

Lower East Coast Regional Water Supply Plan

Appendices

Volume 1



prepared by

South Florida Water Management District

May 2000

**Water Supply Planning and
Development Department
West Palm Beach, Florida**

TABLE OF CONTENTS

Appendix A: Selected Passages from the Florida Statutes and Florida Administrative Code **A-1**

Selected Passages from Section 187.201, F.S.	A-3
Selected Passages from Sections 373.016 - 373.62, F.S.....	A-4
Selected Passages from Chapter 62-40, F.A.C.	A-53
Florida Forever Program Legislation.....	A-76

Appendix B: Demand Estimates and Projections **B-1**

Overview	B-3
Percentage of Use	B-5
Urban Water Demand	B-7
Agricultural Water Demand.....	B-18
Total Irrigated Acreage	B-22
Total Average Annual Water Demand	B-23
Public Water Supply Data Sets	B-25
Caloosahatchee Basin Water Demands	B-73
References	B-76

Appendix C: Description of Restudy/Comprehensive Everglades Restoration Plan Components **C-1**

Overview.....	C-7
Lake Okeechobee.....	C-19
Lake Okeechobee Service Area	C-21
Estuaries.....	C-30
Everglades Agricultural Area	C-33
North Palm Beach Service Area	C-37
Lower East Coast Service Area 1	C-41
Lower East Coast Service Area 2	C-50
Lower East Coast Service Area 3	C-53
Water Conservation Areas and Everglades National Park	C-67

Bays	C-79
Florida Keys.....	C-80
Big Cypress Basin.....	C-81
Systemwide	C-84
References	C-85
 Appendix D: Performance Measures Used in the Lower East Coast Water Supply Planning Process	 D-1
Overview.....	D-3
Water Supply Performance Measures.....	D-4
Water Supply Performance Indicators	D-10
Environmental Performance Measures for Natural Areas	D-17
Regional Performance Indicators.....	D-28
References	D-30
 Appendix E: Regional Modeling for the Lower East Coast Regional Water Supply Plan	 E-1
General Description	E-3
Specific Assumptions and Routines Developed for South Florida Water Management Model Version 3.7	E-14
References.....	E-19
 Appendix F: Subregional Ground Water Models for the Lower East Coast Regional Water Supply Plan	 F-1
Overview of Subregional Modeling	F-3
Subregional Models	F-11
References.....	F-57
 Appendix G: Engineering Design and Cost Estimates	 G-1
Capacity	G-3
Cost Estimates.....	G-3
References.....	G-7

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. 373.036¹.

- (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.

¹Note.--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 and shall 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. 373.036¹, 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.

¹Note.--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 Orders¹

- (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.

¹Note.--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 division¹ 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.

¹Note.--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. 373.019¹;
 - (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 watercourses 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.

¹Note.--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)¹Each 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

must² 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.

¹Note.--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.

²Note.--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 permissible 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.

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

²Note.—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 FI 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. (See 259.105(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 costs, 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 surplus 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 permissible 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 and 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

DEMAND ESTIMATES AND PROJECTIONS

OVERVIEW

An important aspect in the development of water supply plans is the development of reliable water demand estimates and projections. The Lower East Coast (LEC) Planning Area includes fast growing urban areas along the east coast and extensive agricultural lands as you move towards the west. Urban and agricultural water demands are estimated and projected by county. The Lower East Coast (LEC) Planning Area includes all of Palm Beach, Broward, and Miami-Dade counties, and portions of Hendry, Monroe, and Collier counties (**Figure B-1**). Collier County water demands are addressed only in the *Lower West Coast Water Supply Plan* (SFWMD, 2000a), because the portion of Collier County within the LEC Planning Area is entirely within the Big Cypress National Preserve. Conversely, the portion of Monroe County within the Lower West Coast (LWC) Planning Area is entirely within Everglades National Park, so all of the Monroe County water demands are addressed within the LEC Planning Area. Only the eastern portion of Hendry County is within the LEC Planning Area, so countywide water demands are adjusted and only the demands for the eastern portion are discussed within this plan.

Demand estimates were made for 1995 and demand projections were made for 2020 for the following water use categories:

- Public Water Supply
- Domestic Self-Supplied
- Commercial and Industrial Self-Supplied
- Recreation Self-Supplied
- Thermoelectric Power Generation Self-Supplied
- Agricultural Self-Supplied

The first five categories are population related demand categories, or urban water uses, and are discussed in the Urban Demand section of this appendix. The category of public water supply refers to all potable water supplied by regional water treatment facilities with pumpage of 0.5 million gallons per day (MGD) or more to all customers, not just residential. The other four categories of urban water use are self-supplied. Commercial and industrial self-supplied refers to operations using over 0.1 MGD. Recreation self-supplied includes landscape and golf course irrigation demand. The landscape subcategory includes water used for parks, cemeteries, and other irrigation applications greater than 0.1 MGD. The golf course subcategory includes those operations not supplied by a public water supply or regional reuse facility. Domestic self-supplied is used to designate those households whose primary source of water is private wells and water treatment facilities with pumpages of less than 0.5 MGD. Thermoelectric self-supplied for power generation includes water used by electric power generating facilities for cooling purposes. The Agricultural Demand section contains the discussion of the agricultural self-supply water use category. Agricultural self-supplied demand includes water used to irrigate crops, to water cattle, and for aquaculture (fish production).

Demand assessments for 1995 and projections for 2020 were obtained from the *Districtwide Water Supply Assessment* (SFWMD, 1998), with the exception of public water supply. The public water supply demands that are dependent on Surficial Aquifer

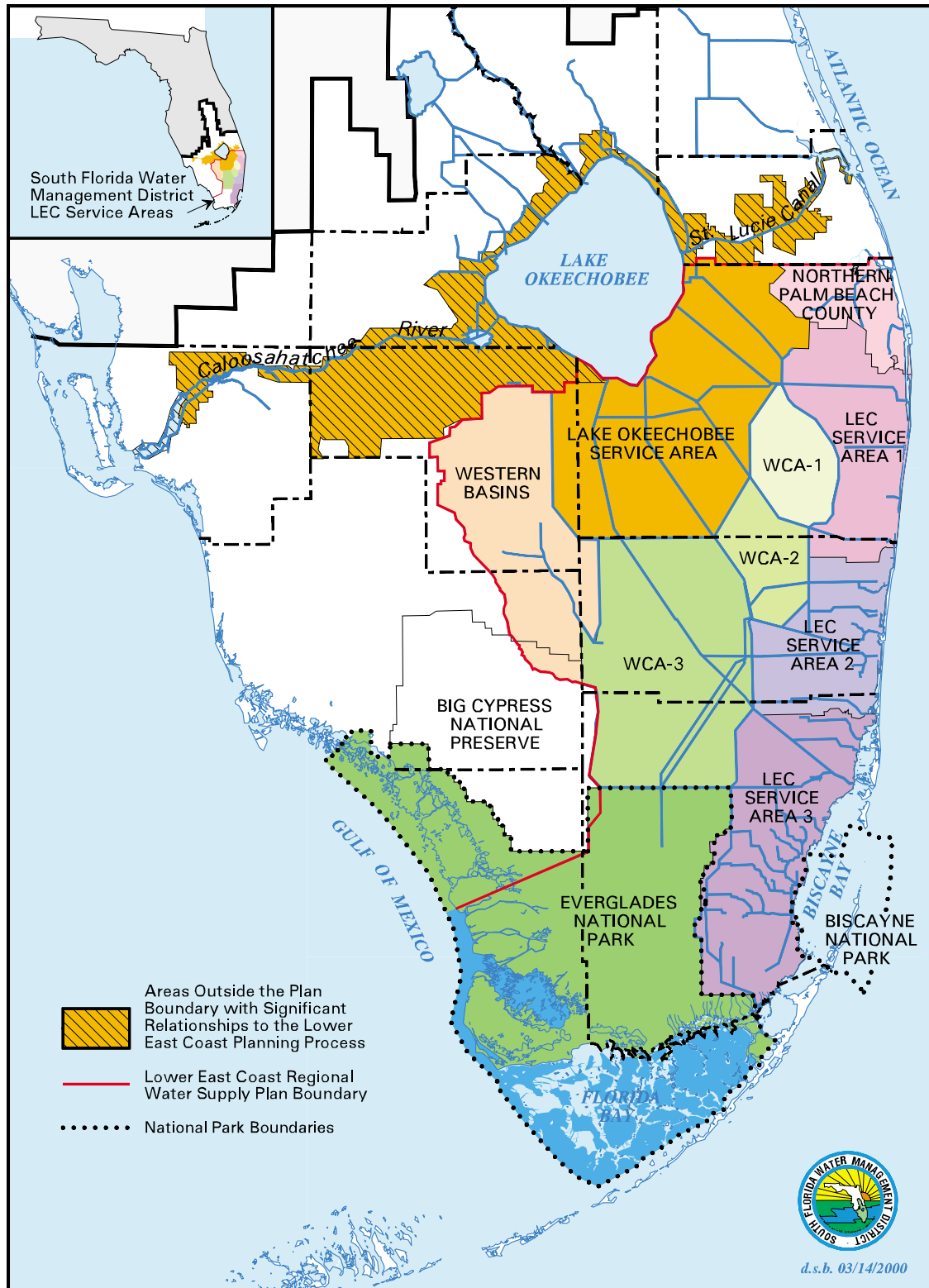


Figure B-1. Lower East Coast Planning Area.

