed source of water
- Reduced demand on the ground- or surface-water resource
- Exempt from water shortage/restriction requirements

- Reduced application of commercial fertilizers since reclaimed water contains nutrients
- More water available and reduced demands during water shortages for the regional water supplier
- Ground water recharge
- Satisfaction of antidegradation requirement for expansion of a surface water disposal facility
- Exempt from SFWMD permitting

Public Health

Health risks with reclaimed water are relative to the degree of human contact and adequacy/reliability of the treatment processes that produce the reclaimed water. The FDEP has developed reuse regulations that require extensive treatment and disinfection to assure that continuous and reliable supplies of high quality reclaimed water are produced to ensure that public health and environmental quality are protected. Each type of reuse is afforded an appropriate level of treatment and disinfection. In addition to extensive treatment requirements, several application site standards must be adhered to which also minimize potential health risks. The Florida Department of Health and Rehabilitative Services has concluded that a reuse facility designed, constructed, and operated to meet the requirements of the state’s reuse rules poses no threat to public health (Hunter, 1990).

Regulatory Agencies and Requirements

Reclaimed water treatment, quality and use is regulated by the FDEP. The primary document utilized for regulation of reclaimed water and reuse is Chapter 62-610, F.A.C., “Reuse of Reclaimed Water and Land Application”. This chapter contains specific reuse and land application requirements of the FDEP and the Local Pollution Control Authority delegated programs providing design, operation and maintenance requirements for land application systems. Chapter 62-610 provides the requirements for reuse via (1) Slow-Rate Land Application Systems; Public Access Areas, Residential Irrigation, and Edible Crops; (2) Slow-Rate Land Application Systems; Restricted Public Access, and; (3) Rapid Rate Land Application Systems; (4) Ground Water Recharge and Indirect Potable Reuse; (5) Industrial Uses. The document specifies the level of treatment required for specific uses of the reclaimed water, the required reclaimed water monitoring equipment, the reliability of the treatment facility, the criteria for the land application system (i.e., golf course, percolation pond, etc.) and system operation.

In addition to Chapter 62-610, F.A.C., the state has adopted the Wetlands Application Rule, Chapter 62-611, F.A.C., which establishes the foundation and criteria for wetlands receiving reclaimed water.

Potential Uses

Florida's water policy states that water management programs shall seek to "encourage the use of water of the lowest acceptable quality for the purpose intended... where economically and environmentally feasible." The District and State support reclaimed water as an appropriate alternate source for irrigation when reasonable and available. There are many uses of reclaimed water as identified previously. A discussion of each follows.

Golf Courses. One of the predominate methods of reuse in Florida is for large-scale irrigation, particularly irrigation of golf courses. Currently, there are approximately 346 golf courses in Florida utilizing reclaimed water for irrigation. In the LWC Planning Area, there are a total of 146 golf courses with a total irrigated acreage of 19,333 acres. The estimated average supplemental (irrigation) water requirements of the existing golf course acreage is 55 MGD. Sixty-two of these courses utilize reclaimed water for all or a portion of their irrigation. The irrigated golf course acreage in the LWC Planning Area is projected to increase to 33,587 acres by the year 2020. The 2020 projected acreage will require an average supplemental irrigation of 115 MGD (see Appendix F for a detailed discussion of demand projections). The city of Naples and the Loxahatchee Environmental Control District (ENCON) are examples of golf course reuse systems.

The City of Naples Wastewater Treatment Facility is a 10.00 MGD facility which provides reclaimed water for irrigation to 15 large users including nine golf courses, two schools and two parks. In 1998, the irrigation sites utilized an average of 3.89 MGD of reclaimed water. Besides providing irrigation water, reuse provides Naples with an environmentally acceptable alternate disposal method to the existing surface water discharge pursuant to a FDEP no-discharge requirement. The reuse system significantly reduces the demand for ground water, which is one of the city's major sources of potable water (Marcello and Chaffee, 1988).

Collier County operates three wastewater facilities with a total treatment capacity of 17.50 MGD that provides reclaimed water for irrigation of 13 golf courses, 5 parks, and approximately 1600 residences. The reclaimed water distribution systems for two of these facilities are interconnect to increase the use of reclaimed water. These facilities reused over 11 MGD in 1998. The use of reclaimed water in this area has significantly reduced the demand for ground water.

Outdoor Residential. It is estimated that up to 50 percent of the potable water delivered to single family homes is utilized for outside uses. This can amount to a considerable volume of water treated to potable standards. A substantial savings in potable water, and in turn ground water, could be realized by utilizing reclaimed water for these outdoor nonpotable water uses. These savings may eliminate the need for expansion of existing water treatment facilities, drilling of new wells, or reduce the need for new facilities. The benefit to the consumer in utilizing reclaimed water are lower monthly water bills, reduced need for fertilizer, and exclusion from water shortage restrictions. Several municipalities, including the cities of Naples and Fort Myers, have adopted ordinances that require new developments over 10 acres to install dual water distribution systems with the anticipation of reclaimed water becoming available in the future. Some Florida communities which have implemented, or which are proposing to implement, residential reclaimed water systems are Cape Coral, St. Petersburg, and Boca Raton.

The city of Cape Coral initiated operation of a system in early 1992 to provide reclaimed water for public access irrigation on residential lawns and other green space via a secondary water line as part of the Water Independence for Cape Coral (WICC) program. As part of WICC, reclaimed water and canal water is used are used as supply sources for the secondary system, which will be distributed throughout the city for residential lawn and other green space irrigation. Approximately 25,000 properties are connected to the system. The city will continue to connect additional users to the secondary system.

St. Petersburg has one of the largest urban reuse irrigation systems in the nation. The program was initiated in the mid-to-late 1970s when the city recognized the need to reduce future potable water imports from adjoining counties. In addition, they were faced with required wastewater treatment facility upgrades because of more stringent water quality standards established for Tampa Bay. St. Petersburg was also declared a water short area (Eingold and Johnson, n.d.). In 1998, the reuse system served over 9,000 residential customers, 70 parks, 46 schools and 6 golf courses. The average reclaimed water usage was approximately 21 MGD. Deep well injection systems serve as an alternate means of disposal for the reuse system. It has been estimated that the reuse program in St. Petersburg has extended the capacity of their potable water treatment and supply system by 15 years (phone conversation March 26, 1991 with Joe Towery, Reuse Coordinator, city of St. Petersburg, Florida).

Other Green Space. This category includes all other green space that requires supplemental irrigation where use of reclaimed water is desirable. This would include irrigation of parks, activity fields, schools, median strips, cemeteries, commercial landscapes, common areas, and retail nurseries. The development of Pelican Bay utilizes reclaimed water to supply their master irrigation system, which supplies irrigation water for residential lawns, median strips, common areas and other green space. In addition, Lee County's Fort Myers Beach Facility provides reclaimed water to five developments for their green space irrigation needs.

Agriculture. Agricultural irrigation includes irrigation of food, fiber, fodder and seed crops, wholesale nurseries, sod farms, and pastures. State regulations prohibit direct contact of reclaimed water with edible crops that will not be peeled, skinned, cooked, or thermally processed before human consumption. However, if an indirect reclaimed water-application irrigation method is used (such as ridge and furrow, drip, or subsurface), precluding direct contact of the reclaimed water with the crop, irrigation is allowed. There are several agricultural operations that utilize reclaimed water for irrigation throughout the state, including sites in Tallahassee, Orlando, and Okeechobee and Manatee counties. Citrus, gladiolus, sod, ridge and furrow crops, ferns, hay, corn, soybeans, rye, oats, and wholesale nursery plants are some of the crops presently being irrigated with reclaimed water.

The Conserv II Water Reclamation Facility, located in Orange County, is jointly owned and utilized for reclaimed water disposal by both the city of Orlando and Orange County. Conserv II currently provides reclaimed water for irrigation of 7,000 acres of citrus and 10 acres of ferns plus ground water recharge via 2,000 acres of rapid infiltration basins. This site receives reclaimed water from the city of Orlando Sand Lake Road and Orange County McLeod Road wastewater treatment facilities with rated capacities of 21 MGD and 23 MGD, respectively. Conserv II has a capacity to irrigate 15,000 acres and dispose of 50 MGD (Metcalf & Eddy, n.d.).

Industrial. Potential industrial uses of reclaimed water include cooling, process and wash waters. Potential users include power plants, manufacturers such as metal fabricators and plating, cement makers, commercial and institutional facilities. Facilities in Hillsborough and Broward counties, Tampa and Largo use reclaimed water for industrial uses. In certain situations, reclaimed water is not fully consumed in some industrial processes. Proper disposal of this reclaimed water must be satisfactorily addressed. Two examples of industrial facilities that utilize reclaimed water are the Lee County Waste-To-Energy Facility and the Curtis Stanton Energy Center.

The Lee County Waste-To-Energy Facility uses reclaimed water from Fort Myer's Central Wastewater Facility. The system was placed into operation in 1994 and used approximately 0.45 MGD in 1998.

The coal fired Curtis Stanton Energy Center power plant in Orange County utilizes approximately 3.5 MGD of reclaimed water from the Orange County Eastern Service Area Wastewater Treatment Facility for boiler cooling water.

Environmental Enhancement. Reclaimed water could be utilized for environmental enhancement in the restoration of hydrologically altered wetlands. There are several wetlands projects utilizing reclaimed water in Florida, two of which are the city of Orlando Iron Bridge and the Orange County Eastern Service Area wastewater treatment facilities.

The Orlando Iron Bridge Regional Water Pollution Control Wastewater Treatment Facility utilizes a man-made wetlands system for reclaimed water disposal. The 1,200 acre created wetlands consist of a deep marsh, mixed marsh, and hardwood swamp. The current flow into the wetlands is limited to 13 MGD, but ultimately the wetland will receive up to 20 MGD of reclaimed water that has received advanced wastewater treatment. From the created wetlands, the reclaimed water flows through the 660 acre Seminole Ranch wetlands prior to discharge to the St. John’s River. This system was placed into operation in 1987 (Schnelle and Ferraro, 1991).

The Orange County Eastern Service Area Wastewater Treatment Facility utilizes an overland flow and wetlands system to currently dispose of 1.55 MGD of reclaimed water that has received advanced wastewater treatment. The wetlands system consists of 150 acres of natural wetlands and 150 acres of pine flatwood converted to wetlands which discharges to the Econlockhatchee River. The system will have an ultimate capacity of 6.2 MGD. This system was placed into operation in 1988.

Rapid Rate Land Application. Rapid rate land application involves discharging reclaimed water to a series of percolation ponds or subsurface absorption systems (drainfields). The FDEP requires, at a minimum, that reclaimed water receive secondary treatment and basic level disinfection prior to discharge to a rapid rate land application system. In addition, reclaimed water discharged to subsurface application systems must not contain total suspended solids greater than 10 mg/L. The application rate is limited to 5.6 gallons per day per square foot, unless greater loading rates are justified. There are many rapid rate land application systems in operation in the LWC Planning Area, mostly associated with reclaimed water disposal from small wastewater treatment plants. However, several large plants utilize rapid rate land application for their primary method of reclaimed water disposal or as a backup to another reuse system.

Hydrodynamic Saltwater Intrusion Barriers. Reclaimed water could be used for ground water recharge in areas of saltwater intrusion. This would be accomplished via rapid rate land application systems or by shallow injection wells. Rapid rate land application such as ponds or drainfields would be strategically placed to deter further migration of the saltwater front. This could be accomplished by constructing long trenches, percolation ponds or subsurface disposal systems parallel to the saltwater front. Injection of reclaimed water by shallow wells has been investigated on Florida's southeast coast. This method of reuse would consist of construction of several injection wells along the saltwater front, which when in operation, would create a positive freshwater head and impede further migration of the saltwater front inland. Injection of reclaimed water is heavily regulated by state and federal agencies. These agencies' regulations prohibit injection of fluids that do not meet applicable water quality standards. Depending on the local geology/geologic profile and the TDS of the formation fluid, various regulations and criteria apply (FDEP, 1990).

Aquifer Storage and Recovery

Aquifer storage and recovery is one storage option that has significant interest throughout south Florida to meet the growing demands for water, and as alternative to above ground storage. Regional and local applications are being considered and constructed. In the LWC Planning area, ASR facilities have recently been constructed for Marco Island, Collier County and Lee County. There are several others proposed at this time, including using this technology for reclaimed water.

Regulatory Criteria

Guidance for preparation of Class V Aquifer Storage and Recovery injection well system permit applications is provided in a document titled "Guidance for Development of Class V Aquifer and Storage and Recovery Injection Well Systems in South Florida – November 1993" (U. S. Environmental Protection Agency, 1993). This document was prepared by the South Florida Aquifer Storage and Recovery Work Group, which consisted of representatives from the U.S. Environmental Protection Agency, Florida Department of Environmental Protection and the South Florida Water Management District. The following are excerpts taken from that document.

Background

This section outlines circumstances in which a Class V permit would be needed. Aquifer Storage and Recovery (ASR) is the "emplacement of water through the use of an injection well into a suitable aquifer during periods of excess water supply for later retrieval and use during periods of need." Traditionally, public water supply systems employ ASR to store finished drinking water for later recovery and use. ASR can also be used to store excess wet season surface water for later recovery during the dry season as needed to augment drinking water supplies and for other uses, such as agricultural irrigation.

A major impediment to implementing ASR is that the Underground Injection Control (UIC) regulations prohibit injection of fluids into underground sources of drinking water (USDW) if the fluid contains contaminants which violate any federal primary drinking water standard or may adversely affect the public health. If the proposed ASR project will violate any of these criteria, an aquifer exemption must be obtained. In addition to meeting the federal primary drinking water standards, Florida's ground water and UIC rules require that all fluids injected into a USDW meet the secondary drinking water standards and minimum criteria. There are, however, state mechanisms which may be used to grant relief from these requirements when appropriate. A costly way to resolve this dilemma is to treat the surface water to the appropriate standards prior to injection. An alternative may be to inject the water into a deeper portion of the aquifer which contains a total dissolved solids (TDS) concentration of more than 10,000 mg/L. The state has limited experience regarding the success or feasibility of recovery from such zones.

The U.S. Environmental Protection Agency (USEPA) is currently considering revising their policy regarding requirements of water injected into an underground source of drinking water aquifer. These proposed changes were prompted by the incorporation of ASR in the Restudy and in particular, the use of water from Lake Okeechobee as an ASR source of water. Even though this change in policy is in response to a specific project, it may have national and state implications. Specifically, the USEPA is considering evaluating coliform from a public health risk based approach rather than from a formal drinking water standard.

Aquifer exemptions represent major or minor modifications to State UIC programs depending on the level of TDS in the aquifer. If the aquifer which is to be exempted contains water with a TDS concentration of less than 3000 mg/L a major modification is required. Major modifications require notice in the Federal Register and a minimum 30-day public comment period. The state of Florida was delegated primary program responsibility (primacy) for implementing the federal UIC program and follows this process. Minor exemptions require a more limited public notice but still may be difficult to obtain. Under the current state UIC rules only minor exemptions (3,000-10,000 mg/L TDS) are allowed.

Although ASR is generally considered to be a beneficial use of underground injection, concerns with its use include treatment costs, the classification of the ground water and competing uses for the aquifer. Ground water is classified under Chapter 62-

520.410, F.A.C. The fluid injection for storage must meet applicable water quality standards according to the classification. Water may have to be treated to acceptable levels prior to injection. Depending on the source of the water to be stored, treatment costs could be significant. Also, application of the drinking water standards does not give credit for pollutant reductions obtained from the ASR injection process (i.e., bacteria die-off, phosphorus reductions). Current laws do not provide flexibility for addressing this issue.

In some cases, the receiving aquifer for an ASR project is the same aquifer that is being used to monitor for fluid movement at a Class I injection facility. If the ASR and Class I facilities are in the same area, the use of the aquifer for Class I monitoring may be impaired. If this is the case, it may not be possible to obtain an ASR permit in area where a Class I injection well systems is located. A case-by-case evaluation is therefore essential.

Underground Injection Control General Comments

The following comments are provided by the Florida Department of Environmental Protection's Underground Injection Control (UIC) program regarding ASR in general.

> General Comment - ASR Projects - Aquifer storage and recovery is a proven technology for seasonal storage and recovery of potable water. Projects are currently being constructed, or are in the initial stages of testing, for storage of untreated surface and ground water, and reclaimed water. Some 41 ASR projects are in the various stages of permitting statewide.
>
> The permitting of ASR projects will be difficult when the water which is to be stored in an underground source of drinking water (USDW; i.e., aquifer containing less than 10,000 mg/L total dissolved solids; TDS) does not meet primary drinking water standards prior to injection. In order to inject water into a USDW that does not meet the federal primary drinking water standards an aquifer exemption will be required. The time needed to obtain an aquifer exemption may be lengthy.
>
> Aquifer exemptions are of two types; major and minor. A minor aquifer exemption is needed if the portion of the aquifer to be exempted contains between 3,000 and 10,000 mg/L TDS. If the water quality in the portion of the aquifer to be exempted contains a TDS concentration of less than 3,000 mg/L, a major aquifer exemption is required.
>
> Minor Aquifer Exemption - In order to obtain a minor aquifer exemption an applicant must demonstrate that the portion of the aquifer to be exempted contains a TDS concentration of 3,000 - 10,000 mg/L and it is not currently being used for drinking water supply, nor is it reasonably expected to be used in the future for a drinking water supply. Once the Department tentatively approves an aquifer exemption request, the request is then sent to EPA for approval. EPA has 45 days in which to deny the aquifer exemption request or it is approved by default. EPA may approve the request in less than 45 days if they choose. After EPA approval there is a 21-day period in which a party may request an Administrative Hearing.

Major Aquifer Exemption - A major aquifer exemption is required if the portion of the aquifer to be exempted contains a TDS concentration of less than 3,000 mg/L. In order to obtain a major aquifer exemption an applicant must demonstrate that the portion of the aquifer to be exempted is not currently being used for drinking water supply, and it can not now or in the future be used as a source of drinking water because (1) it is mineral, hydrocarbon, or geothermal energy producing, or can be demonstrated by a permit applicant for a Class III operation to contain minerals or hydrocarbons that considering their quantity and location are expected to be commercially producible; (2) it is situated at a depth or location which makes recovery of water for drinking water purposes economically or technologically impractical; (3) it is so contaminated that it would be economically or technologically impractical to render that water fit for human consumption; or (4) it is located over a Class III well mining area subject to subsidence or catastrophic collapse.

Because of the requirements above, it is unlikely any major aquifer exemption could be issued under current regulations and policy. Also, unlike with a minor aquifer exemption, there is no default approval. EPA must approve a major aquifer exemption and there is no time limit in which they must do so. Thus, under the current UIC regulations, ASR projects used to store and recover fluids that do not meet federal primary drinking water standards are practically limited to aquifers containing a TDS concentration of greater than 3,000 mg/L where a minor aquifer exemption can be obtained.

Summary - Treated water ASR systems have proven to be technically feasible and should be encouraged. However, ASR projects using untreated surface or ground water, although technically feasible, may be difficult to permit if all federal primary drinking water standards are not met prior to injection. ASR projects injecting untreated water, especially untreated surface water which is generally high in coliform bacteria, will be very difficult to permit if injection is into an aquifer containing a TDS concentration of less than 3,000 mg/L.

ASR Projects Associated with the Restudy - EPA is allowing the Department to take a more "risk-based" approach to permitting pilot ASR projects associated with the Restudy. Under the "risk-based" approach an aquifer exemption would not be required if total coliform bacteria are the only primary drinking water standard that is not met prior to injection if certain risk-benefit criteria can be met and other water users will not be adversely affected by the ASR project.

Proposed Statutory Revisions - There is currently ASR legislation proposed that, if passed, would allow a zone of discharge for ASR wells injecting into aquifers containing a TDS concentration of 1,500 mg/L or more if certain criteria could be met. If passed, this would eliminate the need for an aquifer exemption if criteria for obtaining the zone of discharge could be met.

However, the ultimate fate of this legislation is unknown. In addition, EPA has stated that if the current legislation is approved the State's primacy for the Underground Injection Control program could be in jeopardy and some environmental groups have weighed in against the proposed legislation.

Types of ASR

There are three basic types or uses for ASR: (1) ASR used to provide potable or drinking water; (2) ASR used for storing raw ground water; and (3) ASR used for storing surface water. Another use that has increasing interest is the use of ASR for storing reclaimed water.

Potable or drinking water during peak demand. Public water supply systems can employ ASR to store finished drinking water for later recovery and use. Water is treated to drinking water standards, stored in the aquifer, and later recovered for use during periods of need.

This is the most common use for ASR. In particular, it is a major benefit to water treatment plants at or near capacity. Stored water can be used during periods of peak demand, reducing the need for increasing plant production capacity. ASR also reduces the impacts on natural systems during peak demand times, particularly when peak demands occur during times of drought.

ASR can also be used as a water storage method to provide an alternative water supply in coastal areas for potential use during emergencies or when regular facilities are not operating. This method can be particularly valuable as a readily available local source of water in emergencies where water lines are destroyed preventing access to regional water supplies (i.e., the Florida Keys). However, disadvantages include costs of establishing the services (capital expenditures) and the unknowns associated with planning for such emergencies.

Raw Ground Water ASR. ASR may be used where “untreated” ground water is stored in an aquifer for later recovery. The advantages of using ground water is that the quality of ground water is less variable over time than surface water, thereby potentially reducing treatment costs. In cases where the ground water quality is good, treatment may not be needed. Limitations include the limited sites available for use and the need to evaluate the water quantity and quality impacts on the natural systems and other users of the shallow water aquifer from which ground water is being withdrawn.

Surface Water ASR. Treated or untreated surface water is stored in an aquifer for later recovery and use. Specific uses of surface water ASR include salinity control, agriculture, and as a storage option for urban supply. This method provides a conservation tool for water quantity (back-up systems), providing recycling benefits, and reducing evaporation losses. It conserves water that would be lost to runoff and can be used later for water supply or natural systems. However, treatment may be required to meet UIC regulatory requirements or an aquifer exemption may be needed.

Reclaimed Water ASR. Reuse systems can employ ASR to store reclaimed water for later recovery and use. Similar to potable water ASR, reclaimed water is stored in the aquifer during periods of low demand and later recovered for use during periods of peak demand. ASR could allow systems to expand the number users they serve where they are limited by reclaimed water availability during certain times of the year.

Project Feasibility

An ASR project must be evaluated in terms of its technical, environmental and economic feasibility. The technical valuation should include a discussion of the appropriateness of the receiving aquifer and address the adequacy of aquifer storativity and transmissivity.

Where applicable, the following environmental effects must be examined: adverse impacts on adjacent aquifers, the lateral and vertical extent of the water quality impacts, effects on nearby surface waters and saltwater intrusion concerns. The effects of the ASR project on existing uses of the aquifer system must also be examined (i.e., monitoring zones associated with existing Class I and Class V wells, existing sources of potable water).

Economic considerations to the facility and the community should be identified, evaluated and discussed. The costs of initial injection and monitor well construction, operation and maintenance (including mechanical integrity testing and ground water monitoring) should be considered when determining project feasibility.

Advantages and Disadvantages of ASR

The following are potential advantages and disadvantages of ASR:

<u>Advantages</u>

- Small-scale land acquisition required, compared to above ground water storage
- No loss of water to evaporation, as compared to above ground water storage, where evaporation losses can be significant
- Ability to locate an ASR facility at the point of need
- Use of recovered water during the dry season does not adversely affect the surficial aquifer, water conservation, or wetlands
- Improved reliability for a utility system in the event of an emergency or drought

<u>Disadvantages</u>

- The quantity of water recovered may be less than the amount injected due to the degradation of the stored water over time
- Increased well maintenance may be needed – formation of deposits, which result from mixing of chemically dissimilar waters, is accelerated

Existing ASR Facilities

Manatee County. In 1978, Manatee County began treated water ASR investigations in cooperation with the Southwest Florida Water Management District (SWFWMD) and CH2M Hill Engineers. This program start up was a direct result of a 1976 CH2M Hill project for Naples, Florida which included two shallow connector wells that recharged the local production zone by gravity from the overlying water table.

The Manatee County Utilities Department has a surface water treatment plant that operates at 54 MGD adjacent to Lake Manatee, which is an impoundment on the Manatee River. An investigation of an artesian limestone aquifer beneath Lake Manatee was conducted which evaluated aquifer hydraulic characteristics such as transmissivity, storativity and leakance. After a series of injection and recovery tests were conducted to determine water quality and percent of water recovered, it was concluded that Manatee County could meet peak water demands as high as 70 MGD without expanding their water treatment plant. The ASR facility is currently in operation, with a rated storage capacity of 316 million gallons. At the end of 1993, 294 million gallons were in storage in the aquifer (phone conversation January 6, 1994 with Bruce McCloud, Manatee County Utilities, Bradenton, FL.).

Peace River. A 12 MGD surface water treatment plant built by General Development Utilities, Inc. (GDU) supplies water to Port Charlotte. Port Charlotte's source of raw water is the Peace River (now owned and operated by the Peace River/ Manasota Regional Water Supply Authority). Due to variations in both water flow and water quality of the river, including occasional movement of saltwater upstream of the plant intake, a 1,920 acre-foot capacity offstream reservoir was constructed for raw water storage. In 1984, GDU was faced with the need to expand their water storage capacity, and as a result, treated water ASR was examined as a potentially less expensive storage option. Two potential production zones were tested to determine if treated water ASR was feasible. Six ASR wells were installed which provide a treated water expansion of 4.9 MGD. Three additional wells are planned for feasibility testing in 1994 (phone conversation January 6, 1994 with Grady Sorah, Peace River/Manasota Regional Water Supply Authority, Port Charlotte, FL.). Over the next 30 years, ASR is expected to reduce capital investment for water supply and treatment facilities for the Peace River by over 50 percent.

Cocoa. The Floridan Aquifer System (FAS) is the source of well water for the Cocoa service area. The wells are located inland as far as 50 miles from some locations in the service area. This great distance is due to saltwater intrusion which is occurring along the coast. The Claude H. Dyal water treatment plant has a capacity of 40 MGD. In 1987 demand had reached 37 MGD, which prompted the city of Cocoa to investigate the potential for treated water ASR as an alternative to water treatment plant expansion.

The success of this test program allowed Cocoa to proceed with treated water ASR and defer a water treatment plant expansion. The system was permitted in 1991 and presently operates at a maximum permitted recovery rate of 8 MGD, utilizing 6 ASR wells (phone conversation January 6, 1994 with Glenn Loffler, Claude Dyal Water Treatment

Plant, Cocoa, FL). Present indications are that plant expansion can be deferred until maximum day demand reached 50 MGD, but an expansion of raw water supply will be necessary to sustain increases in average withdrawals.

Port Malabar. In 1987, the Palm Bay Utility Corporation at Port Malabar began treated water ASR investigations. The Port Malabar development is within the city limits of Palm Bay on the east coast of Florida and obtains its water supply from an intermediate aquifer. At the time the ASR investigation began, water demands were approaching the water treatment plant capacity of 6 MGD and were, at times, equal to wellfield supply capacity. If the treated water ASR project investigation proved successful, it would help Port Malabar meet its upcoming seasonal and daily peak demands and defer water treatment plant expansion.

A test facility was constructed within the Port Malabar distribution system. This location enabled the recovered water to be put directly into a nearby transmission main. The treated water ASR facility was tested and the recovered water met all drinking water standards and required no retreatment other than disinfection. Today, the Port Malabar ASR facility is fully operational and provides an additional 1 MGD of treated water supply during peak demand months.

Boynton Beach. In late 1992, the city of Boynton Beach began testing of its ASR facility. During the wet season, treated ground water from the Surficial Aquifer System is pumped into the upper portion of the Floridan Aquifer System for storage. Upon recovery, the water is filtered and rechlorinated, then used to augment the public water supply during dry periods and during peak demands. This serves to alleviate stress on the Surficial aquifer System which is susceptible to saltwater intrusion.

During a dry spell in May 1993, about 17 million gallons of water were recovered from the ASR system. The single ASR well can provide 2,000 GPM of recovered water, although the city is still gathering information. As of early 1994, five injection/storage/recovery cycles had been completed (phone conversation January 6, 1994 with Peter Mazzella, City of Boynton Beach Utilities, Boynton Beach, FL).

REFERENCES CITED

Eingold, J.C. and W.C. Johnson. n.d. *St. Petersburg's Wastewater Reclamation and Reuse Project -- Eight Years Later.* City of St. Petersburg, FL. 7 pp.

Florida Department of Environmental Regulation. 1990. *1990 Reuse Inventory.* FDER, Tallahassee, FL.

Florida Department of Environmental Protection. 1999. *1998 Reuse Inventory.* FDEP, Tallahassee FL.

Hunter, R.G. 1990. In: *Florida: State of the Environment-Reuse of Reclaimed Water.* Florida Department of Environmental Regulation, Tallahassee, FL. 9 pp.

Marcello, L.G. and Chaffee, J.L. 1988. Recycling water saves two billion gallons a year. Reprinted from *Consulting/Specifying Engineer,* December 1988.

Metcalf & Eddy, n.d. Project Log-Orange County & City of Orlando, Florida, water reclamation facilities. Metcalf & Eddy Services, Inc., Winter Garden, FL.

Schnelle, J.F. and C.C. Ferraro. 1991. Integrated, created and natural wetland systems using wastewater. Presented at: Florida Association of Environmental Professionals Annual Seminar in Jupiter, FL. Environmental Management & Engineering, Palm Beach Gardens, FL. and FDER, Orlando, FL.

Appendix I
HYDROGEOLOGIC DATA SUMMARY OF THE FLORIDAN AQUIFER SYSTEM, LOWER WEST COAST PLANNING AREA

I-2

The Lower West Coast (LWC) Planning Area includes Collier and Lee counties and portions of Hendry, Charlotte, and Glades counties. A combination of natural drainage basins and political boundaries define the extent of the LWC Planning Area. Water supply plans developed for the LWC Planning Area have identified the Floridan Aquifer System (FAS) as a possible water supply alternative. Based on these plans, the South Florida Water Management District (SFWMD) initiated a program of well construction, aquifer testing, and long-term monitoring to provide data needed to assess the FAS underlying this area. Between 1994 and the present, ten multizone wells were drilled into the FAS at five locations (**Figure I-1**). Five of these wells were used in aquifer performance tests to define the hydraulic characteristics of various sections of the Floridan, while the remaining five wells were used solely as water level and water quality monitor wells. These wells will supply information needed to characterize the water supply potential of the FAS and to support the development of a ground water flow model, which will be used to support future planning and regulatory decisions.

The FAS wells were drilled, constructed, and tested by drilling firms licensed by the State of Florida. The firms were retained by the District under two separate contracts (C-4172 & C-7663). The total costs for services rendered and material supplied under these two contracts were approximately 3.1 million dollars.

The purpose of this appendix is to document the hydrogeologic field data collected during this well drilling and aquifer testing program. The information includes a summary of the following:

- Well drilling and construction details
- Lithologic and geophysical log data
- Water quality and stable isotope data
- Petrophysical data
- Aquifer performance test data and analyses
- Long-term potentiometric head data

The FAS consists of a series of Tertiary age limestones and dolostones. The system includes permeable sediments of the lower Arcadia Formation, Suwannee Limestone, Ocala Group, Avon Park Formation, and the Oldsmar Formation. The Paleocene age Cedar Keys Formation with evaporitic gypsum and anhydrite forms the lower boundary of the FAS (Miller, 1986).

The FAS consists of thin, discrete, highly permeable, water bearing horizons interspersed within thick, low permeable units. Relatively impermeable high magnesium limestones and dolostones form a middle confining unit that subdivides the aquifer system into an upper and lower aquifer (Miller, 1986). The top of the FAS, as defined by the Southeastern Geological Society AdHoc Committee on Florida Hydrostratigraphic Unit Definition (1986), coincides with the top of the vertically continuous permeable carbonate sequence. The top of the upper FAS is not stratigraphically controlled and may occur within various stratigraphic units ranging from the lower Arcadia Formation to the upper

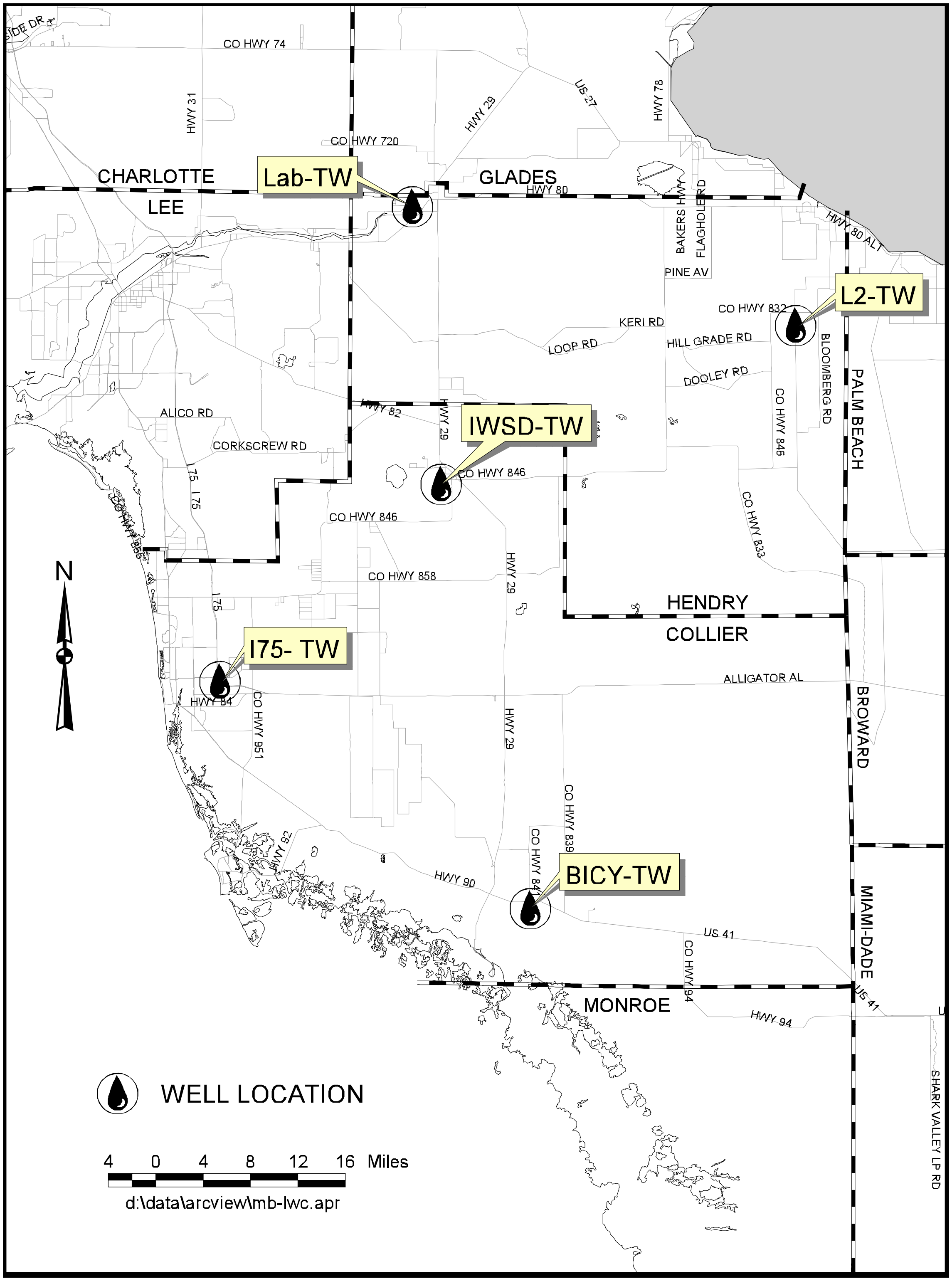

Figure I-1. Location of Floridan Aquifer Test Wells.

portion of the Ocala Group. Based on the above definition, the upper FAS ranges from 670 to 800 feet below land surface at the five locations.