System or surface water other than Lake Okeechobee and the associated population projections were developed by South Florida Water Management District (SFWMD, District) staff using input provided by the utilities within the LEC Planning Area.

Section 373.0361(2)(a)1, F.S., states that the level of certainty planning goal associated with identifying demands shall be based upon meeting the needs of a 1-in-10 year drought event. Therefore, water demand projections for the year 2020 included analyses under both average rainfall conditions and 1-in-10 year drought conditions. An average rainfall year is defined as rainfall with a 50 percent probability of being exceeded over a twelve-month period. A 1-in-10 year drought condition is defined as below normal rainfall with a 90 percent probability of being exceeded over a twelve-month period. This means that there is only a ten percent chance that less than this amount of rain will fall in any given year.

PERCENTAGE OF USE

For 1995, the total estimated water demand for the LEC Planning Area was 766,015 million gallons for the year. This demand was used equally for agriculture and urban water uses (**Figure B-2**). The urban portion of total water demand was 37 percent public water supply, three percent domestic self-supplied, three percent commercial and industrial self-supplied, and seven percent recreation self-supplied. Although thermoelectric power generation facilities withdraw large amounts of water, virtually all of this water is returned to the hydrologic system near the point of withdrawal.

From 1995 to 2020, the total projected average water demand is projected to increase by 20 percent from 766,015 to 920,124 million gallons per year (MGY), as shown in **Table B-1** and **Figure B-3**. Public water supply has the largest projected increase of 55 percent due to a projected increase in population, while agricultural self-supplied water demand is projected to decrease by seven percent and become the second largest category of use. As agricultural self-supplied demands decrease to 39 percent of the total demand, public water supply will become the largest user by 2020, accounting for 48 percent of the total demand in that year. Overall, urban demand is projected to be 61 percent of total demand in 2020.

Table B-1. Overall Water Demands for 1995 and 2020.

Category	1995		2020		Percent Change 1995-2020	Projected 1-in-10 Demand 2020 (MGY)
	Estimated Demand (MGY)	Percent of Total	Projected Demand (MGY)	Percent of Total		
Public Water Supply	286,429	37%	443,411	48%	55%	493,799
Domestic Self-Supplied	19,166	3%	21,079	2%	10%	23,152
Commercial and Industrial Self-Supplied	22,859	3%	27,324	3%	20%	27,324
Recreation Self-Supplied	51,785	7%	71,131	8%	37%	87,023
Thermoelectric Self-Supplied	741	0.1%	741	0.1%	0.0%	741
Total Urban Demand	380,980	50%	563,686	61%	48%	632,039
Agricultural Self-Supplied	385,035	50%	356,438	39%	-7%	506,803
Total	766,015		920,124		20%	1,138,842

Distribution of Total Water Demand (Urban and Agricultural) by Water Use Category

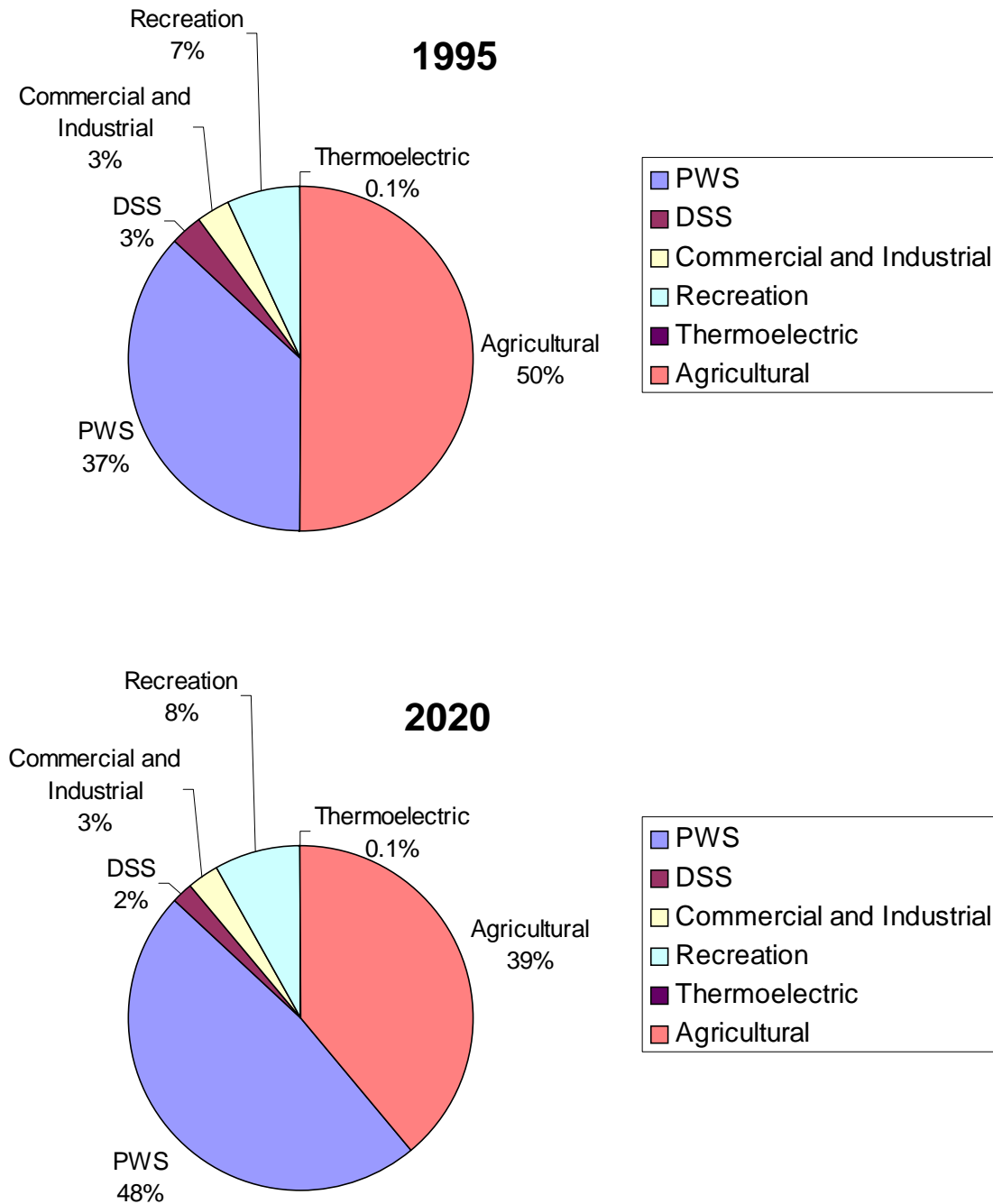


Figure B-2. Distribution of Total Estimated Water Demands (Urban and Agricultural) for 1995 and Total Projected Water Demands for 2020 in the Lower East Coast Planning Area.