Both mud rotary and reverse-air techniques were employed during drilling operations. Mud rotary drilling was used to advance the bore hole through the unconsolidated to semiconsolidated sediments of the Surficial and Intermediate aquifer systems. Reverse air drilling was used to advance the pilot hole through the FAS. This method provides better lithologic samples, reduces the potential for formation damage by invading drilling fluids, and provides a drilling method that can be continued through potential zones of high permeabilities (e.g., lost circulation). Upon completion of each stage of pilot hole drilling operations, geophysical logs were run in the open hole section of the well bore.

Data from formation samples, packer tests, and geophysical logs were used to select the open hole section for long-term monitoring and further aquifer testing and to determine the actual casing setting depths. The pilot hole was then reamed to specified diameters for the selected casing setting.

Various diameter concentric steel casings ranging in diameter from 4 to 24 inches were used in the construction of both the multihorizon monitor and test production wells. Small diameter fiberglass casing was used in the construction of the lower FAS monitor wells due to the corrosive nature of the formation waters. **Figures I-2** through **I-6** show well construction details of the multihorizon FAS monitor wells.

Geologic formation samples were collected, washed, and described during the drilling of the pilot hole. Formation samples were collected continuously and separated based on their dominant lithologic or textural characteristics and, to a lesser extent, color. Representative formation samples were split into two sets and distributed to the District and the Florida Geological Survey (FGS). Well cuttings were described in detail by the Florida Geological Survey and incorporated into their statewide database. Lithologic columns were constructed using the District's on-site drilling log and lithologic descriptions provided by the FGS. A copy of the FGS's detailed lithologic descriptions for each pilot hole/monitor well (identified by the FGS generated reference number) can be obtained from their Internet web site: www.dep.state.fl.us/geo/data/litholog.htm. **Figures I-7** through **I-11** summarize the lithology, geologic units, and hydrogeologic units identified at each of the five locations.

Geophysical logs were run in the pilot hole after each stage of drilling. These logs were run to provide a continuous record that can be interpreted to provide the physical properties of the subsurface formations and the contained fluids. Logs were also used to assist in the interpretation of lithology, to quantify permeability, porosity, bulk density, and resistivity of the aquifer, and to identify chemical characteristics of the ground water. The extent and degree of confinement of confining intervals can also be discerned from the individual logs. Geophysical logging companies (e.g., Western-Atlas) provided specialty logging services using more technologically advanced bore hole and data processing equipment. All geophysical log data were downloaded directly from the on-site logging processor. The District and local nonspecialty logging firms provided supplemental

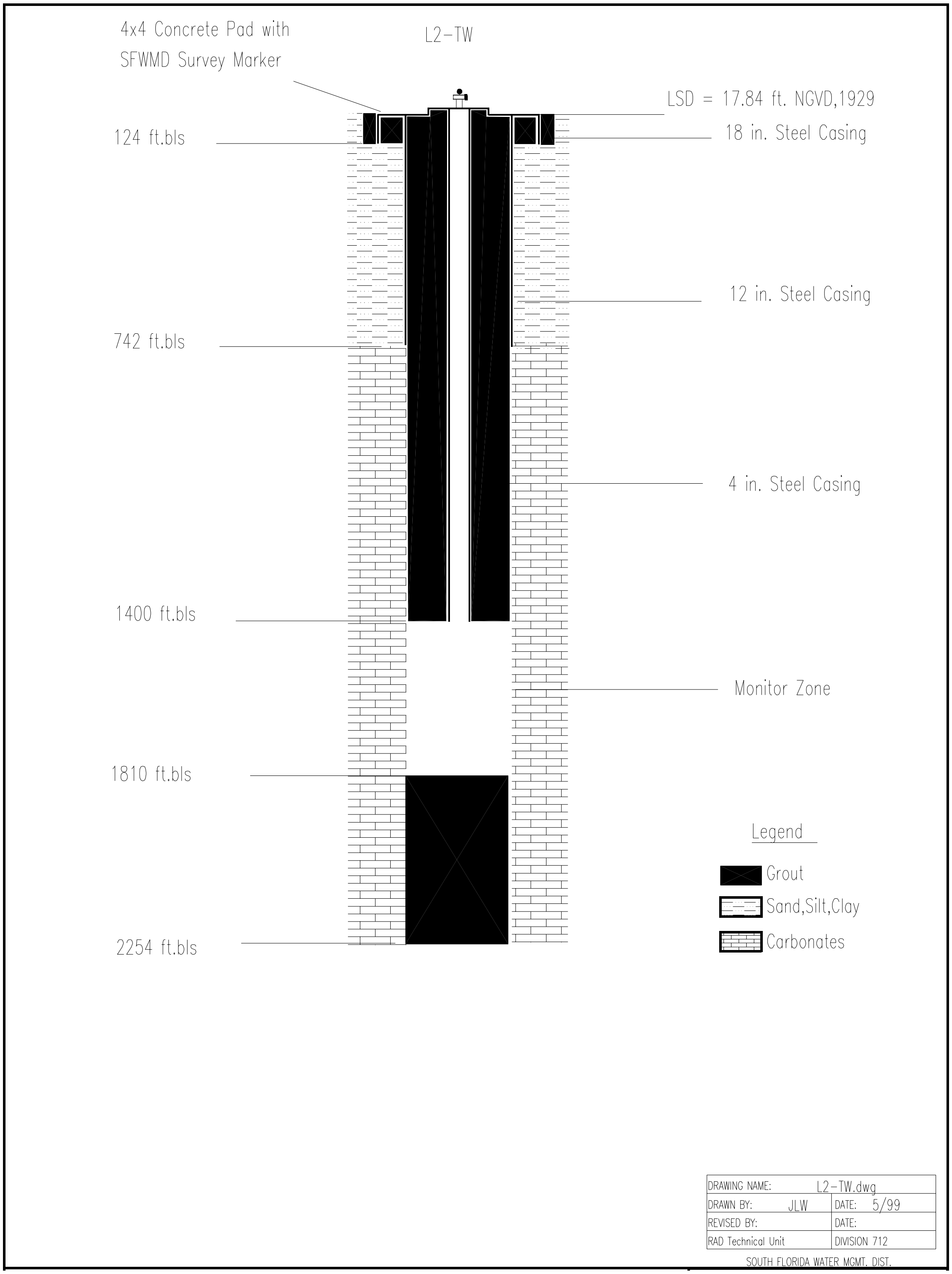

Figure I-2. L-2 Canal Single Zone Monitor Well.

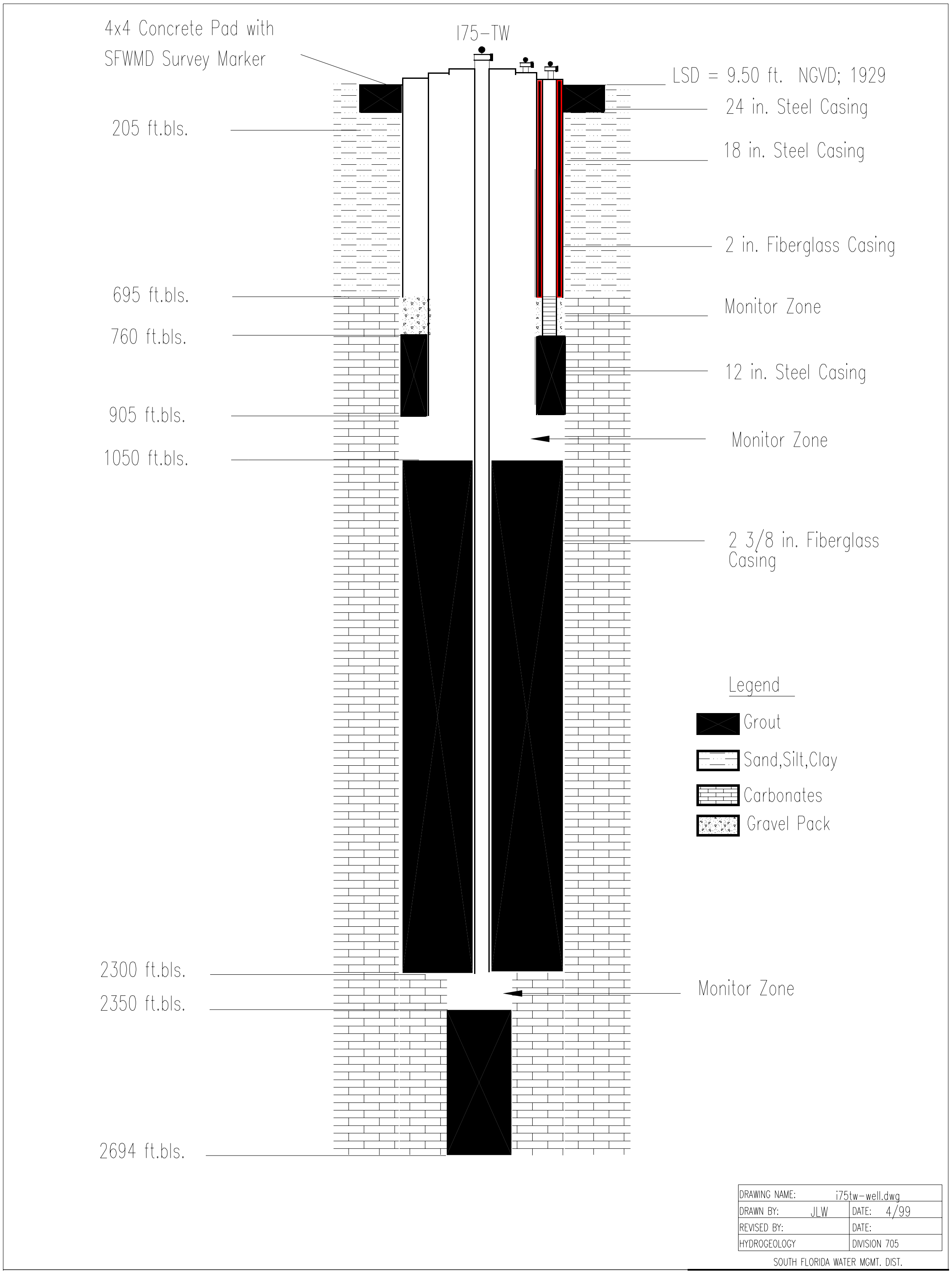

Figure I-3. I-75 Canal Tri-Zone Monitor Well.

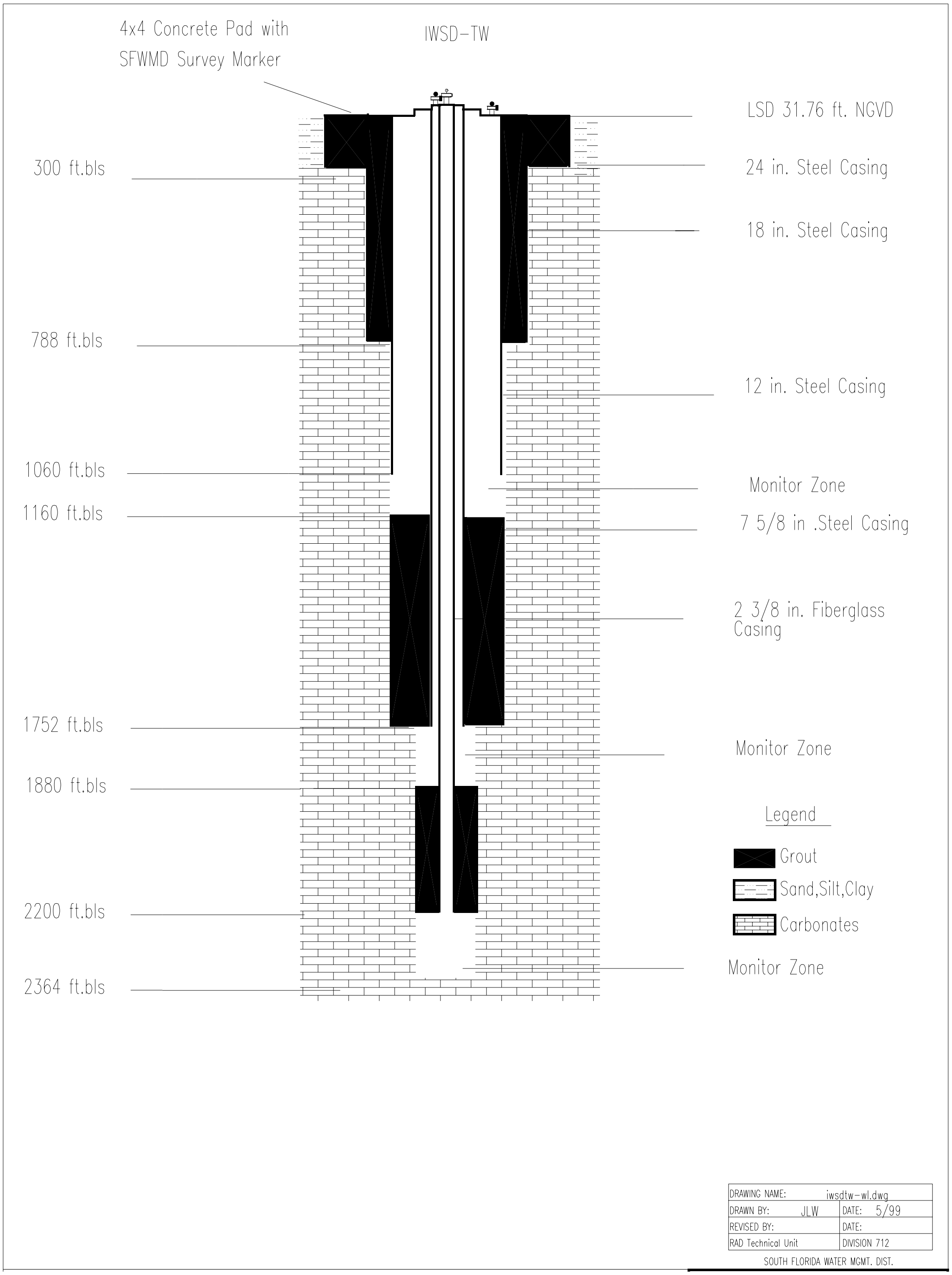

Figure I-4. IWSD Tri-Zone Monitor Well.

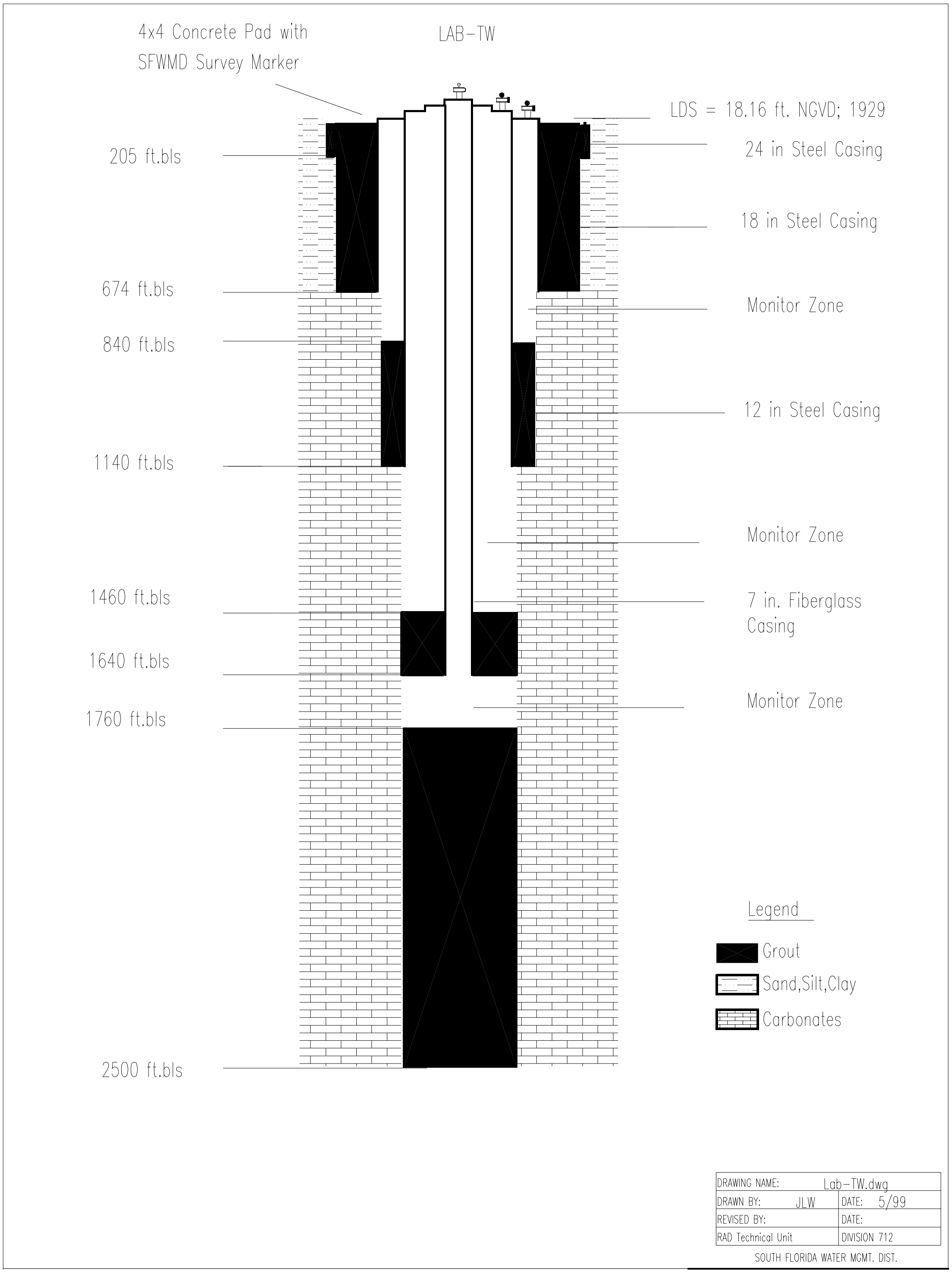

Figure I-5. LaBelle Tri-Zone Monitor Zone.