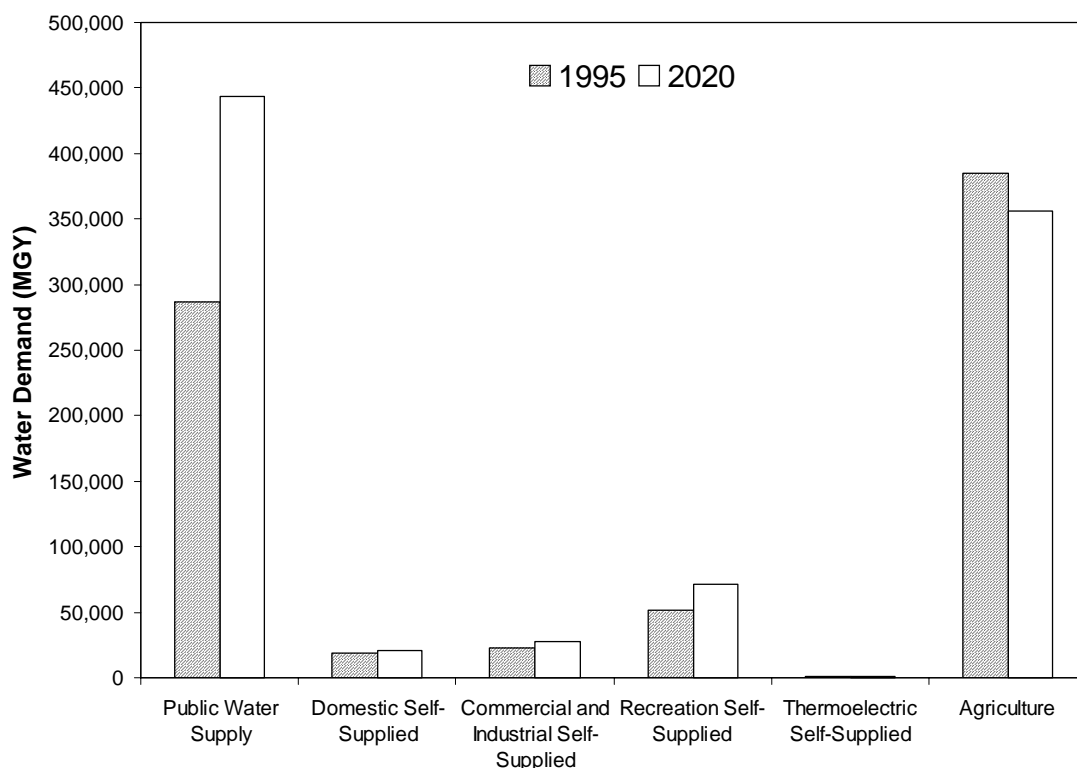


Figure B-3. Comparison of Estimated 1995 and Projected 2020 Water Demands by Water Demand Category for the Lower East Coast Planning Area.

URBAN WATER DEMAND

The major driving force behind urban demand is population. Population numbers for 1995 were taken from the U.S. Census. Population projections for 2020 used to determine public water supply demands were based on figures submitted by public water supply utilities. Domestic self-supplied population projections were obtained from the *Districtwide Water Supply Assessment* (SFWMD, 1998) (**Table B-2**). The total population of the planning area for 1995 was 4,518,401 and is projected to increase 58 percent to 7,139,453 in 2020. Miami-Dade, Broward, and Palm Beach counties account for approximately 98 percent of the planning area urban population. Therefore, urban demands are concentrated in these counties.

Urban demand is composed of five categories of use: public water supply, domestic self-supplied, commercial and industrial self-supplied, recreation self-supplied and thermoelectric self-supplied. Public water supply was the largest component (75 percent) of urban water demand in 1995, followed by recreation self-supplied (14 percent), commercial and industrial self-supplied (6 percent), and domestic self-supplied (five percent). Urban water demand in 1995 was estimated to be about 380,980 MGY (**Table B-1**). Urban demand is projected to increase to almost 563,686 MGY in 2020. One-in-ten urban demand in 2020 is projected at 632,039 MGY (**Table B-1**).

Table B-2. Estimated 1995 and Projected 2020 Total, Public Water Supply, and Domestic Self-Supplied Populations in the Lower East Coast Planning Area.

County	1995			2020		
	Total	Public Water Supply	Domestic Self-Supplied	Total	Public Water Supply	Domestic Self-Supplied
Palm Beach	976,358	809,088	101,157	1,679,266	1,577,014	102,252
Broward	1,412,942	1,380,362	23,049	1,967,707	1,936,658	31,049
Miami-Dade	2,046,078	1,989,282	24,443	3,374,678	3,334,013	40,665
Monroe	81,152	78,850	2,302	115,102	112,800	2,302
Eastern Hendry	1,871	0	1,871	2,700	0	2,700
Total LEC Planning Area	4,518,401	4,257,582	152,822	7,139,453	6,960,485	178,968

Public Water Supply and Domestic Self-Supplied Demand

The estimated water demand for both public water supply and domestic self-supplied users was 305,595 MGY in 1995. These water demands are projected to increase 52 percent from 1995 to 2020 to a total water demand of 464,490 MGY. About seven percent of the population were self-supplied in 1995. This is projected to decrease to five percent in 2020. Public water supply and domestic self-supplied water demands are presented in **Table B-3** for each county and for the planning area as whole.

Table B-3. Public Water Supply and Domestic Self-Supplied Water Demands.

County	1995				2020				Percent Change Between 1995 and 2020	
	Public Water Supply		Domestic Self-Supplied		Public Water Supply		Domestic Self-Supplied		Public Water Supply	Domestic Self-Supplied
	MGY	MGD	MGY	MGD	MGY	MGD	MGY	MGD		
Palm Beach	63,869	175	13,060	36	104,285	286	12,990	36	63%	-1%
Broward	81,152	222	1,843	5	114,085	313	2,497	7	41%	35%
Miami-Dade	141,408	387	3,971	11	225,041	617	5,227	14	59%	32%
Monroe	0	0	150	0.4	0	0	153	0.4	0%	2%
Eastern Hendry	0	0	142	0.4	0	0	212	0.6	0%	49%
Total LEC Planning Area	286,429	784	19,166	53	443,411	1,215	21,079	58	54%	10%

Table B-4 breaks the public water supply demand that is dependent on Surficial Aquifer System or surface water other than Lake Okeechobee down by utility. Utilities are listed by service area: North Palm Beach (NPBSA), Lower East Coast Service Area 1 (LECSA 1), Lower East Coast Service Area 2 (LECSA 2), and Lower East Coast Service Area 3 (LECSA 3) (see **Figures 19** through **22** in **Chapter 3** of the Planning Document). The 1995 Base Case figures were generated based on actual pumpage records submitted to

Table B-4. Public Water Supply Demands on the Surficial Aquifer by Utility.

Utility	Permit Number	Average Annual Demands (MGY)		Average Daily Demands (MGD)	
		1995	2020	1995	2020
North Palm Beach (NPBSA)					
Town of Jupiter	50-00010-W	3,463.85	4,818.00	9.49	13.20
Mangonia Park	50-00030-W	122.90	122.90	0.34	0.34
Tequesta	50-00046-W	512.97	638.75	1.41	1.75
Seacoast	50-00365-W	5,276.22	10,369.65	14.45	28.41
Riviera Beach	50-00460-W	3,270.72	4,275.00	8.96	11.71
Good Samaritan Hospital	50-00653-W	127.75	135.05	0.35	0.37
PB Park Commerce	50-01528-W	3.65	357.00	0.01	0.98
Total for NPBSA		12,778.06	20,716.35	35.01	56.76
LEC Service Area 1 (LECSA1)					
Deerfield	06-00082-W	4,000.42	4,069.00	10.96	11.15
Parkland	06-00242-W	74.48	112.00	0.20	0.31
North Springs	06-00274-W	515.62	1,715.50	1.41	4.70
Palm Springs	50-00036-W	1,465.87	2,292.20	4.02	6.28
Atlantis	50-00083-W	17.68	0.00	0.05	0.00
PBC (2W,8W)	50-00135-W	6,821.62	10,442.65	18.69	28.61
Tropical MHP	50-00137-W	33.29	0.00	0.09	0.00
Delray Beach	50-00177-W	4,441.69	5,810.80	12.17	15.92
Century Utilities/PBC	50-00178-W	152.42	0.00	0.42	0.00
Jamaica Bay	50-00179-W	0.00	0.00	0.00	0.00
Lake Worth	50-00234-W	2,611.92	3,556.50	7.16	9.74
Highland Beach	50-00346-W	411.27	508.00	1.13	1.39
Boca Raton	50-00367-W	13,106.54	17,136.75	35.91	46.95
PBC System (3W, 9W)	50-00401-W	5,719.56	16,516.25	15.67	45.25
Royal Palm Beach	50-00444-W	803.70	0.00	2.20	0.00
ACME (Wellington)	50-00464-W	1,475.09	3,504.00	4.04	9.60
Boynton Beach	50-00499-W	3,226.66	6,278.00	8.84	17.20
Manalapan	50-00506-W	365.86	474.50	1.00	1.30
Nat'l MHP (Worth Village)	50-00572-W	70.24	97.00	0.19	0.27
Lantana	50-00575-W	752.29	890.60	2.06	2.44
Lion Country Safari	50-00605-W	18.49	42.00	0.05	0.12
Village of Golf	50-00612-W	152.66	196.00	0.42	0.54
City of West Palm Beach ^a	50-00615-W	9,206.80	15,330.00	25.22	42.00
AG Holley (St of FL)	50-01092-W	24.70	85.00	0.07	0.23
Arrowhead	50-01283-W	0.00	0.00	0.00	0.00
United Technologies	50-00501-W (old) 50-01663-W	212.57	408.80	0.58	1.12
Total for LECSA 1		55,681.44	89,465.55	152.55	245.11
LEC Service Area 2 (LECSA2)					
Seminole Tribe	06-00001-W	126.70	321.15	0.35	0.88
Royal Utility Company	06-00003-W	133.05	149.00	0.37	0.41
North Lauderdale	06-00004-W	1,107.97	2,299.50	3.04	6.30

Table B-4. Public Water Supply Demands on the Surficial Aquifer by Utility. (Continued)

Utility	Permit Number	Average Annual Demands (MGY)		Average Daily Demands (MGD)	
		1995	2020	1995	2020
Hollywood	06-00038-W	7,048.74	8,030.00	19.31	22.00
Miramar	06-00054-W	1,529.04	4,504.10	4.19	12.34
Pompano	06-00070-W	5,929.80	7,300.00	16.25	20.00
Tamarac	06-00071-W	2,044.49	3,650.00	5.60	10.00
Coral Springs I/D	06-00100-W	1,488.85	1,752.00	4.08	4.80
Hillsboro Beach	06-00101-W	313.85	360.00	0.86	0.99
Coral Springs City	06-00102-W	2,642.64	3,525.90	7.24	9.66
Plantation	06-00103-W	5,082.17	6,293.00	13.92	17.24
Sunrise	06-00120-W	6,612.50	11,351.50	18.12	31.10
Margate	06-00121-W	3,045.09	4,124.50	8.34	11.30
Ft. Lauderdale	06-00123-W	17,791.10	21,900.00	48.74	60.00
Lauderhill	06-00129-W	2,712.21	2,887.10	7.43	7.91
Davie	06-00134-W	1,112.42	1,929.00	3.05	5.29
Pembroke Pines	06-00135-W	3,405.35	7,300.00	9.33	20.00
Hallandale	06-00138-W	1,261.06	1,277.50	3.45	3.50
Broward 2A (East)	06-00142-W	5,305.05	4,015.00	14.53	11.00
Broward 3A/3C (Piccolo)	06-00145-W (old) 06-01474-W	964.80	5,657.50	2.64	15.50
Broward 1A,1B	06-00146-W	3,406.95	4,380.00	9.33	12.00
Broward 3B (South System Regional)	06-00147-W (old) 06-01474-W	793.50	0.00	2.17	0.00
Ferncrest	06-00170-W	285.35	401.00	0.78	1.10
Dania Beach	06-00187-W	898.93	730.00	1.85	2.00
Cooper City	06-00365-W	1,278.26	2,226.00	3.50	6.10
South Broward	06-00435-W	241.89	0.00	0.66	0.00
Broward North Regional	06-01634-W	0.00	1,825.00	0.00	5.00
Total for LECSA 2		76,561.76	108,188.75	209.13	296.41
LEC Service Area 3 (LECSA3)					
FKAAb	13-00005-W	5,136.91	6,935.00	14.07	19.00
Alexander Orr (WASDc)	13-00017-W	61,375.50	103,065.05	168.15	282.37
Florida City	13-00029-W	837.97	1,025.65	2.30	2.81
WASD-Hialeah Preston	13-00037-W	60,875.50	76,723.00	166.78	210.20
REX (WASD-S Dade)	13-00040-W	2,209.80	17,395.90	6.05	47.66
Homestead	13-00046-W	2,354.09	5,694.00	6.45	15.60
North Miami	13-00059-W	2,622.19	3,252.55	7.18	8.91
North Miami Beach	13-00060-W	5,618.61	10,950.00	15.39	30.00
Opa Locka	13-00065-W	0	0	0	0
Homestead AFB	13-00068-W	377.80	0.00	1.04	0.00
Total for LECSA 3		141,408.37	225,041.15	387.41	616.55
LEC Planning Area Total		286,429.63	443,411.80	784.10	1,214.82

a. From surface water

b. To supply Monroe County

c. WASD = Water and Sewer Department

the District as a requirement of the Consumptive Use Permitting (CUP) Program. To obtain the 2020 projected demand, the District sent each utility a questionnaire requesting their projected average raw water withdrawals for 2020. These projections were reviewed by District staff and some adjustments were made following discussions with the utilities. These projections were used in the regional and subregional ground water models. In addition, utilities were requested to provide information concerning locations of future water withdrawals, proposed wells and wellfields, and future distribution systems. These data were incorporated into the LEC 2020 Base Case model simulations. Public water supply service areas and existing wellfields in 1995 are shown in **Figures B-4, B-5, and B-6** and projected wellfields in 2020 are shown in **Figures B-7, B-8, and B-9** for Palm Beach, Broward, and Miami-Dade counties, respectively.

Commercial and Industrial Self-Supplied

In 1995, commercial and industrial self-supplied demand for the planning area was estimated at 22,859 MGY (**Table B-5**). This demand is projected to increase to 27,324 MGY by 2020. In 1995, Palm Beach and Miami-Dade counties were the largest commercial and industrial self-supplied water users of the LEC Planning Area with demands of 10,939 and 10,556 MGY, respectively. These two counties are projected to continue being the largest users in 2020 within this water use category with demands of 12,167 and 13,300 MGY, respectively. Broward and Monroe counties have relatively small commercial and industrial self-supplied demands and eastern Hendry County has none. These estimates and projections do not include commercial and industrial demands supplied by public utilities, as these are already included in the public water supply demands.

Table B-5. Commercial and Industrial Self-Supplied Demand.

County	1995		2020	
	MGY	MGD	MGY	MGD
Palm Beach	10,939	30	12,167	33
Broward	1,338	4	1,824	5
Miami-Dade	10,556	29	13,300	36
Monroe	26	0.1	33	0.1
Eastern Hendry	0	0	0	0
Total LEC Planning Area	22,859	63	27,324	75

**Figure B-4.
Removed for Security Purposes**

**Figure B-5.
Removed for Security Purposes**

**Figure B-6.
Removed for Security Purposes**

Figure B-7. Removed for Security Purposes

**Figure B-8.
Removed for Security Purposes**

**Figure B-9.
Removed for Security Purposes**

Recreational Self-Supplied Demand

In 1995, the LEC Planning Area used an estimated 51,785 MGY self-supplied water for recreation, including landscape and golf course irrigation (**Table B-6**). This demand is projected to increase to 71,131 MGY by 2020 in response to increased urban development within the planning area. Palm Beach and Broward counties had the highest estimated demand in 1995 for this water use category using 23,991 and 21,916 MGY, respectively. These counties are projected to remain the largest users during the next 20 years with projected demands of 35,828 and 27,643 MGY, respectively. Estimates and projections do not include recreational demands supplied by public utilities, as these are already included in the public water supply demands.

Table B-6. Recreational Self-Supplied Demand.

County	1995		2020	
	MGY	MGD	MGY	MGD
Palm Beach	23,991	66	35,828	98
Broward	21,916	60	27,643	76
Miami-Dade	5,078	14	6,860	19
Monroe	800	2	800	2
Eastern Hendry	0	0	0	0
Total LEC Planning Area	51,785	142	71,131	195

AGRICULTURAL WATER DEMAND

Summary of Agricultural Demand

Seven categories of agricultural water demand are analyzed in this section: citrus, tropical fruit, vegetables, field crops, sod, greenhouse/nursery, and cattle and fish production (**Table B-7**). Field crops include sugarcane, rice, field corn, soybean, and sorghum. Agricultural water demand was estimated for 1995 to be approximately 385,035 MGY (**Table B-1**). In 1995, field crops used 70 percent and vegetables used 11 percent of the overall agricultural water demand. The remaining crops accounted for approximately 18 percent of the total agricultural demand. The combined water demand for cattle watering, irrigation of improved pasture, and aquaculture account for approximately one percent of total agricultural demand.