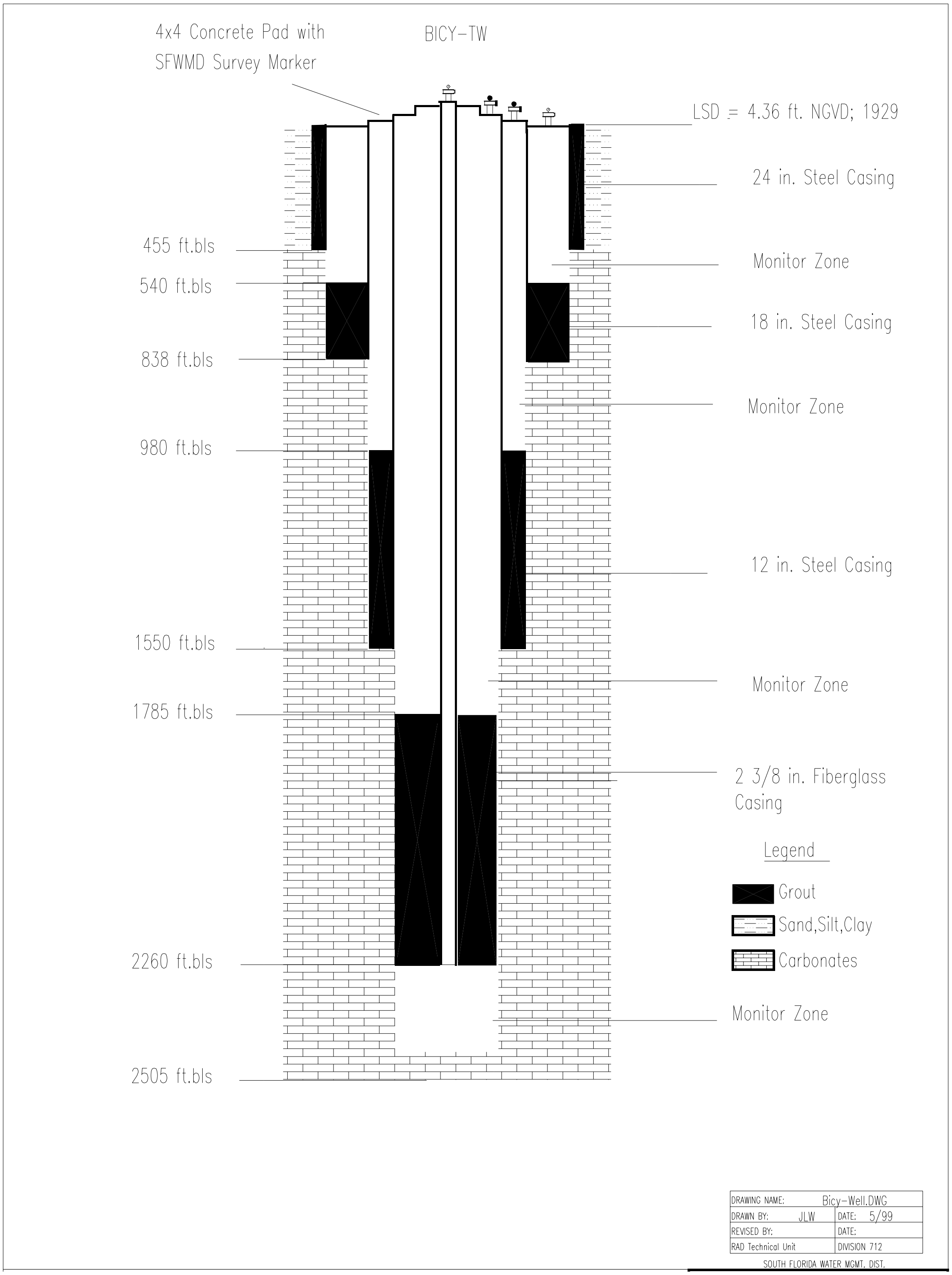

Figure I-6. BICY Preserve Quad-Zone Monitor Well.

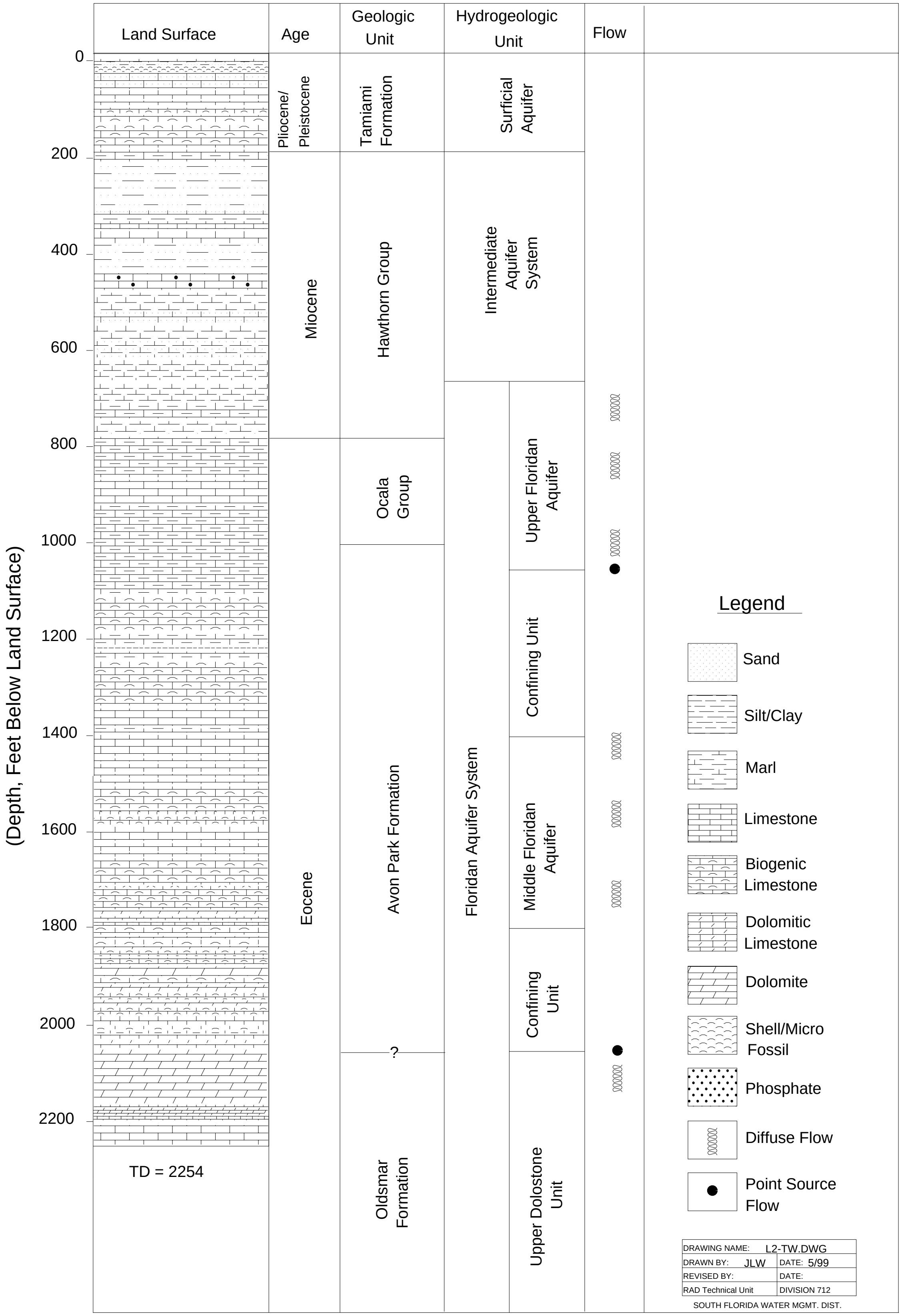

Figure I-7. Generalized Hydrogeologic Column for L2-TW.

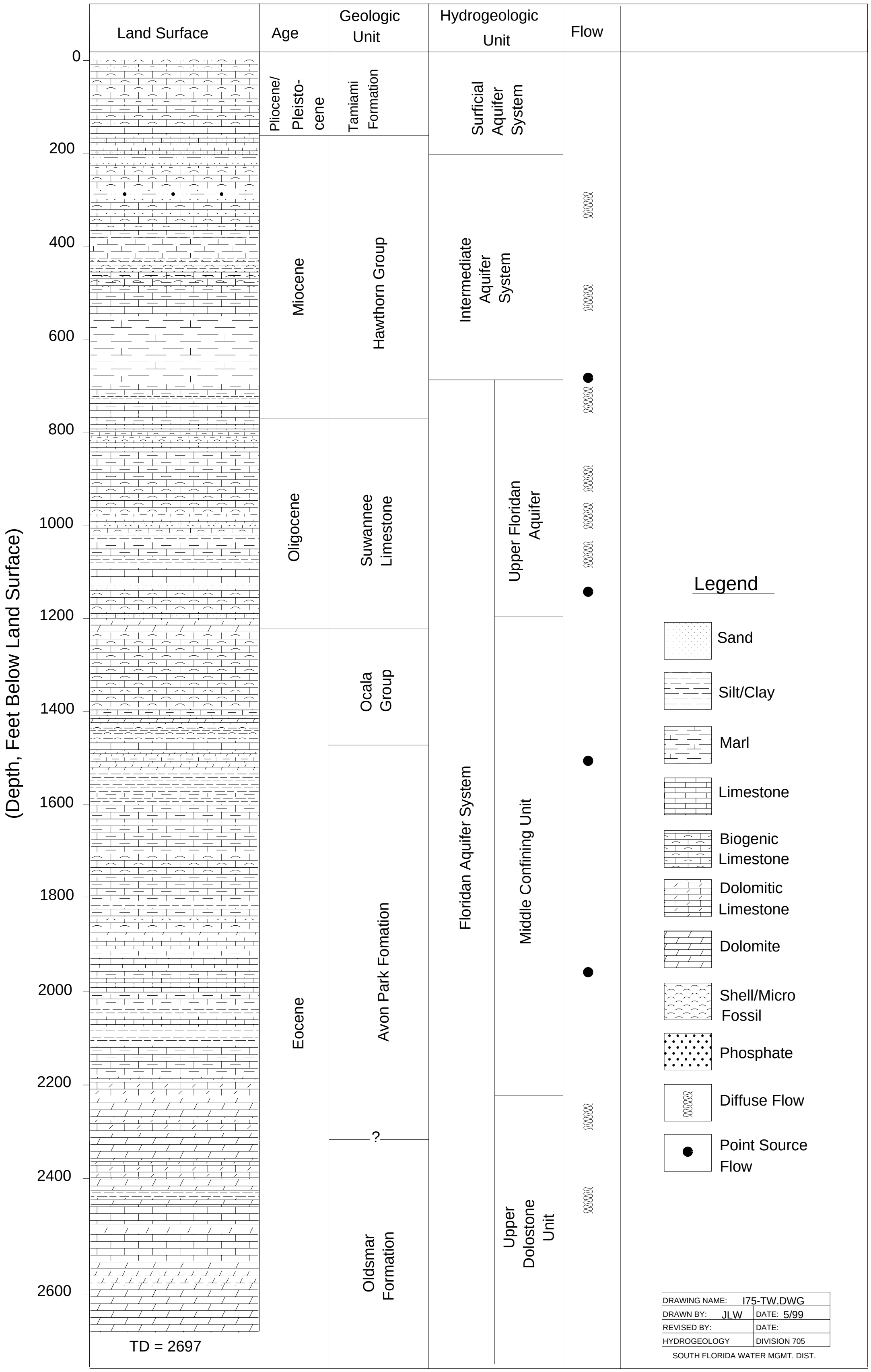

Figure I-8. Generalized Hydrogeologic Column for I-75-TW.

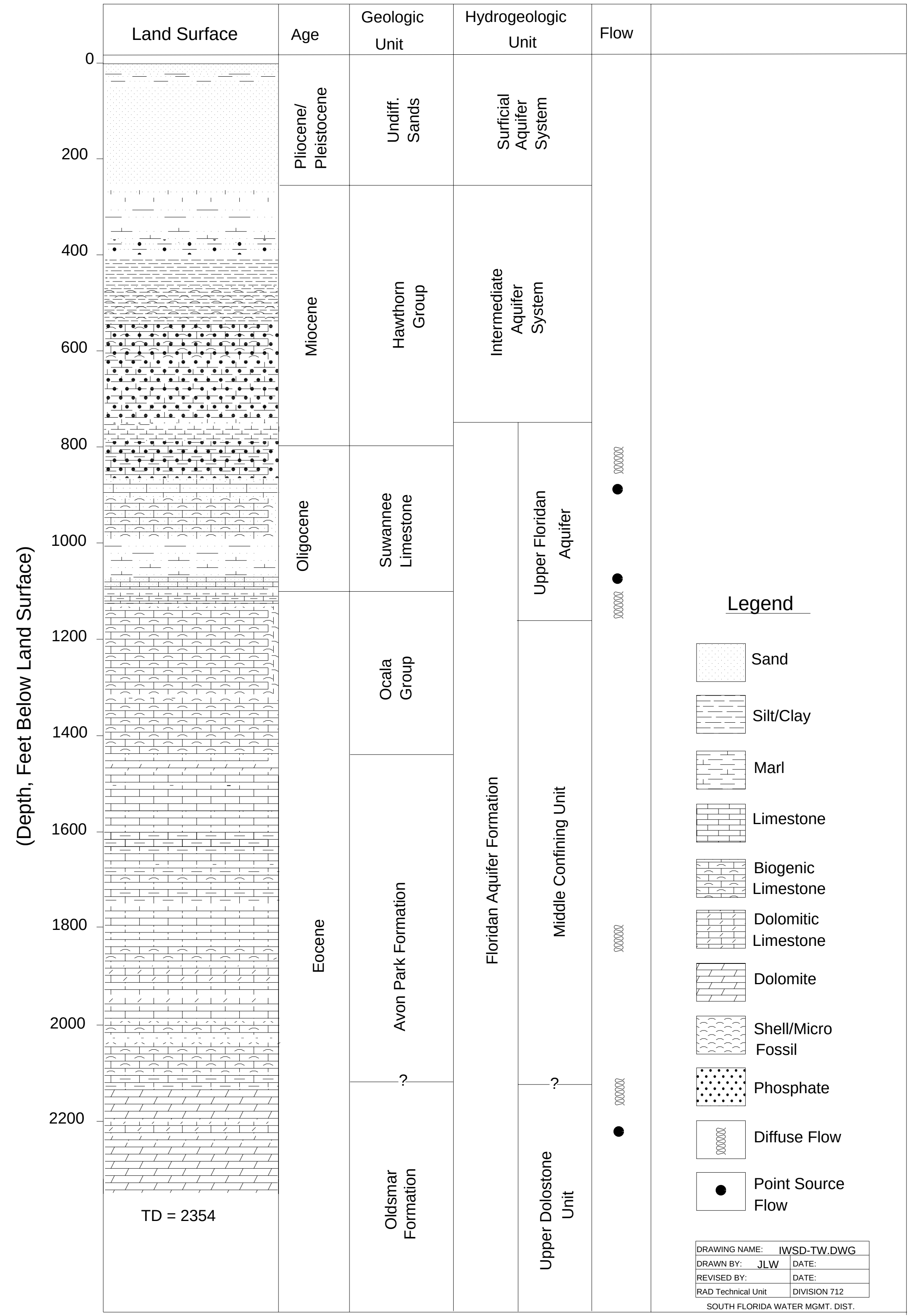

Figure I-9. Generalized Hydrogeologic Column for IWSD-TW.