The LEC Planning Area is experiencing a slight decrease in agricultural growth, especially in vegetable acreage within Palm Beach County. Broward County vegetable production is projected to continue declining to an insignificant level by 2020. Miami-Dade County, however, is projecting a slight overall increase due to significant increase in greenhouse/nursery production. Overall, agricultural water demand is forecast to decrease by seven percent to 356,438 MGY in 2020 (**Table B-1**). Approximately two-thirds of the agricultural water demand in 2020 is anticipated to be for sugarcane. **Figure B-10** presents a graphical comparison of agricultural demand by crop type for 1995 and 2020.

Descriptions of the agricultural acreage in each county, projection methodology, and the calculation of irrigation requirements and other agricultural water use, including data sources, are detailed in the *Districtwide Water Supply Assessment* (SFWMD, 1998).

Table B-7. Water Demand (MGY) and Irrigated Acreage by Crop Type.

Category	1995		2020		Percent Change 1995-2020		Projected 2020 1-in-10 Demands
	Estimated Demands (MGY)	Total Irrigated Acres/ Head of Cattle	Estimated Demands (MGY)	Total Irrigated Acres/ Head of Cattle	Demands	Acreage	
Citrus	31,722	43,408	32,270	43,641	2%	1%	39,324
Tropical Fruits/Nuts	4,786	8,200	5,048	8,650	5%	5%	6,868
Vegetables/ Melons	42,412	98,772	26,661	64,057	-37%	-35%	31,517
Field Crops	268,847	368,982	240,498	326,707	-11%	-11%	364,903
Sod	12,667	10,100	12,667	10,100	0%	0%	16,299
Greenhouse /Nursery	19,597	16,383	34,468	29,597	76%	81%	43,066
Cattle/Fish Production	5,004	0	4,826	0	-4%	NA	4,826
Total Planning Area*	385,035	545,845	356,438	482,752	-7%	-12%	506,803

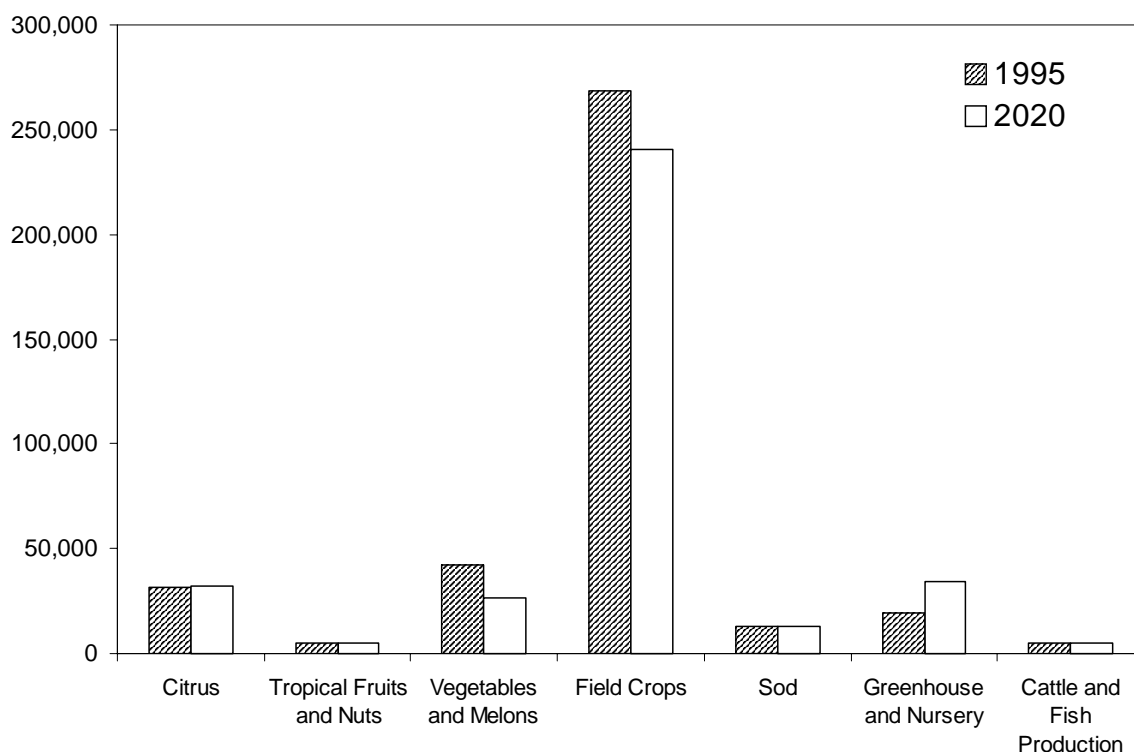


Figure B-10. Comparison of Estimated 1995 and Projected 2020 Agricultural Water Demands for the Lower East Coast Planning Area.

Citrus

Citrus acreage in Palm Beach, Broward, and Miami-Dade counties is projected to decline by 2020. Miami-Dade County citrus is dominated by lime production. Eastern Hendry County citrus acreage has continuously increased due to interregional movement of citrus from central to southwest Florida following the severe freezes in the mid-1980s. Citrus acreage in the planning area is projected to grow slightly from 43,408 acres in 1995 to 43,641 acres in 2020. This slight growth in acreage represents an increase in average irrigation requirements from 31,722 MGY in 1995 to 32,270 MGY in 2020. The 1-in-10 year demands estimated for 2020 are 39,324 MGY.

Tropical Fruits

Within the LEC Planning Area, tropical fruits (primarily avocados, mangoes, and papayas) are produced only in Miami-Dade County. In 1995, Miami-Dade County had 8,200 acres of tropical fruits. The acreage is projected to increase to 8,650 acres in 2020. Average irrigation requirements for this acreage were estimated at 4,786 MGY in 1995 and projected at 5,048 MGY for 2020. The projected 2020 1-in-10 year irrigation requirement is 6,868 MGY (**Table B-7**).

Vegetables and Melons

Vegetable crops grown in the LEC Planning Area include cucumbers, peppers, tomatoes, squash, eggplant, watermelons, carrots, celery, lettuce, escarole, endive, radishes, sweet corn, strawberries, subtropical vegetables, snap beans, and potatoes. Different types of vegetables are often grown interchangeably. In 1995, the LEC Planning Area had 98,772 acres of land used for vegetable production. This is projected to decrease to 64,057 acres in 2020 due to urban development within the planning area. The average irrigation requirement for vegetable crops was estimated at 42,412 MGY in 1995 and is projected to be 26,661 MGY in 2020. The 1-in-10 year irrigation requirement for the 2020 vegetable acreage is 31,517 MGY (**Table B-7**).

Field Crops

Sugarcane

Sugarcane is grown in both Palm Beach County and eastern Hendry County. As a result of the cultivation practices used for sugarcane (ratoon and fallow), 25 percent of the land used for sugarcane production is fallow in any given year. This fallow land does not require irrigation and, therefore, is not included in the demand projections presented here.

In 1995, the LEC Planning Area total acreage of sugarcane was estimated at 366,332 acres. It is projected to decrease to 322,432 acres by 2020. Average irrigation requirements were estimated at 253,299 MGY in 1995 and are projected to decrease to 224,635 MGY by 2020. The 1-in-10 year irrigation requirement for sugarcane within the planning area is projected to be 346,535 MGY in 2020.

Sugarcane is the dominant crop in the Everglades Agricultural Area (EAA). Production of sugarcane in the EAA (Palm Beach County) was estimated at 328,592 acres in 1995 requiring an average irrigation requirement of 202,614 MGY. This acreage is forecast to decline to 285,542 acres by 2020, primarily due to the conversion of agricultural land into Stormwater Treatment Areas (STAs). The associated average irrigation requirements are projected to decrease to 176,069 MGY by 2020.

The irrigated sugarcane acreage in eastern Hendry County was 37,740 acres in 1995 and declined slightly to 36,890 acres (for sugar and seed) between 1995 and 1997. The acreage is projected to stay at that level through 2020. The average irrigation requirement of eastern Hendry County in 1995 was estimated at 49,685 MGY. This is projected to decrease to 48,566 MGY in 2020. The 1-in-10 year irrigation requirement for the 2020 sugarcane acreage in eastern Hendry County is projected to be 57,929 MGY.

Other Field Crops

Rice is also grown in the EAA in both Palm Beach and eastern Hendry counties. It is grown during the summer months in rotation with sugarcane or winter vegetables and takes place on land that would otherwise be fallow. Total rice acreage in the LEC Planning Area was assessed at 22,100 acres in 1995, and is projected to decrease to 20,900 acres by 2020. Average irrigation requirements were estimated at 15,075 MGY for 1995 and projected to be 14,064 MGY by 2020. The 1-in-10 demands projected for 2020 are 16,392 MGY.