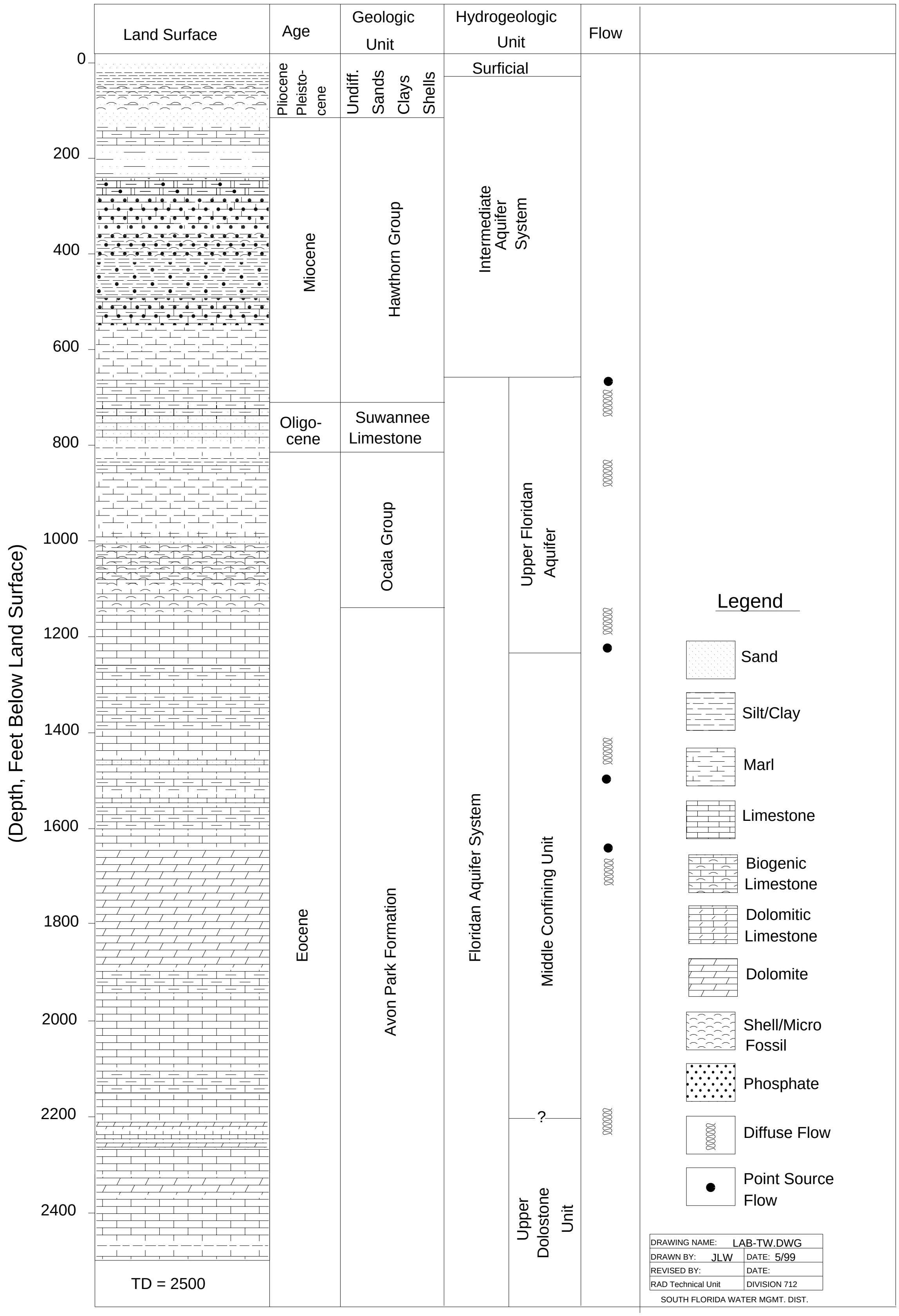

Figure I-10. Generalized Hydrogeologic Column for LAB-TW.

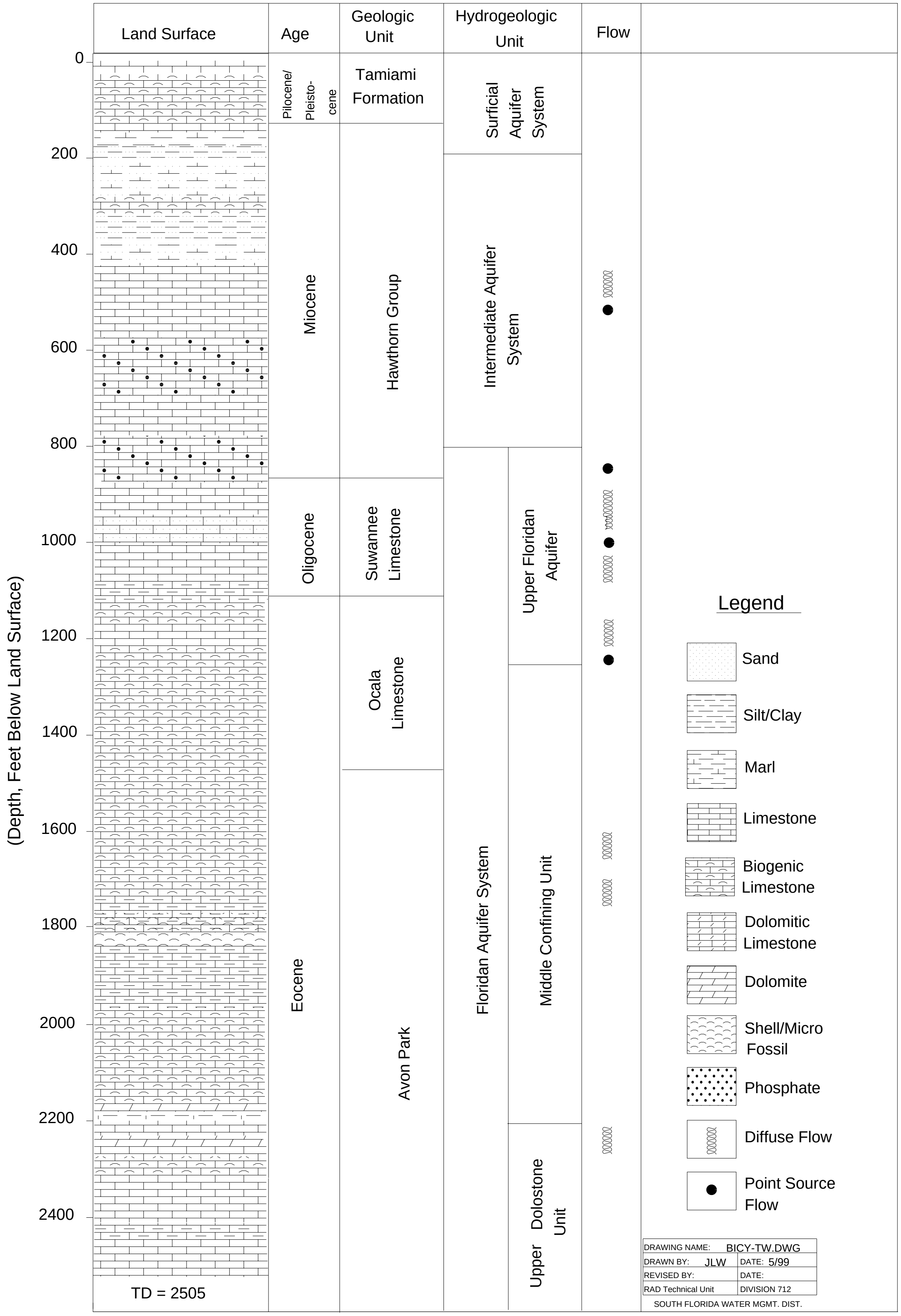

Figure I-11. Generalized Hydrogeologic Column for BICY-TW.

geophysical logging services. A summary of the geophysical logging program for each site is listed in **Table I-1**.

Table I-1. Summary of Geophysical Log Suites.

Site Name	SFWMD Geophy-Log #	Date	Run #	Logging Company	Elevation (ft., NGVD)	Logged Interval (ft.) bls	Caliper	Natural Gamma	SP	Res. SP/16"/64"	Res. Lateral	Induction	Density	Neutron	Sonic	Flow-Meter	Temp	Fluid Res.	Video
L-2 Canal	051-0000019	12/30/93	1	Florida Geophysical	17.35	120-742	x	x	x			x	x	x	x				
		1/28/94	2	Florida Geophysical		700-2236	x	x	x			x	x	x	x	x	x		
		2/25/94	3	Florida Geophysical		720-2210	x									x	x		x
I-75 Canal	021-0000066	8/27/94	1	SFWMD	9.87	490-922'	x	x	x	x	x			x		x	x	x	
		10/13/94	2	SFWMD		490-1360	x	x	x	x	x					x	x	x	x
		12/13/94	3	Florida Geophy.		875-2371	x	x	x			x	x	x	x	x	x		x
Immokalee Water & Sewer District	021-0000090	11/10/95	1	RST Enterprises	31.67	300-850	x	x	x	x	x								
		12/7/99	2	RST Enterprises		780-1270	x	x	x	x	x								
		1/25/96	3	Florida Geophysical		1020-2354	x	x	x			x		x	x	x	x		x
LaBelle	051-0000031	3/6/97	1	Western-Atlas	18.16	204-1100	x	x	x			x	x	x	x	x	x		
		3/25/97	2	Western-Atlas		678-2501	x	x	x			x	x	x	x	x	x		x
BICY Preserve	021-0000103	11/24/97	1	Western-Atlas	4.01	452-1500	x	x	x			x	x	x	x	x	x	x	
		1/23/98	2	Western-Atlas		700-2500	x	x	x			x	x	x	x	x	x	x	x

Straddle-packer pumping tests were performed to characterize the water quality of discrete horizons within the FAS. Intervals having total dissolved solids (TDS) content greater than 10,000 mg/l were not considered for further aquifer hydraulic characterization or long-term monitoring. Formation waters with TDS concentrations greater then 10,000 mg/l are not considered potential sources of drinking water (USEPA). **Table I-2** summarizes the water quality data of tested intervals. Based on the water quality data from the five locations, upper Floridan waters are nonpotable. Generally, water quality degrades with increasing depth and from east to west as the water moves along the flow path toward the Gulf of Mexico.

Table I-2. Water Quality Data from Floridan Aquifer System Wells.

Identifier	Depth Interval (ft. bls)	Sample Date	Na (mg/l)	K (mg/l)	Ca (mg/l)	Mg (mg/l)	Cl (mg/l)	Br (mg/l)	ALKA (mg/l)	HCO3 (mg/l)	SO4 (mg/l)	Fl (mg/l)	TDS (mg/l)	Conductance (umhos/cm)	Temp ^{o}C	pH (S.U.)	Total Cation	Total Anion	%Error
L-2 Canal Drill Site (Hendry County)																			
L2-TW[a]	1266-1284	02/07/94	307.0	15.9	72.5	71.1	490.7	ND[b]	90.7	110.6	365.9	ND	1370	2240	27.30	7.00	23.23	23.27	-0.10%
L2-TW	1442-1494	02/09/94	257.0	11.8	77.5	70.5	444.7	ND	90.1	109.9	321.6	ND	1370	2230	26.40	7.10	21.15	21.04	0.26%
L2-TW	1400-1810	01/10/97	366.0	17.0	88.3	88.8	755.0	2.2	91.5	111.6	347.2	0.846	1900	3371	27.35	7.51	28.75	30.43	-2.84%
L2-TW	1652-1704	02/09/04	535.0	23.6	101.0	103.9	881.6	ND	91.4	111.5	439.4	ND	2160	3400	25.40	7.10	37.47	35.84	2.21%
L2-TW	1890-1908	02/04/94	1615.0	46.3	204.0	224.2	3083.8	ND	95.6	116.6	424.0	ND	5550	9990	25.60	7.30	100.07	97.73	1.18%
L2-TW	2072-2124	02/01/94	5910.0	197.4	476.0	678.0	10734.0	ND	101.7	124.0	1358.8	ND	19100	30800	26.00	7.00	341.68	333.13	1.27%
I-75 Canal Drill Site (Collier County)																			
I75-TW	495-550	09/19/94	1035.0	39.5	140.0	170.0	1630.0	ND	195.0	237.8	532.0	1.990	3640	6230	28.62	7.01	67.25	61.06	4.82%
I75-TW	654-710	09/20/94	1092.0	40.5	190.0	171.0	1754.0	ND	160.0	195.1	558.0	1.040	3890	7150	28.29	7.18	72.47	64.35	5.93%
I75-TW	695-760	04/13/95	902.0	36.7	157.0	152.0	1529.0	ND	174.0	212.1	486.0	1.200	3410	5790	28.90	7.90	60.78	56.79	3.39%
I75-PW	690-780	11/26/96	1060.0	42.9	169.0	157.0	1848.0	ND	151.8	185.1	562.0	0.840	3910	6690	28.39	7.01	68.93	66.91	1.49%
I75-TW	905-1050	04/13/95	1820.0	65.3	246.0	263.0	3558.0	ND	159.0	193.9	630.0	0.906	6750	11560	29.23	7.11	115.04	116.71	-0.72%
I75-PW	890-1040	01/23/97	2080.0	80.4	274.0	304.0	4020.8	14.0	160.9	196.2	665.3	1.010	6900	12410	29.67	7.02	131.76	130.72	0.40%
I75-TW	1158-1185	12/30/94	6050.0	200.0	400.0	638.0	10151.0	36.0	165.0	201.2	1336.0	0.787	17600	25390	29.67	6.89	341.38	317.96	3.55%
I75-TW	1287-1318	01/25/94	9780.0	321.0	491.0	994.0	14330.0	55.0	153.6	187.3	1745.0	0.771	27300	35650	29.42	6.91	540.84	444.38	9.79%
I75-TW	1469-1524	12/21/94	11460.0	432.0	620.0	1368.0	19037.0	70.0	110.0	134.1	2259.0	0.414	35100	45050	30.00	6.84	653.20	587.16	5.32%
I75-TW	1851-1901	12/20/94	11260.0	418.0	600.0	1334.0	19281.0	72.0	108.0	131.7	2136.0	0.469	34900	45080	30.16	6.81	640.35	591.47	3.97%
I75-TW	2195-2251	12/19/94	11520.0	428.0	620.0	1354.0	19262.0	72.0	108.0	131.7	2511.0	0.478	34600	46610	29.56	6.91	654.56	598.74	4.45%
I75-TW	2300-2350	04/13/95	11200.0	407.0	533.0	1235.0	19398.0	ND	105.5	128.6	2531.0	0.490	35700	46360	30.66	7.21	625.96	602.05	1.95%
I75-TW	2300-2350	12/13/96	10200.0	454.0	482.0	1124.0	20068.0	100.0	94.0	114.6	2800.0	0.424	34900	52901	30.24	7.62	572.08	627.57	-4.63%
Immokalee Water & Sewer District Drill Site (IWSD) (Collier County)																			
IWSD-PW[c]	1060-1140	02/05/97	579.0	26.6	138.8	122.0	1103.0	4.5	110.9	135.2	483.3	0.996	2830	4980	29.45	7.42	43.23	43.50	-0.32%
IWSD-TW	1070-1165	06/25/96	635.9	30.7	129.3	111.0	1172.8	3.7	111.6	136.1	636.0	1.040	2750	4810	31.14	7.53	44.39	48.66	-4.58%
IWSD-TW	1700-1774	02/26/96	783.9	44.3	136.6	129.4	1162.2	3.5	115.4	140.7	616.0	1.370	3090	5000	30.33	7.45	53.23	48.03	5.13%
IWSD-TW	1752-1880	06/25/96	873.2	41.8	167.4	160.2	1697.0	5.2	117.0	142.7	704.0	1.270	3980	6750	31.37	7.98	61.13	65.00	-3.07%

Table I-2. (Continued) Water Quality Data from Floridan Aquifer System Wells.

Identifier	Depth Interval (ft. bls)	Sample Date	Na (mg/l)	K (mg/l)	Ca (mg/l)	Mg (mg/l)	Cl (mg/l)	Br (mg/l)	ALKA (mg/l)	HCO3 (mg/l)	SO4 (mg/l)	Fl (mg/l)	TDS (mg/l)	Conductance (umhos/cm)	Temp ^{o}C	pH (S.U.)	Total Cation	Total Anion	%Error
IWSD-TW	1876-1950	02/22/96	1897.5	102.7	246.5	288.2	3107.0	10.2	112.4	137.0	1032.0	1.330	6570	10700	31.04	7.33	121.81	111.58	4.39%
IWSD-TW	2134-2354	06/25/96	12140.0	459.0	1418.0	1348.0	18155.0	53.0	112.9	137.7	4322.0	0.930	35100	50060	30.94	7.68	721.94	605.11	8.80%
LaBelle Drill Site (Hendry County)																			
LAB-TW	490-540	03/11/97	691.0	40.8	66.7	63.8	881.0	1.5	112.9	137.7	426.7	2.200	2270	3880	27.09	7.70	40.11	36.13	5.23%
LAB-TW	850-920	04/01/97	383.0	21.4	91.9	74.2	640.0	2.1	91.1	111.1	376.3	1.060	1680	2810	29.23	7.67	28.58	27.79	1.40%
LAB-TW	670-840	12/10/97	460.0	17.0	92.0	74.0	700.0	1.3	90.0	109.7	350.0	0.810	1800	2777	29.94	7.78	31.76	28.89	4.74%
LAB-PW	670-840	08/14/97	390.0	17.0	78.0	62.0	591.0	ND	86.6	105.6	351.6	0.590	1590	2716	29.50	7.77	27.09	25.75	2.53%
LAB-TW	1145-1270	05/02/97	242.0	18.8	73.7	70.3	429.0	0.2	94.6	115.4	349.2	1.160	1300	2240	30.12	7.65	21.05	21.33	-0.66%
LAB-TW	1140-1460	12/10/97	330.0	16.0	81.0	70.0	500.0	0.9	88.0	107.3	350.0	1.200	1500	2177	30.54	7.69	25.18	23.22	4.04%
LAB-PW	1140-1465	10/09/97	310.0	18.0	75.0	72.0	566.4	ND	83.8	102.2	358.3	1.100	1440	2466	31.17	7.64	24.23	25.17	-1.90%
LAB-TW	1650-1760	12/10/97	5100.0	160.0	450.0	570.0	9900.0	18.0	93.0	113.4	1200.0	0.550	18000	26582	32.83	7.17	296.06	306.38	-1.71%
Big Cypress Preserve Drill Site (BICY) (Collier County)																			
BICY-TW	455-534	12/15/97	1100.0	49.0	120.0	150.0	1850.0	3.5	150.0	182.9	500.0	0.960	4000	6428	25.45	7.46	67.73	65.69	1.53%
BICY-TW	455-540	05/27/98	1080.0	44.6	116.0	140.0	1807.0	3.5	152.8	186.3	505.0	0.990	3800	5976	27.73	7.41	65.69	64.64	0.81%
BICY-TW	838-1000	05/27/98	1550.0	61.4	165.0	195.0	2946.0	ND	139.7	170.3	610.8	0.941	5460	8647	28.02	7.50	94.36	98.66	-2.23%
BICY-TW	1195-1295	12/18/97	2200.0	99.0	170.0	260.0	3600.0	6.6	170.0	207.3	730.0	0.930	7000	11828	26.71	7.46	128.52	120.28	3.31%
BICY-TW	1550-1785	06/05/98	8490.0	268.0	587.0	923.0	15244.2	ND	137.9	168.1	1421.8	1.140	26500	42225	28.69	7.50	482.49	462.46	2.12%
BICY-TW	1790-1910	02/02/98	11000.0	470.0	660.0	1100.0	19000.0	66.0	130.0	158.5	2400.0	0.160	33000	50941	28.32	7.13	614.89	589.39	2.12%
BICY-TW	2260-2500	01/29/98	12000.0	490.0	670.0	1200.0	20000.0	ND	130.0	158.5	2500.0	2.000	34000	51767	26.74	7.28	667.63	618.95	3.78%
BICY-TW	2260-2505	01/28/99	11300.0	400.0	794.0	1180.0	20790.0	ND	190.5	232.3	2479.0	1.120	35800	52647	26.86	6.08	638.50	641.96	-0.27%

a. TW - test well
b. ND - no data
c. PW - production well

Water samples were collected during straddle packer tests and monitor well development. The University of Waterloo provided analytical services for the determination of stable isotope compositions including oxygen, hydrogen, carbon, sulfur, chlorine and apparent carbon-14 age. Isotope background information is presented in **Table I-3**. The information obtained through the acquisition of isotopic data will help to better define the ground water circulation patterns and may identify recharge and discharge areas within the FAS. This information will also help to identify and assist in the mapping of ASR and reverse osmosis (RO) intervals within the upper FAS. Kaufmann and Bennett summarize the results of the FAS isotope study. The stable isotope data are summarized in **Table I-4**.

During the drilling of the test production wells, 4 inch diameter rock cores were recovered from the upper FAS. Conventional coring methods were employed using a 4-inch diameter, 10 to 20 foot long, diamond-tipped core barrel. Core recoveries ranged from 0 to 90 percent. A total of thirty-four oriented cores were sent to Core Laboratories in Midland, Texas to determine horizontal and vertical permeability, porosity, grain density, and lithologic character. The petrophysical data are summarized in **Table I-6**. The abbreviations used in **Table I-6** are explained in **Table I-5**.

The ten multicompleted wells constructed under these two contracts were used to conduct eight aquifer performance tests. These tests were performed to determine aquifer parameters and water quality of distinct horizons within the upper FAS. Type-curve analyses of the displacement data indicate semiconfined conditions for 7 out of 8 of the intervals tested. Transmissivity varies greatly and ranges from 10,960 gals/day/ft to 268,700 gals/day/ft. No single upper Floridan transmissive horizon was correlated among the five locations. The hydraulic character of the Floridan seems to be controlled by localized subsurface conditions. Localized hydraulic characteristics may be a function of the original depositional fabric or duration of subaerial exposure. Flow tends to develop at, or proximal to, formational boundaries, zones within a stratigraphic unit altered by diagenetic factors or near lithologic contacts within a stratigraphic unit. The hydraulic data are summarized in **Table I-7**.

Shortly after the construction of the monitor wells, a monthly potentiometric head monitoring program was established. Pressures recorded at the wellhead are converted to equivalent freshwater head and are added to the measuring point elevation to obtain a potentiometric head elevation referenced to the National Geodetic Vertical Datum (NGVD) of 1929. The long-term potentiometric data from various monitor horizons are summarized by the hydrographs shown in **Figures I-12** through **I-16**. Average upper Floridan potentiometric heads range between 35 feet and 62 feet NGVD with the flow direction to the west-southwest. Potentiometric data for the lower Floridan (upper dolostone unit) is limited but suggests a relatively flat surface (low gradient) with no discernible flow direction.

Table I-3. Isotope Background Information.

Stable Isotopes
Oxygen: The reporting of the stable oxygen ratio in natural water is as follows: Del ^{18}O per mill = $[(R_{Sample} – R_{SMOW})/R_{SMOW}$ x 1000 $^{o}/_{00}$ Where R = $^{18}O/^{16}O$ ratio and SMOW (standard mean ocean water) is the referenced standard.
Hydrogen: The reporting of the hydrogen ratio in natural water is as follows: Del ^{2}H per mil = $[(R_{Sample} – R_{SMOW} / R_{SMOW}]$ x 1000 $^{o}/_{00}$ Where R= $^{2}H/^{1}H$ ratio and SMOW (standard mean ocean water) is the referenced standard.
Chlorine: The reporting of the chlorine ratio in natural water is as follows: Del ^{37}Cl per mill = $[(R_{Sample} – R_{SMOC})/R_{SMOC}]$ x 1000 $^{o}/_{00}$ Where R = $^{37}Cl/^{35}Cl$ ratio and SMOC (standard mean ocean chloride) is the referenced standard.
Sulfur: The reporting of the sulfur ratios in natural water is as follows: Del ^{34}S per mill = $[(R_{Sample} – R_{CDT})/R_{CDT}]$ x 1000 $^{o}/_{00}$ Where R = $^{34}S/^{32}S$ ratio and the standard is the sulfur isotope ratio of reduced sulfur (FeS; Troilite) in the Canyon Diablo meteorite (CDT).
Carbon: The reporting of the carbon ratio in natural water is as follows: Del ^{13}C per mill = $[(R_{Sample} – R_{PDB})/R_{PDB}]$ x 1000 $^{o}/_{00}$ Where R = $^{13}C/^{12}C$ ratio and the standard is the carbon isotope ratio derived from the CO_2 liberated from belemenite of the Coastal Plain Cretaceous Peedee Formation of South Carolina.
Radioisotopes
The activity of “modern carbon” is defined as 95% of the ^{14}C in the 1950 NBS oxalic acid standard Del ^{14}C is defined as the relative difference between the absolute standard activity and the sample activity correct for age. Del $^{14}C = (A_s/A_{abs} – 1)$ *1000 $^{o}/_{00}$ Where A_s is the activity of the sample and A_{abs} is the activity of the standard. The conventional radiocarbon age (C^{14} Age) is calculated in the following manner: t = -8033 ln (A_{sn}/A_{on}) Where A_{sn} is the normalized sample activity and A_{on} is the normalized oxalic acid activity (count rate) Further information concerning radiocarbon dating can be found in Stuiver and Polach (1977), Radiocarbon v.19: pp. 355-363. Information on the Tamer’s method for radiocarbon age corrections can be found in Tamer (1975), Geophysical Surveys v.2 pp. 217-239.

Table I-4. Stable Isotope Data from Florida Aquifer System Wells, Lower West Coast Planning Area.

Identifier	Depth	Sample Date	Del-O18	Del-D	Del-Cl37	Del-C13	Del-S34	Del-C14	C-14 Age	Percent Modern Carbon (pmc)	Tamer's Corrected Age
L-2 Canal Drill Site (Hendry County)											
L2-TW[a]	1400-1810	01/10/97	-1.56	-8.74	-0.16	-2.89	22.24	-980	-31250	2.03	-28706
I-75 Canal Drill Site (Collier County)											
I75-TW	695-760	04/13/95	-1.05	-6.51	0.11	-3.97	23.08				
I75-PW[b]	690-780	11/26/96				-4.24		-993	-40130	0.67	-38742
I75-TW	905-1050	04/13/95	-1.05	-6.45	0.24	-2.64	21.99				
I75-TW	1158-1185	12/30/94	0.57	2.61	0.19	-1.87	20.44				
I75-TW	1287-1318	01/25/94	0.10	5.27	-0.06	-1.43	20.22				
I75-TW	1469-1524	12/21/94	0.67	2.97	0.15	-1.42	20.81				
I75-TW	1851-1901	12/20/94	0.54	4.28	-0.01	-1.59	20.86				
I75-TW	2195-2251	12/19/94	0.60	2.46	0.19	-1.35	20.86				
I75-TW	2300-2350	04/13/95	0.65	1.16	0.01	-1.78	21.11		-13429	19.70	-14318
I75-TW	2300-2350	12/13/96				-2.44		-809	-13267	19.07	
Immokalee Water & Sewer District Drill Site (IWSD) (Collier County)											
IWSD-TW	1065-1165	06/25/96	-1.69	-4.72	0.00	-2.72	21.32	-988	-36080	1.11	-33872
IWSD-TW	1700-1774	02/26/96	-1.44	-6.04	-0.27	-1.62	21.16				
IWSD-TW	1700-1880	06/25/96	-1.61	-2.38	0.14	-2.58	21.44				
IWSD-TW	1876-1950	02/22/96	-1.35	-6.42	-0.14	-1.13	20.80				
IWSD-TW	2100-2354	06/25/96	0.12	3.72	0.01	-2.88	20.78	-949	-24150	4.92	-21335
LaBelle Drill Site (Hendry County)											
LAB-TW	490-540	03/11/97	-1.47	-7.91	0.01	-3.98	21.64	-986	-34140	1.42	-33380
LAB-TW	670-840	12/10/97	-1.70	-8.07	-0.07	-3.60	21.75	-934	-40910	0.61	
LAB-TW	1145-1270	05/02/97	-1.49	-7.34	-0.23	-1.55	22.25	-993	-39250	0.75	-37014
LAB-TW	1140-1460	12/10/97	-1.68	-15.33	-0.12	-1.39	22.06	-993	-40680	0.63	
LAB-TW	1650-1720	12/10/97	-0.54	-7.37	0.09	-1.58	20.33	-992	-38690	0.80	
Big Cypress Preserve Drill Site (BICY) (Collier County)											
BICY-TW	455-534	12/15/97	-1.54	-10.71	-0.01	-2.35	22.50	-990	-37650	0.92	
BICY-TW	455-540	05/27/98	-1.52	-7.13	0.08	-3.40	21.50	-979	-31670	1.93	
BICY-TW	838-980	05/27/98	-1.31	-8.65	-0.06	-2.70	23.20	-991	-37730	0.91	
BICY-TW	1195-1295	12/18/97	-1.20	-4.55	-0.26	-2.10	21.45	-995	-43310	0.45	
BICY-TW	1550-1785	06/05/98	0.25	-0.16	0.21	-1.10	20.64	-996	-43340	0.45	
BICY-TW	1790-1910	02/02/98	0.68	1.22	0.05	-1.47	20.30	-997	-46500	0.31	
BICY-TW	2260-2500	01/29/98	0.74	-1.06	-0.13	-2.03	20.30				

a. TW - test well
b. PW - production well

Table I-5. Explanation of Abbreviations Used in the Core Analysis Table (**Table I-6**).

Abbreviation	Description
brec	Breccia
Chlk, chlky	Chalk (-y)
Dol, dol	Dolomite (-ic)
foss	Fossil (iferous)
frg	Fragmented
gry	Gray
hvy	Heavy
lam	Lamina (-ated, -tions)
lim	Limestone
lmy	Limey
lt	Light
min	Mineral
pp	Pin-point (Porosity)
rk frag	Rock Fragments
sl	Slightly
slt, slty	Silt (-y)
sndy	Sandy
tn	Tan
tr	Trace
v	Very

Table I-6. Core Analysis Results.

Core #	Sample #	Depth (ft.) bls	Horizontal Permeability (Kair-md)	Vertical Permeability (Kair-md)	Vertical/ Horizon Ratio	Porosity Helium (%)	Grain Density (g/cm^{3})	Description
L-2 Canal Drill Site (Hendry County)								
1	1	830.4	76.40	65.4	0.856	40.1	2.67	Lim, pp
	2	831.2	72.56	67.0	0.923	39.8	2.66	Lim, pp
	3	832.0	52.03	43.3	0.832	38.0	2.64	Lim, pp, foss
	4	833.4	48.09	29.1	0.605	37.6	2.63	Lim, pp
	5	834.8	21.81	10.9	0.500	36.0	2.64	Lim, pp
	6	835.2	7.15			34.9	2.67	Lim, pp
	7	836.9	77.98	55.7	0.714	39.4	2.67	Lim, pp
	8	837.5	56.23	46.0	0.818	38.4	2.70	Lim, pp
	9	838.4	97.82	91.6	0.936	40.2	2.68	Lim, pp
	10	839.9	114.74	89.1	0.777	39.3	2.66	Lim, pp
Average:			62.5	55.3	0.774	38.4	2.66	
Standard Deviation:			32.6	26.4	0.145	1.8	0.02	
2	11	1020.3	158.46	9.8	0.062	35.7	2.68	Ls, pp, lam
	12	1021.1	68.20	20.3	0.298	35.9	2.70	Lim, sl vug, foss
	13	1022.5	50.67	34.6	0.683	36.1	2.69	Lim, sl vug, foss
	14	1023.5	40.47	23.4	0.578	36.1	2.66	Lim, sl vug, foss
	15	1024.9	21.90	13.6	0.621	34.9	2.67	Lim, sl vug, foss
	16	1025.5	42.29	28.8	0.681	36.4	2.69	Lim, sl vug, foss
	17	1026.6	69.51	29.5	0.424	36.7	2.66	Lim, sl vug, foss
	18	1027.8	51.70	1.6	0.031	20.1	2.71	Lim, sl vug, foss
	19	1028.4	304.21	21.4	0.070	38.1	2.67	Lim, sl vug, foss
	20	1029.2	317.68	9.7	0.031	38.1	2.64	Lim, sl vug, foss
Average:			112.5	19.3	0.348	34.8	2.68	
Standard Deviation:			110.9	10.4	0.283	5.3	0.02	
3	21	1190.3	23.65	16.8	0.710	32.1	2.76	Lim, sl vug, foss
	22	1191.2	70.55	1.5	0.021	41.3	2.78	Lim, sl vug, foss
	23	1192.2	63.67	39.0	0.612	38.7	2.67	Lim, sl vug, foss
	24	1192.9	21.84	13.8	0.632	37.2	2.67	Lim, sl vug, foss
	25	1195.0	37.90	17.6	0.464	37.2	2.69	Lim, pp
	26	1195.8	72.30	3.3	0.046	38.7	2.70	Lim, pp
	27	1196.5	65.01	42.2	0.649	43.5	2.75	Lim, pp
	28	1196.0	169.42	51.6	0.305	42.5	2.74	Lim, pp, lam
	29	1197.0	106.27	12.6	0.119	42.9	2.74	Lim, pp, lam
Average:			70.1	22.0	0.395	39.3	2.72	
Standard Deviation:			45.8	17.8	0.278	3.6	0.04	
4	30	1330.5	33.30	19.3	0.580	28.9	2.76	Lim, pp
	31	1331.3	39.99	28.0	0.700	27.8	2.78	Lim, pp
	32	1332.8	220.91	190.0	0.860	36.6	2.67	Lim, pp
	33	1333.8	108.38	86.8	0.801	33.9	2.67	Lim, pp
	34	1334.8	505.59	165.0	0.326	34.4	2.69	Lim, pp
	35	1335.8	184.22			35.5	2.70	Lim, pp
	36	1336.4	145.83	85.2	0.584	32.3	2.75	Lim, sl vug

Table I-6. (Continued) Core Analysis Results.