Sod

In 1995, irrigated sod acreage within the LEC Planning Area was estimated at 10,100 acres and is expected to remain the same through 2020. The associated average irrigation requirement is estimated at 12,667 MGY through 2020. The 1-in-10 year irrigation requirement for sod for 2020 is projected to be 16,299 MGY (**Table B-7**).

Greenhouse/Nursery

In 1995, greenhouse/nursery operations in the planning area were estimated to use 16,383 acres. This acreage is projected to increase 81 percent to 29,597 acres by 2020. Average water demands for greenhouse/nurseries in the planning area were estimated at 19,597 MGY in 1995 and is projected to increase to 34,468 MGY in 2020. The 1-in-10 year irrigation requirement associated with the projected 2020 acreage is projected to be 43,066 MGY (**Table B-7**).

Cattle and Fish Production

Demand for cattle watering and barn washing is associated with cattle production (which is in turn associated with pasture acreage). Aquaculture, associated with fish production, is only located in Palm Beach and Miami-Dade counties. Combined cattle and fish production was assessed at 5,004 MGY in 1995, and is projected to decline slightly to

4,826 MGY in 2020 (**Table B-7**). This decline is related to the displacement of pasture land by other agricultural or urban land uses.

TOTAL IRRIGATED ACREAGE

Total irrigated acreage or the LEC Planning Area is summarized in **Table B-8**. Monroe County has no agriculture acreage.

Table B-8. Total Irrigated Agriculture Acreage for the LEC Planning Area.

Use Classification	Total Irrigated Acreage	
	1995	2020
PALM BEACH COUNTY		
Citrus	12,746	10,121
Vegetables/Melons	43,245	23,874
Field Crops	328,592	285,542
Sod	6,000	6,000
Greenhouse/Nursery	5,045	10,175
TOTAL IRRIGATED AGRICULTURE ACREAGE FOR PALM BEACH COUNTY	395,628	335,712
BROWARD COUNTY		
Citrus	108	0
Vegetables/Melons	579	0
Greenhouse/Nursery	2,668	2,668
TOTAL IRRIGATED AGRICULTURE ACREAGE FOR BROWARD COUNTY	3,355	2,668
MIAMI-DADE COUNTY		
Citrus	2,618	1,667
Tropical Fruits/Nuts	8,200	8,650
Vegetables/Melons	49,348	34,023
Field Crops	3,500	4,275
Greenhouse/Nursery	8,403	16,278
TOTAL IRRIGATED AGRICULTURE ACREAGE FOR MIAMI-DADE COUNTY	72,069	64,893
MONROE COUNTY		
TOTAL IRRIGATED AGRICULTURE ACREAGE FOR MONROE COUNTY	0	0
EASTERN HENDRY COUNTY		
Citrus	27,936	31,853
Vegetables/Melons	5,600	6,160
Field Crops	36,890	36,890
Sod	4,100	4,100
Greenhouse/Nursery	267	476
TOTAL IRRIGATED AGRICULTURE ACREAGE FOR EASTERN HENDRY COUNTY	74,793	79,479
LEC PLANNING AREA TOTAL IRRIGATED AGRICULTURAL ACREAGE	545,845	482,752

TOTAL AVERAGE ANNUAL WATER DEMAND

Estimated and projected demands for the LEC Planning Area are shown in **Table B-9**. Urban demand is summarized by water use category and agricultural demand and irrigated acreage are summarized by crop type.

Table B-9. Annual Average Water Demand by Use Classification.

Use Classification	Average Annual Water Demand (MGY)	
	1995	2020
PALM BEACH COUNTY		
Urban		
Public Water Supplied	63,869	104,285
Domestic Self-Supplied	13,060	12,990
Commercial and Industrial Self-Supplied	10,939	12,167
Recreation Self-Supplied	23,991	35,828
Thermoelectric Self-Supplied	69	69
TOTAL URBAN	111,928	165,339
Agriculture		
Citrus	8,034	6,341
Vegetables/Melons	19,170	9,566
Field Crops	214,679	188,069
Sod	5,695	5,695
Greenhouse/Nursery	8,202	14,794
Cattle Watering/Aquaculture	778	778
TOTAL AGRICULTURAL SELF-SUPPLIED DEMAND	256,558	225,243
TOTAL PALM BEACH COUNTY WATER DEMAND	368,486	390,582
BROWARD COUNTY		
Urban		
Public Water Supplied	81,152	114,085
Domestic Self-Supplied	1,843	2,497
Commercial and Industrial Self-Supplied	1,338	1,824
Recreation Self-Supplied	21,916	27,643
Thermoelectric Self-Supplied	179	179
TOTAL URBAN	106,428	146,228
Agriculture		
Citrus	67	0
Vegetables/Melons	413	0
Greenhouse/Nursery	2,485	2,485
Cattle Watering/Aquaculture	248	78
TOTAL AGRICULTURAL SELF-SUPPLIED DEMAND	3,213	2,563
TOTAL BROWARD COUNTY WATER DEMAND	109,641	148,791

Table B-9. Annual Average Water Demand by Use Classification. (Continued)

Use Classification	Average Annual Water Demand (MGY)	
	1995	2020
MIAMI-DADE COUNTY		
Urban		
Public Water Supplied	141,408	225,041
Domestic Self-Supplied	3,971	5,227
Commercial and Industrial Self-Supplied	10,556	13,300
Recreation Self-Supplied	5,078	6,860
Thermoelectric Self-Supplied	493	493
TOTAL URBAN	161,506	250,921
Agriculture		
Citrus	1,996	1,271
Tropical Fruits/Nuts	4,786	5,048
Vegetables/Melons	19,526	13,462
Field Crops	1,473	1,799
Greenhouse/Nursery	8,456	16,380
Cattle Watering/Aquaculture	3,701	3,701
TOTAL AGRICULTURAL SELF-SUPPLIED DEMAND	39,938	41,661
TOTAL MIAMI-DADE COUNTY WATER DEMAND	201,444	292,582
MONROE COUNTY		
Urban		
Public Water Supplied	0 ^a	0 ^a
Domestic Self-Supplied	150	153
Commercial and Industrial Self-Supplied	126	33
Recreation Self-Supplied	800	800
TOTAL URBAN	976	986
Agriculture		
TOTAL AGRICULTURAL SELF-SUPPLIED DEMAND	0	0
TOTAL MONROE COUNTY WATER DEMAND	976	986
EASTERN HENDRY COUNTY		
Urban		
Public Water Supplied	0	0
Domestic Self-Supplied	142	212
TOTAL URBAN	142	212
Agriculture		
Citrus	21,625	24,658
Vegetables/Melons	3,303	3,633
Field Crops	52,695	50,630
Sod	6,972	6,972
Greenhouse/Nursery	454	809
Cattle Watering/Aquaculture	277	269
TOTAL AGRICULTURAL SELF-SUPPLIED DEMAND	85,326	86,971
TOTAL EASTERN HENDRY COUNTY WATER DEMAND	85,468	87,183
LEC PLANNING AREA TOTAL WATER DEMAND	766,015	920,124

a. Monroe County public water supply is included in the Miami-Dade County public water supply due the location of the wellfield that supplies Monroe County.

PUBLIC WATER SUPPLY DATA SETS

The regional and subregional computer hydrologic simulations incorporated the same public water supply data sets. These sets were developed to depict various aspects of local water supply withdrawals from the Surficial Aquifer System (SAS). The details of the assumptions that were used are discussed in **Chapter 4**.

Average annual and average daily demands for each well, as opposed to the wellfield as a whole, were used in the ground water simulations to more realistically maximize the existing wellfields to meet future demands. The demands for each well were calculated by multiplying the estimated 1995 and projected 2020 water demands for the wellfield as a whole (**Table B-11**) by percentages of water demand that was, or was expected to be, pumped out of each well during each simulation (**Table B-12**). The percentage distribution in **Table B-12** was based on well capacity as listed in the consumptive use permit and present usage records **Table B-10** presents an example of the average daily demand calculation. This calculation is for the Hillsboro Beach wellfield (CUP number 06-00101-W), which has a projected 2020 demand of 0.99 MGD (**Table B-11**). This projection is multiplied by the 2020 percentage value of each of the four wells within the wellfield (**Table B-12**). A zero percent value indicates that the well was not operating in that simulation.

Table B-10. An Example of the Calculation of Average Daily Demand for Each Well in the Hillsboro Beach (06-00101-W) Wellfield Using Projected 2020 Demands.