Core #	Sample #	Depth (ft.) bls	Horizontal Permeability (Kair-md)	Vertical Permeability (Kair-md)	Vertical/ Horizon Ratio	Porosity Helium (%)	Grain Density (g/cm^3)	Description
	37	1337.8	79.10	47.3	0.598	28.2	2.74	Lim, sl vug
	38	1338.6	66.37	55.6	0.838	27.3	2.72	Lim, sl vug
		Average:	153.7	84.7	0.661	31.7	2.72	
		Standard Deviation:	146.6	62.4	0.177	3.6	0.04	
5	39	1480.5	154.30			39.6	2.70	Lim, pp
	40	1481.5	38.58			30.7	2.70	Lim, pp
	41	1482.5	443.37	310.0	0.699	26.7	2.71	Lim, pp
	42	1483.5	185.16			35.2	2.70	Lim, pp
	43	1484.5	18.96			22.3	2.74	Lim, pp
		Average:	168.1			30.9	2.71	
		Standard Deviation:	169.8			6.8	0.02	
6	44	1580.4	118.00	112.0	0.949	31.8	2.70	Lim, pp
	45	1581.4	108.35	83.6	0.772	29.2	2.70	Lim, pp
	46	1581.9	94.15	66.0	0.701	33.8	2.68	Lim, pp
	47	1583.2	593.02	75.5	0.127	32.7	2.71	Lim, pp
		Average:	228.4	84.3	0.637	31.9	2.70	
		Standard Deviation:	243.3	19.8	0.356	2.0	0.01	
7	48	1630.7	51.90	26.5	0.511	32.0	2.68	Lim, sl vug
	49	1631.2	226.00	43.2	0.191	30.3	2.69	Lim, pp
	50	1632.5	202.00			33.8	2.71	Lim, pp
		Average:	**160.0**	34.9	0.351	32.0	2.69	
		Standard Deviation:	94.4			1.8	0.02	
8	51	1710.3	115.00	45.3	0.394	34.3	2.69	
	52	1710.8	129.96			34.6	2.71	
		Average:	122.5			34.5	2.70	
		Standard Deviation:	10.6			0.2	0.0	
I-75 Canal Drill Site (Collier County)								
1	1	830.4	76.40	65.4	0.856	40.1	2.67	Lim, pp
	2	831.2	72.56	67.0	0.923	39.8	2.66	Lim, pp
	3	832.0	52.03	43.3	0.832	38.0	2.64	Lim, pp, foss
	4	833.4	48.09	29.1	0.605	37.6	2.63	Lim, pp
	5	834.8	21.81	10.9	0.500	36.0	2.64	Lim, pp
	6	835.2	7.15			34.9	2.67	Lim, pp
	7	836.9	77.98	55.7	0.714	39.4	2.67	Lim, pp
	8	837.5	56.23	46.0	0.818	38.4	2.70	Lim, pp
	9	838.4	97.82	91.6	0.936	40.2	2.68	Lim, pp
	10	839.9	114.74	89.1	0.777	39.3	2.66	Lim, pp
		Average:	62.5	55.3	0.774	38.4	2.66	
		Standard Deviation:	32.6	26.4	0.145	1.8	0.02	
2	11	1020.3	158.46	9.8	0.062	35.7	2.68	Ls, pp, lam
	12	1021.1	68.20	20.3	0.298	35.9	2.70	Lim, sl vug, foss
	13	1022.5	50.67	34.6	0.683	36.1	2.69	Lim, sl vug, foss
	14	1023.5	40.47	23.4	0.578	36.1	2.66	Lim, sl vug, foss
	15	1024.9	21.90	13.6	0.621	34.9	2.67	Lim, sl vug, foss

Table I-6. (Continued) Core Analysis Results.

Core #	Sample #	Depth (ft.) bls	Horizontal Permeability (Kair-md)	Vertical Permeability (Kair-md)	Vertical/ Horizon Ratio	Porosity Helium (%)	Grain Density (g/cm^3)	Description
	16	1025.5	42.29	28.8	0.681	36.4	2.69	Lim, sl vug, foss
	17	1026.6	69.51	29.5	0.424	36.7	2.66	Lim, sl vug, foss
	18	1027.8	51.70	1.6	0.031	20.1	2.71	Lim, sl vug, foss
	19	1028.4	304.21	21.4	0.070	38.1	2.67	Lim, sl vug, foss
	20	1029.2	317.68	9.7	0.031	38.1	2.64	Lim, sl vug, foss
		Average:	112.5	19.3	0.348	34.8	2.68	
		Standard Deviation:	110.9	10.4	0.283	5.3	0.02	
3	21	1190.3	23.65	16.8	0.710	32.1	2.76	Lim, sl vug, foss
	22	1191.2	70.55	1.5	0.021	41.3	2.78	Lim, sl vug, foss
	23	1192.2	63.67	39.0	0.612	38.7	2.67	Lim, sl vug, foss
	24	1192.9	21.84	13.8	0.632	37.2	2.67	Lim, sl vug, foss
	25	1195.0	37.90	17.6	0.464	37.2	2.69	Lim, pp
	26	1195.8	72.30	3.3	0.046	38.7	2.70	Lim, pp
	27	1196.5	65.01	42.2	0.649	43.5	2.75	Lim, pp
	28	1196.0	169.42	51.6	0.305	42.5	2.74	Lim, pp, lam
	29	1197.0	106.27	12.6	0.119	42.9	2.74	Lim, pp, lam
		Average:	70.1	22.0	0.395	39.3	2.72	
		Standard Deviation:	45.8	17.8	0.278	3.6	0.04	
4	30	1330.5	33.30	19.3	0.580	28.9	2.76	Lim, pp
	31	1331.3	39.99	28.0	0.700	27.8	2.78	Lim, pp
	32	1332.8	220.91	190.0	0.860	36.6	2.67	Lim, pp
	33	1333.8	108.38	86.8	0.801	33.9	2.67	Lim, pp
	34	1334.8	505.59	165.0	0.326	34.4	2.69	Lim, pp
	35	1335.8	184.22			35.5	2.70	Lim, pp
	36	1336.4	145.83	85.2	0.584	32.3	2.75	Lim, sl vug
	37	1337.8	79.10	47.3	0.598	28.2	2.74	Lim, sl vug
	38	1338.6	66.37	55.6	0.838	27.3	2.72	Lim, sl vug
		Average:	153.7	84.7	0.661	31.7	2.72	
		Standard Deviation:	146.6	62.4	0.177	3.6	0.04	
5	39	1480.5	154.30			39.6	2.70	Lim, pp
	40	1481.5	38.58			30.7	2.70	Lim, pp
	41	1482.5	443.37	310.0	0.699	26.7	2.71	Lim, pp
	42	1483.5	185.16			35.2	2.70	Lim, pp
	43	1484.5	18.96			22.3	2.74	Lim, pp
		Average:	168.1			30.9	2.71	
		Standard Deviation:	169.8			6.8	0.02	
6	44	1580.4	118.00	112.0	0.949	31.8	2.70	Lim, pp
	45	1581.4	108.35	83.6	0.772	29.2	2.70	Lim, pp
	46	1581.9	94.15	66.0	0.701	33.8	2.68	Lim, pp
	47	1583.2	593.02	75.5	0.127	32.7	2.71	Lim, pp
		Average:	228.4	84.3	0.637	31.9	2.70	
		Standard Deviation:	243.3	19.8	0.356	2.0	0.01	
7	48	1630.7	51.90	26.5	0.511	32.0	2.68	Lim, sl vug
	49	1631.2	226.00	43.2	0.191	30.3	2.69	Lim, pp

Table I-6. (Continued) Core Analysis Results.

Core #	Sample #	Depth (ft.) bls	Horizontal Permeability (Kair-md)	Vertical Permeability (Kair-md)	Vertical/ Horizon Ratio	Porosity Helium (%)	Grain Density (g/cm^3)	Description
	50	1632.5	202.00			33.8	2.71	Lim, pp
		Average:	160.0	34.9	0.351	32.0	2.69	
		Standard Deviation:	94.4			1.8	0.02	
8	51	1710.3	115.00	45.3	0.394	34.3	2.69	
	52	1710.8	129.96			34.6	2.71	
		Average:	122.5			34.5	2.70	
		Standard Deviation:	10.6			0.2	0.0	
IWSD Drill Site (Collier County)								
1	1	882.9	185.42	115.0	0.620	19.5	2.70	Lim, vug
	2	883.7	171.22	97.3	0.568	23.1	2.70	Lim, pp
	3	884.5	76.20	44.8	0.588	22.1	2.69	Lim, pp
	4	885.2	316.00	18.2	0.058	19.8	2.70	Lim, pp
	5	886.4	42.20	37.4	0.886	18.4	2.69	Lim, pp
	6	887.8	52.10	24.5	0.470	19.3	2.70	Lim, sl vug
	7	888.3	69.40	32.1	0.463	23.2	2.70	Lim, sl vug
	8	889.1	1296.00			32.9	2.71	Lim, sl vug
		Average:	276.1	52.8	0.5	22.3	2.7	
		Standard Deviation:	494.57	10.46	0.30	5.35	0.01	
2	9	955.1	240.52			23.7	2.69	Lim, pp
	10	956.3	3744.00			34.7	2.69	Lim, pp
	11	957.0	2046.60	1733.0	0.847	35.0	2.71	Lim, pp
	12	958.4	2492.10			35.1	2.69	Lim, pp
	13	959.5	3523.50			35.4	2.69	Lim, pp
	14	961.0	3902.20			35.9	2.69	Lim, pp
	15	961.6	13507.00			39.1	2.70	Lim, vug
		Average:	4208.0			34.1	2.7	
		Standard Deviation:	4293.51			4.83	0.01	
3	16	1040.9	633.36			25.2	2.70	Lim, pp
	17	1041.5	141.78	1041.0	7.342	25.3	2.68	Lim, pp, foss
	18	1042.7	483.76	301.0	0.622	29.8	2.70	Lim, pp
	19	1043.6	3088.30	1899.0	0.615	31.5	2.74	Lim, pp
	20	1044.2	6132.60	4123.0	0.672	34.7	2.78	Lim, vug, foss
	21	1045.5	3043.10	944.0	0.310	33.0	2.79	Lim, vug, foss
	22	1046.5	3719.96	721.0	0.194	32.4	2.80	Lim, vug, foss
	23	1047.7	3546.40	1955.0	0.551	37.8	2.83	Lim, vug, foss
	24	1048.3	7179.90	1342.0	0.187	36.6	2.82	Lim, vug, foss
	25	1049.2	9539.00	1255.0	0.132	35.0	2.85	Lim, vug, foss
		Average:	3750.8	1509.0	1.2	32.1	2.8	
		Standard Deviation:	3079.22	1112.14	2.32	4.32	0.06	
4	26	1060.8	14720.00			26.3	2.72	Lim, vug, foss
	27	1061.5	10018.00			25.8	2.71	Lim, vug, foss
		Average:	12369.0			26.1	2.7	
5	28	1080.7	1621.10	387.0	0.239	27.7	2.73	Lim, pp
	29	1081.6	12.41	1.2	0.093	22.9	2.71	Lim, sl vug

Table I-6. (Continued) Core Analysis Results.

Core #	Sample #	Depth (ft.) bls	Horizontal Permeability (Kair-md)	Vertical Permeability (Kair-md)	Vertical/ Horizon Ratio	Porosity Helium (%)	Grain Density (g/cm^3)	Description
	30	1082.5	16.90	844.0	49.941	28.8	2.79	Lim, sl vug
	31	1084.0	241.33	9.3	0.039	28.1	2.72	Lim, vug, foss
	32	1085.0	236.98	25.0	0.105	28.7	2.70	Lim, vug, foss
	33	1086.7	34.82	21.9	0.629	26.0	2.71	Lim, sl vug, foss
	34	1087.8	41.04	42.6	1.038	27.0	2.71	Lim, pp
	35	1088.9	280.50			34.2	2.71	Lim, sl vug
		Average:	310.6	190.1	7.4	27.9	2.7	
		Standard Deviation:	541.48	319.39	18.74	3.18	0.03	
6	36	1090.2	106.45			25.7	2.72	Lim, sl vug, foss
	37	1091.4	230.52	158.0	0.685	36.2	2.69	Lim, pp
	38	1092.7	386.75	394.0	1.019	40.7	2.69	Lim, pp
	39	1093.6	182.14	162.0	0.889	39.0	2.69	Lim, pp
	40	1094.5	149.74	146.0	0.975	41.2	2.69	Lim, pp
	41	1095.7	321.69	327.0	1.017	36.5	2.70	Lim, pp
	42	1096.6	270.17	228.0	0.844	26.8	2.70	Lim, pp, foss
	43	1097.5	1581.30			40.2	2.72	Lim, pp, foss
		Average:	403.6	235.8	0.9	35.8	2.7	
		Standard Deviation:	484.55	102.93	0.13	6.17	0.01	
LaBelle Drill Site (Hendry County)								
1	1	725.8	190.49			44.4	2.72	Lim, pp
	2	726.3	2901.33			31.0	2.72	Lim, vug
		Average:	1545.9			37.7	2.7	
2	1	755.4	101.60			33.7	2.72	Lim, vug, foss
	2	755.7	21.70			26.5	2.71	Lim, vug, foss
	3	756.9	236.64			49.0	2.71	Lim, vug, foss
	4	757.8	223.15			48.2	2.72	Lim, vug, foss
	5	758.4	307.57			49.9	2.72	Lim, vug, foss
		Average:	178.1			41.5	2.7	
		Standard Deviation:	114.60			10.69	0.01	
3	1	820.4	660.75			40.7	2.72	Lim, vug
	2	821.4	2224.19			37.8	2.72	Lim, vug, foss
	3	822.0	1309.97			39.8	2.72	Lim, vug
	4	823.0	1962.07			40.3	2.72	Lim, vug
	5	823.5	123.10			37.5	2.72	Lim, vug
	6	824.8	62.33			35.8	2.72	Lim, vug
	7	825.4	266.44			39.4	2.72	Lim, vug
	8	826.2	284.27			51.7	2.71	Lim, vug
		Average:	861.6			40.4	2.7	
		Standard Deviation:	860.30			4.86	0.00	
4	1	1194.4	51.30			28.0	2.72	Lim, vug
	2	1196.2	73.70			30.4	2.72	Lim, foss, vug
	3	1196.7	0.29			11.3	2.80	Lim, sl hvy min, sl vug
		Average:	41.8			23.2	2.7	
		Standard Deviation:	37.62			10.40	0.05	

Table I-6. (Continued) Core Analysis Results.

Core #	Sample #	Depth (ft.) bls	Horizontal Permeability (Kair-md)	Vertical Permeability (Kair-md)	Vertical/ Horizon Ratio	Porosity Helium (%)	Grain Density (g/cm^3)	Description
5	1	1295.7	42.50			24.1	2.72	Lim, vug
	2	1296.5	1.41			18.9	2.80	Lim, sl hvy min, sl vug
	3	1297.3	138.83			28.6	2.75	Lim, vug
	4	1298.0	28.62			31.8	2.72	Lim, vug
	5	1298.7	123.41			34.7	2.71	Lim, vug
		Average:	67.0			27.6	2.7	
		Standard Deviation:	60.66			6.26	0.04	
6	1	1450.7	24.59			26.5	2.71	Lim, sl vug, brec
	2	1451.5	28.59			25.5	2.71	Lim, sl vug, brec
	3	1452.9	2.54			20.0	2.72	Lim, sl vug, brec
	4	1453.7	8.15			25.8	2.72	Lim, sl vug, brec
	5	1454.2	2.10			24.3	2.71	Lim, sl vug, brec
		Average:	13.2			24.4	2.7	
		Standard Deviation:	12.54			2.60	0.01	
BICY Preserve Drill Site (Collier County)								
Sidewall	1	790.0	19.80			25.5	2.71	Lim, pp
	2	790.0	36.50					
	3	790.0	15.20					
	4	790.0	16.40					
	5	790.0	26.90					
		Average:	23.0					
		Standard Deviation:	8.83					
Sidewall	1	1350.0	112.00			40.1	2.71	Lim, pp
	2	1350.0	232.00					
	3	1350.0	221.00					
	4	1350.0	117.00					
	5	1350.0	113.00					
		Average:	159.0					
		Standard Deviation:	61.77					
Sidewall	1	1425.0	50.60			36.3	2.71	Lim, pp
	2	1425.0	70.90					
	3	1425.0	59.80					
	4	1425.0	53.60					
	5	1425.0	78.30					
		Average:	62.6					
		Standard Deviation:	11.71					
Sidewall	1	1500.0	25.50					Lim, pp
	2	1500.0	29.10					
	3	1500.0	30.20					
	4	1500.0	24.50					
	5	1500.0	24.30					
		Average:	26.7					
		Standard Deviation:	2.74					
1	1	850.2	7.17	0.2	0.022	24.4	2.72	Lim, foss, vug

Table I-6. (Continued) Core Analysis Results.

Core #	Sample #	Depth (ft.) bls	Horizontal Permeability (Kair-md)	Vertical Permeability (Kair-md)	Vertical/ Horizon Ratio	Porosity Helium (%)	Grain Density (g/cm^3)	Description
	2	850.5	3.39	0.0	0.012	24.5	2.72	Lim, foss, vug
	3	851.5	0.63	0.2	0.365	18.8	2.73	Lim, foss, vug
	4	853.0	0.98	0.4	0.388	19.7	2.73	Lim, foss, vug
	5	853.9	0.88			27.9	2.75	Lim, foss, chlk, pp
	6	854.3	0.01			6.5	2.85	Dol, foss, sl vug
	7	855.4	0.03			9.7	2.84	Dol, foss, sl vug
		Average:	1.9	0.2	0.2	18.8	2.8	
		Standard Deviation:	2.60	0.14	0.21	7.97	0.06	
2	1	859.3	5.59	1.1	0.197	10.5	2.85	Dol, foss, tr vug
	2	860.1	0.01			7.9	2.83	Dol, foss, lmy vug
	3	861.3	0.03			5.8	2.84	Dol, foss, tr vug
	4	862.5	38.30			13.2	2.84	Dol, foss, sl vug
		Average:	11.0			9.4	2.8	
		Standard Deviation:	18.40			3.21	0.01	
3	1	879.9	164.00			32.0	2.70	Lim, foss, pp
	2	880.3	3415.00			36.3	2.71	Lim, foss, pp
		Average:	1789.5			34.2	2.7	
		Standard Deviation:						
4	1	899.1	712.00			27.4	2.71	Lim,foss, tr slt, sl vug
	2	900.1	492.00			34.4	2.71	Lim,foss, pp
	3	901.1	11069.00			38.4	2.71	Lim, pp, sl vug
		Average:	4091.0			33.4	2.7	
		Standard Deviation:	6044.13			5.57	0.00	
5	1	919.3	76.70			36.4	2.70	Lim, foss, pp
	2	919.8	562.00			45.3	2.70	Lim, foss, pp
	3	920.8	1660.00	294.0	0.177	37.2	2.72	Lim, foss, pp
	4	921.5	4569.00			32.6	2.71	Lim, foss, pp
	5	922.2	1.18			22.1	2.72	Lim, chlky, rk frag
		Average:	1373.8			34.7	2.7	
		Standard Deviation:	1905.05			8.44	0.01	

Table I-7. Summary of Hydraulic Data from the Floridan Aquifer Wells.