Well Number	Average Daily Demand for the Wellfield Projected for 2020 ^a (MGD)		Percentage of Estimated Demand for the Well ^b (for all simulations)		Average Daily Demand for Each Well Projected for 2020 ^c (MGD)
1	0.99	x	48	=	0.475
2	0.99	x	0	=	0.000
3	0.99	x	48	=	0.475
4	0.99	x	4	=	0.039
Total	0.99	x	100	=	0.989

a. From **Table B-11**

b. From **Table B-12**

c. Used in the 2020 Base Case, 2020 with Restudy, and LEC-1 simulations

The well numbers in **Table B-12** correspond to the well numbers that are listed in Table A of the consumptive use permit issued by the District. Wells that have numbers preceded by fwell are planned wells. These wells were added if the existing wellfield did not have the capacity to fulfill the projected 2020 demand and that additional wells will be required. The well locations are depicted in **Figures B-11** through **B-22**. The wells used in each data set are as follows:

- The 1995 Base Case incorporates the wells in operation and their distribution as of 1995.
- The 2020 Base Case incorporates the existing and future wells expected to be in operation in 2020. The utilities provided well locations and distribution for existing and proposed wells. The proposed wells may or may not meet CUP criteria.
- The 2020 with Restudy data set is very similar to the distribution used in the D13R simulation performed for the *Central and Southern Florida Project Comprehensive Review Study Final Integrated Feasibility Report and Programmatic Environmental Impact Statement* (Restudy) (USACE and SFWMD, 1999). The location of the future wells (those whose numbers are preceded by fwell) have not yet been precisely determined, but for planning purposes they were assigned locations.
- The LEC-1 simulation includes the existing wells expected to be operating in 2020, the utility proposed wells, and proposed modifications to well locations in this plan. These modifications to well locations are proposed to help meet water supply restriction and CUP criteria. A shift of some of North Miami and North Miami Beach demands to the WASD-Hialeah Preston Regional Wellfield were included due to the potential of saltwater intrusion with future demand projections for those utilities.
- The incremental simulations (2005, 2005 SSM¹, 2010, and 2015) rely upon the LEC-1 distribution and a portion of 2020 demands.

Table B-11. Public Water Supply Demands on the Surficial Aquifer by Utility for the 1995 and 2020 Base Cases and the LEC-1 Model Simulation.

Utility	Permit Number	Average Annual Demands (MGY)			Average Daily Demands (MGD)		
		1995 Base Case	2020 Base Case and 2020 with Restudy	LEC-1	1995 Base Case	2020 Base Case and 2020 with Restudy	LEC-1
North Palm Beach Service Area (NPBSA)							
Town of Jupiter	50-00010-W	3,463.85	4,818.00	4,818.00	9.49	13.20	13.20
Mangonia Park	50-00030-W	122.90	122.90	122.90	0.34	0.34	0.34
Tequesta	50-00046-W	512.97	638.75	638.75	1.41	1.75	1.75
Seacoast	50-00365-W	5,276.22	10,369.65	10,369.65	14.45	28.41	28.41
Riviera Beach	50-00460-W	3,270.72	4,275.00	4,275.00	8.96	11.71	11.71
Good Samaritan Hospital	50-00653-W	127.75	135.05	135.05	0.35	0.37	0.37
PB Park Commerce	50-01528-W	3.65	357.00	357.00	0.01	0.98	0.98
Total for NPBSA		12,778.06	20,716.35	20,716.35	35.01	56.76	56.76

1. SSM = Supply-Side Management

Table B-11. Public Water Supply Demands on the Surficial Aquifer by Utility for the 1995 and 2020 Base Cases and the LEC-1 Model Simulation. (Continued)

Utility	Permit Number	Average Annual Demands (MGY)			Average Daily Demands (MGD)		
		1995 Base Case	2020 Base Case and 2020 with Restudy	LEC-1	1995 Base Case	2020 Base Case and 2020 with Restudy	LEC-1
LEC Service Area 1 (LECSA1)							
Deerfield	06-00082-W	4,000.42	4,069.00	4,069.00	10.96	11.15	11.15
Parkland	06-00242-W	74.48	112.00	112.00	0.20	0.31	0.31
North Springs	06-00274-W	515.62	1,715.50	1,715.50	1.41	4.70	4.70
Palm Springs	50-00036-W	1,465.87	2,292.20	2,292.20	4.02	6.28	6.28
Atlantis	50-00083-W	17.68	0.00	0.00	0.05	0.00	0.00
PBC (2W,8W)	50-00135-W	6,821.62	10,442.65	10,442.65	18.69	28.61	28.61
Tropical MHP	50-00137-W	33.29	0.00	0.00	0.09	0.00	0.00
Delray Beach	50-00177-W	4,441.69	5,810.80	5,810.80	12.17	15.92	15.92
Century Utilities/PBC	50-00178-W	152.42	0.00	0.00	0.42	0.00	0.00
Jamaica Bay	50-00179-W	0.00	0.00	0.00	0.00	0.00	0.00
Lake Worth	50-00234-W	2,611.92	3,556.50	3,556.50	7.16	9.74	9.74
Highland Beach	50-00346-W	411.27	508.00	508.00	1.13	1.39	1.39
Boca Raton	50-00367-W	13,106.54	17,136.75	17,136.75	35.91	46.95	46.95
PBC System (3W, 9W)	50-00401-W	5,719.56	16,516.25	16,516.25	15.67	45.25	45.25
Royal Palm Beach	50-00444-W	803.70	0.00	0.00	2.20	0.00	0.00
ACME (Wellington)	50-00464-W	1,475.09	3,504.00	3,504.00	4.04	9.60	9.60
Boynton Beach	50-00499-W	3,226.66	6,278.00	6,278.00	8.84	17.20	17.20
Manalapan	50-00506-W	365.86	474.50	474.50	1.00	1.30	1.30
Nat'l MHP (Worth Village)	50-00572-W	70.24	97.00	97.00	0.19	0.27	0.27
Lantana	50-00575-W	752.29	890.60	890.60	2.06	2.44	2.44
Lion Country Safari	50-00605-W	18.49	42.00	42.00	0.05	0.12	0.12
Village of Golf	50-00612-W	152.66	196.00	196.00	0.42	0.54	0.54
City of West Palm Beach ^a	50-00615-W	9,206.80	15,330.00	15,330.00	25.22	42.00	42.00
AG Holley (St of FL)	50-01092-W	24.70	85.00	85.00	0.07	0.23	0.23
Arrowhead	50-01283-W	0.00	0.00	0.00	0.00	0.00	0.00
United Technologies	50-00501-W (old) 50-01663-W	212.57	408.80	408.80	0.58	1.12	1.12
Total for LECSA 1		55,681.44	89,465.55	89,465.55	152.55	245.11	245.11
LEC Service Area 2 (LECSA2)							
Seminole Tribe	06-00001-W	126.70	321.15	321.15	0.35	0.88	0.88
Royal Utility Company	06-00003-W	133.05	149.00	149.00	0.37	0.41	0.41
North Lauderdale	06-00004-W	1,107.97	2,299.50	2,299.50	3.04	6.30	6.30
Hollywood	06-00038-W	7,048.74	8,030.00	8,030.00	19.31	22.00	22.00
Miramar	06-00054-W	1,529.04	4,504.10	4,504.10	4.19	12.34	12.34
Pompano	06-00070-W	5,929.80	7,300.00	7,300.00	16.25	20.00	20.00
Tamarac	06-00071-W	2,044.49	3,650.00	3,650.00	5.60	10.00	10.00
Coral Springs I/D	06-00100-W	1,488.85	1,752.00	1,752.00	4.08	4.80	4.80

Table B-11. Public Water Supply Demands on the Surficial Aquifer by Utility for the 1995 and 2020 Base Cases and the LEC-1 Model Simulation. (Continued)