Site	APT #	Latitude	Longitude	County	Elevation (ft, NGVD)	Interval (ft.) bls	Aquifer	Date	Duration (min)	Transmissivity (gal/day/ft)	Storativity (unitless)	Leakance (r/b)	Solution	Model
L-2 Canal	1	26 36 30.2E	80 56 58.4N	Hendry	17.35	1400-1810	Avon Park	01/07/97	4395	10,960	1.012E-05	0.053	Moench	Leaky
I-75 Canal	1	26 10 12.0E	81 43 50.8N	Collier	9.87	695-760	Lower-Hawthorn/ Suwannee	11/25/96	3310	126,000	4.370E-05	0.121	Moench	Leaky
I-75 Canal	2	26 10 12.0E	81 43 50.8N	Collier	9.87	890-1050	Suwannee	01/21/97	4375	71,200	1.040E-05	0.192	Moench	Leaky
IWSD	1	26 24 48.2E	81 25 54.2N	Collier	31.67	1060-1160	Suwannee /Ocala	02/04/97	4295	268,700	1.231E-02		Theis	Confined
LaBelle	1	26 45 10.2E	81 28 14.5N	Hendry	18.16	670-840	Lower-Hawthorn/ Suwannee	08/12/97	1120	60,230	3.886E-05	0.091	Moench	Leaky
LaBelle	2	26 45 10.2E	81 28 14.5N	Hendry	18.16	1120-1460	Avon Park	10/10/97	4270	21,330	4.375E-05	0.118	Moench	Leaky
BICY Preserve	1	25 53 35.7E	81 18 33.8N	Collier	4.01	460-540	Mid-Hawthorn	04/13/98	240	505,100	6.800E-05	0.065	Moench	Leaky
BICY Preserve	2	25 53 35.7E	81 18 33.8N	Collier	4.01	870-1010	Suwannee	07/13/98	3000	31,380	5.710E-05	0.271	Hantush-Jacob	Leaky

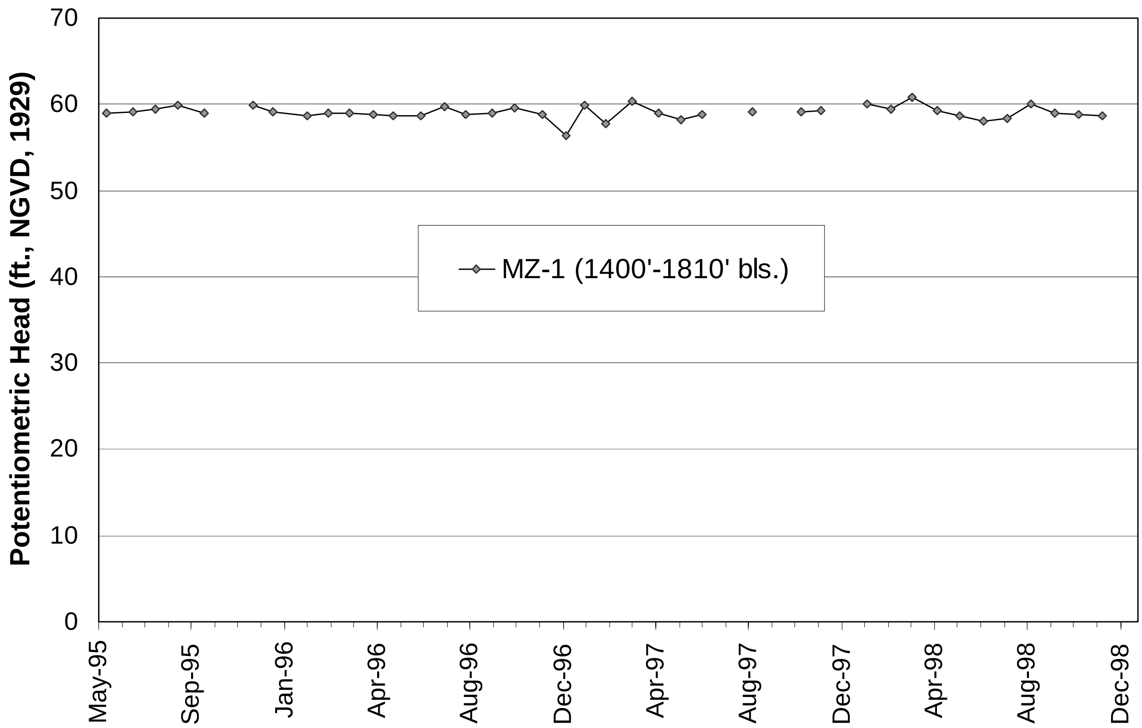

Figure I-12. Potentiometric Head Data from the L-2 Canal Single Zone Floridan Aquifer Monitor Well.

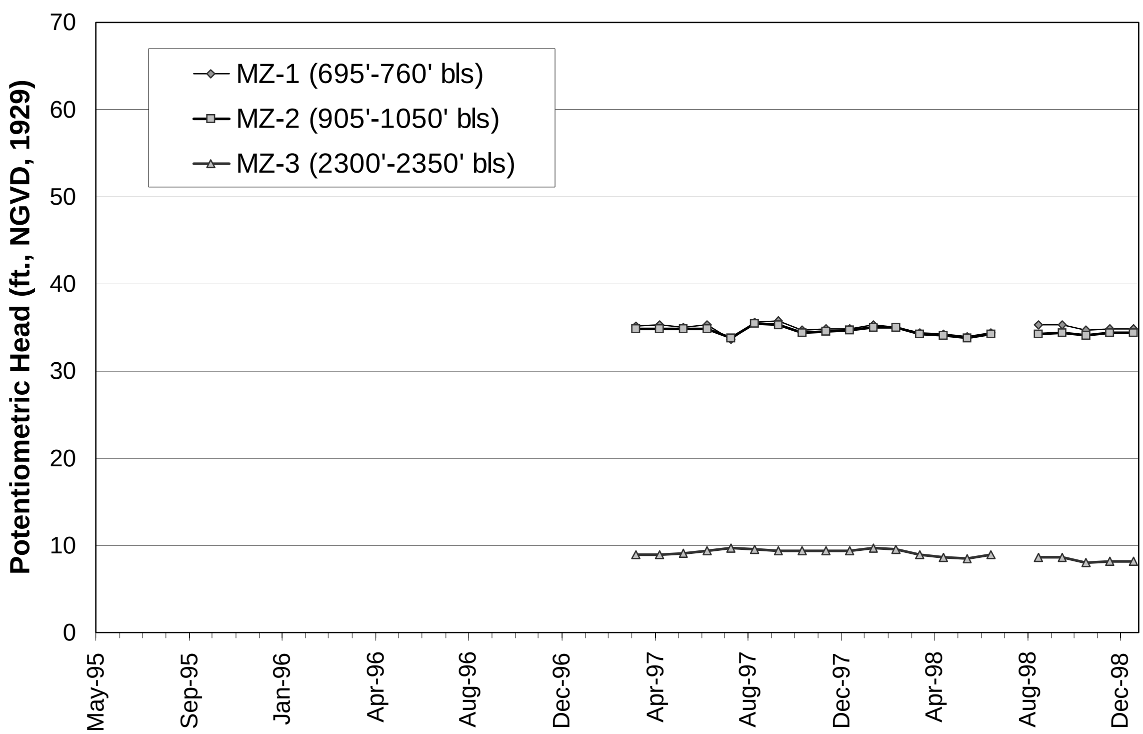

Figure I-13. Potentiometric Head Data from the I-75 Canal Tri-Zone Floridan Aquifer Monitor Well.

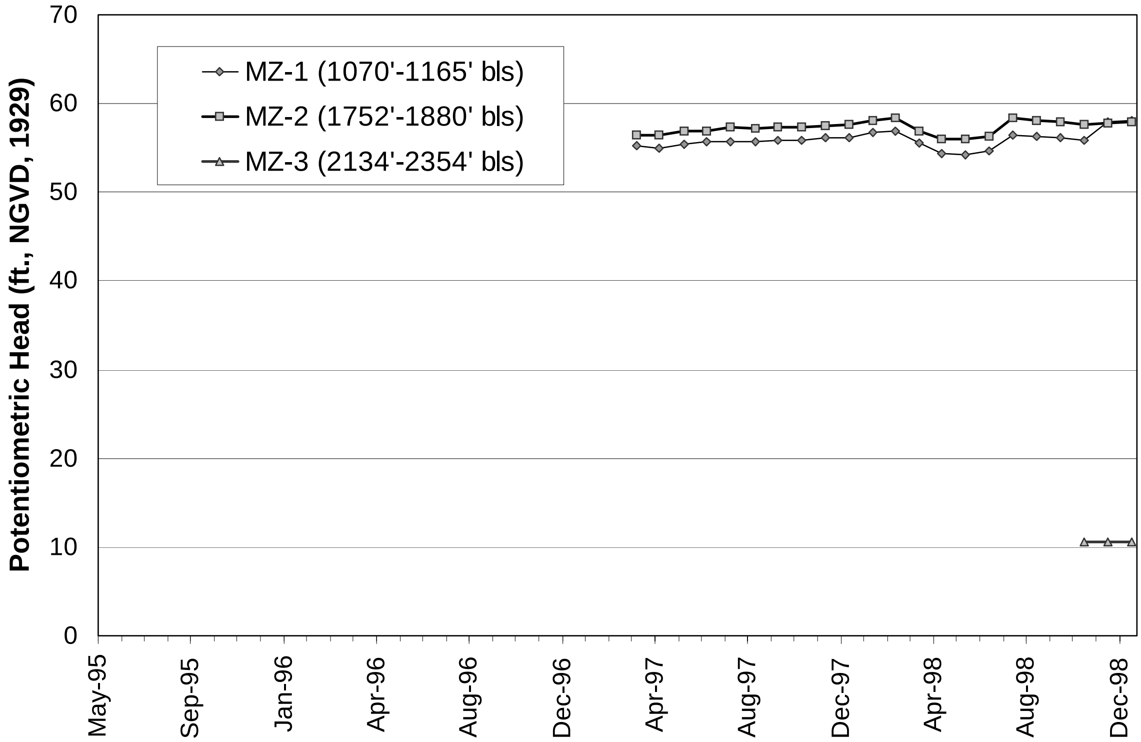

Figure I-14. Potentiometric Head Data from the IWSD Tri-Zone Floridan Aquifer Monitor Well.

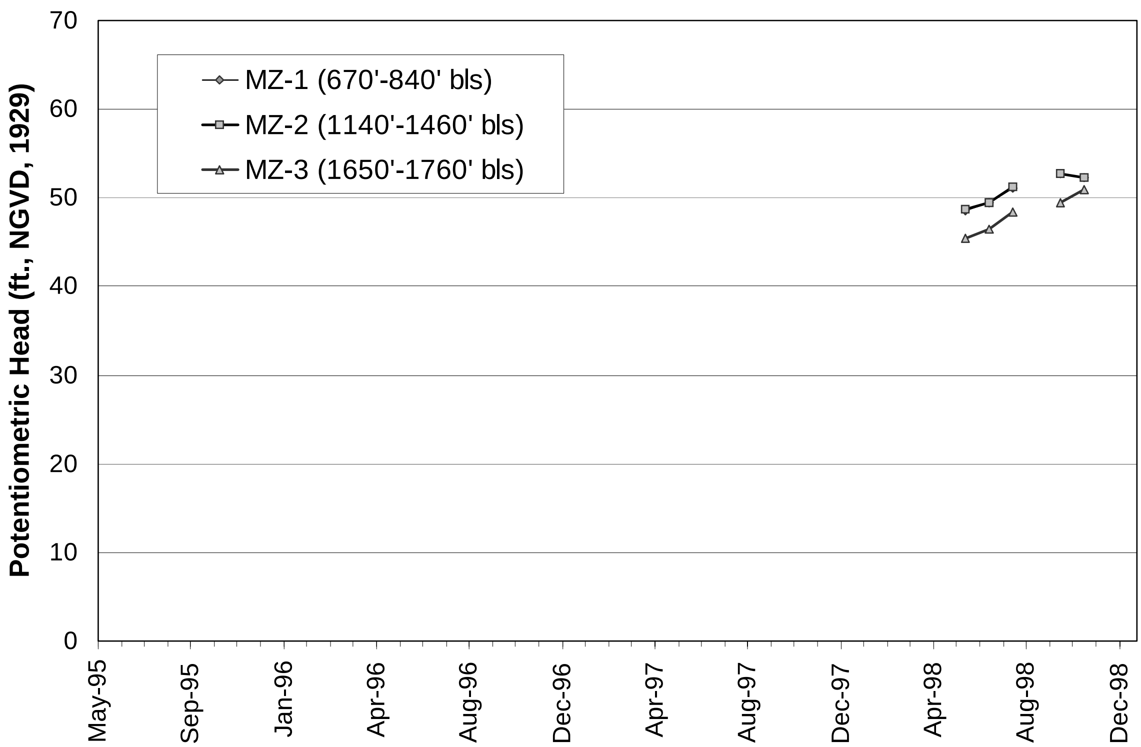

Figure I-15. Potentiometric Head Data from the LaBelle Tri-Zone Floridan Aquifer Monitor Well.

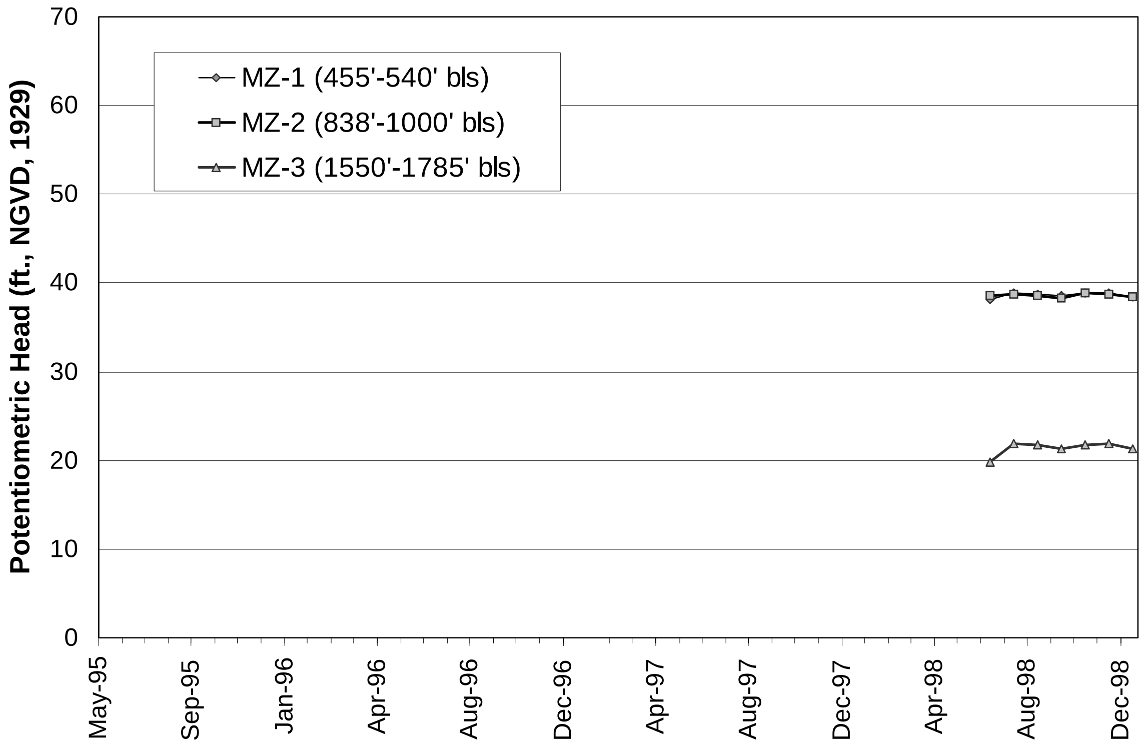

Figure I-16. Potentiometric Head Data from the BICY Preserve Tri-Zone Floridan Aquifer Monitor Well.

REFERENCES CITED

Miller, J. A. 1986. *Hydrogeologic Framework of the Floridan Aquifer System in Florida and in Parts of Georgia, Alabama, and South Carolina*. U.S. Geological Survey Professional Paper 1403-B. U.S. Geological Survey. 91 pp., 33pls.

Southeastern Geological Society Ad Hoc Committee on Florida Hydrostratigraphic Unit Definition. 1986. *Hydrogeologic Units of Florida*. Florida Department of Natural Resources, Bureau of Geology. Special Publication 28. 9 pp.