Utility	Permit Number	Average Annual Demands (MGY)			Average Daily Demands (MGD)		
		1995 Base Case	2020 Base Case and 2020 with Restudy	LEC-1	1995 Base Case	2020 Base Case and 2020 with Restudy	LEC-1
Hillsboro Beach	06-00101-W	313.85	360.00	360.00	0.86	0.99	0.99
Coral Springs City	06-00102-W	2,642.64	3,525.90	3,525.90	7.24	9.66	9.66
Plantation	06-00103-W	5,082.17	6,293.00	6,293.00	13.92	17.24	17.24
Sunrise	06-00120-W	6,612.50	11,351.50	11,351.50	18.12	31.10	31.10
Margate	06-00121-W	3,045.09	4,124.50	4,124.50	8.34	11.30	11.30
Ft. Lauderdale	06-00123-W	17,791.10	21,900.00	21,900.00	48.74	60.00	60.00
Lauderhill	06-00129-W	2,712.21	2,887.10	2,887.10	7.43	7.91	7.91
Davie	06-00134-W	1,112.42	1,929.00	1,929.00	3.05	5.29	5.29
Pembroke Pines	06-00135-W	3,405.35	7,300.00	7,300.00	9.33	20.00	20.00
Hallandale	06-00138-W	1,261.06	1,277.50	1,277.50	3.45	3.50	3.50
Broward 2A (East)	06-00142-W	5,305.05	4,015.00	2,920.00	14.53	11.00	8.00
Broward 3A/3C (Piccolo)	06-00145-W (old) 06-01474-W	964.80	5,657.50	5,657.50	2.64	15.50	15.50
Broward 1A,1B	06-00146-W	3,406.95	4,380.00	4,380.00	9.33	12.00	12.00
Broward 3B (South System Regional)	06-00147-W (old) 06-01474-W	793.50	0.00	0.00	2.17	0.00	0.00
Ferncrest	06-00170-W	285.35	401.00	401.00	0.78	1.10	1.10
Dania Beach	06-00187-W	898.93	730.00	730.00	1.85	2.00	2.00
Cooper City	06-00365-W	1,278.26	2,226.00	2,226.00	3.50	6.10	6.10
South Broward	06-00435-W	241.89	0.00	0.00	0.66	0.00	0.00
Broward North Regional	06-01634-W	0.00	1,825.00	2,920.00	0.00	5.00	8.00
Total for LECSA 2		76,561.76	108,188.75	108,188.75	209.13	296.41	296.41
LEC Service Area 3 (LECSA3)							
FKAA ^b	13-00005-W	5,136.91	6,935.00	6,935.00	14.07	19.00	19.00
Alexander Orr (WASD)	13-00017-W	61,375.50	103,065.05	103,065.05	168.15	282.37	282.37
Florida City	13-00029-W	837.97	1,025.65	1,025.65	2.30	2.81	2.81
WASD- Hialeah Preston	13-00037-W	60,875.50	76,723.00	83,824.30	166.78	210.20	229.65
REX (WASD-S Dade)	13-00040-W	2,209.80	17,395.90	17,395.90	6.05	47.66	47.66
Homestead	13-00046-W	2,354.09	5,694.00	5,694.00	6.45	15.60	15.60
North Miami	13-00059-W	2,622.19	3,252.55	1,626.25	7.18	8.91	4.46
North Miami Beach	13-00060-W	5,618.61	10,950.00	5,475.00	15.39	30.00	15.00
Opa Locka	13-00065-W	0	0	0	0	0	0
Homestead AFB	13-00068-W	377.80	0.00	0.00	1.04	0.00	0.00
Total for LECSA 3		141,408.37	225,041.15	225,041.15	387.41	616.55	616.55
LEC Planning Area Total		286,429.63	443,411.80	443,411.80	784.10	1,214.82	1,214.82

a. From surface water

b. To supply Monroe County

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand.

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
06-00001-W	2	Seminole Tribe	0	0	0	0
06-00001-W	16	Seminole Tribe	50	50	50	50
06-00001-W	19	Seminole Tribe	50	50	50	50
06-00003-W	1	Royal Utility Company	33	33	33	33
06-00003-W	2	Royal Utility Company	33	33	33	33
06-00003-W	3	Royal Utility Company	33	33	33	33
06-00004-W	1	North Lauderdale	33	33	33	33
06-00004-W	2	North Lauderdale	33	33	33	33
06-00004-W	3	North Lauderdale	33	33	33	33
06-00038-W	1	Hollywood	2	0	0	0
06-00038-W	2	Hollywood	3	0	0	0
06-00038-W	3	Hollywood	3	0	0	0
06-00038-W	4	Hollywood	3	0	0	0
06-00038-W	5	Hollywood	3	0	0	0
06-00038-W	6	Hollywood	3	0	0	0
06-00038-W	7	Hollywood	3	0	0	0
06-00038-W	8	Hollywood	3	0	0	0
06-00038-W	9	Hollywood	3	0	0	0
06-00038-W	10	Hollywood	3	0	0	0
06-00038-W	12	Hollywood	2	0	0	0
06-00038-W	13	Hollywood	2	0	0	0
06-00038-W	14	Hollywood	2	0	0	0
06-00038-W	15	Hollywood	3	0	0	0
06-00038-W	16	Hollywood North	3	1.75	0	0
06-00038-W	17	Hollywood North	3	1.75	0	0
06-00038-W	18	Hollywood North	3	1.75	0	0
06-00038-W	19	Hollywood North	3	1.75	0	0
06-00038-W	20	Hollywood North	6	3.2	0	0
06-00038-W	21	Hollywood North	6	3.2	0	0
06-00038-W	22	Hollywood South	6	3.2	0	0
06-00038-W	23	Hollywood South	6	3.2	0	0
06-00038-W	24	Hollywood South	6	3.2	0	0
06-00038-W	25	Hollywood South	6	3.2	0	0
06-00038-W	26	Hollywood South	6	3.2	0	0
06-00038-W	27	Hollywood South	6	3.2	0	0
06-00038-W	28	Hollywood South	0	3.2	0	6.25
06-00038-W	29	Hollywood South	0	3.2	0	6.25
06-00038-W	30	Hollywood South	0	0	0	6.25
06-00038-W	31	Hollywood South	0	0	0	6.25
06-00038-W	32	Hollywood South	0	0	0	6.25
06-00038-W	33	Hollywood South	0	0	0	6.25
06-00038-W	34	Hollywood South	0	0	0	6.25
06-00038-W	35	Hollywood South	0	0	0	6.25

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
06-00038-W	36	Hollywood West	0	0	0	8.33
06-00038-W	37	Hollywood West	0	0	0	8.33
06-00038-W	38	Hollywood West	0	0	0	8.33
06-00038-W	39	Hollywood West	0	0	0	8.33
06-00038-W	40	Hollywood West	0	0	0	8.33
06-00038-W	41	Hollywood	0	0	0	8.33
06-00038-W	fwell1	Hollywood	0	0	0	0
06-00038-W	fwell2	Hollywood	0	0	0	0
06-00038-W	fwell21	Hollywood	0	4.34	0	0
06-00038-W	fwell22	Hollywood	0	4.34	0	0
06-00038-W	fwell23	Hollywood	0	4.34	0	0
06-00038-W	fwell24	Hollywood	0	4.34	0	0
06-00038-W	fwell25	Hollywood	0	4.34	10	0
06-00038-W	fwell26	Hollywood	0	4.34	10	0
06-00038-W	fwell27	Hollywood	0	4.34	10	0
06-00038-W	fwell28	Hollywood	0	4.34	10	0
06-00038-W	fwell29	Hollywood	0	4.34	10	0
06-00038-W	fwell3	Hollywood	0	0	0	0
06-00038-W	fwell30	Hollywood	0	4.34	10	0
06-00038-W	fwell31	Hollywood	0	4.34	10	0
06-00038-W	fwell32	Hollywood	0	4.34	10	0
06-00038-W	fwell33	Hollywood	0	4.34	10	0
06-00038-W	fwell34	Hollywood	0	4.34	10	0
06-00038-W	fwell4	Hollywood	0	0	0	0
06-00038-W	fwell5	Hollywood	0	0	0	0
06-00054-W	1	Miramar	7	5	0	0
06-00054-W	2	Miramar	2	5	0	0
06-00054-W	3	Miramar	18	16	0	5
06-00054-W	4	Miramar	8	16	0	5
06-00054-W	5	Miramar	15	16	0	5
06-00054-W	6	Miramar	16	16	0	10
06-00054-W	7	Miramar	23	16	0	10
06-00054-W	8	Miramar	8	5	0	0
06-00054-W	9	Miramar	3	5	0	0
06-00054-W	10	Miramar West	0	0	25	16.3
06-00054-W	11	Miramar West	0	0	25	16.3
06-00054-W	12	Miramar West	0	0	25	16.3
06-00054-W	13	Miramar West	0	0	25	16.3
06-00070-W	2	Pompano	6	0	0	2
06-00070-W	3	Pompano	3	3	3	3
06-00070-W	4	Pompano	0	6	6	3
06-00070-W	5	Pompano	2	2	2	3
06-00070-W	6	Pompano	3	3	3	3

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
06-00070-W	7	Pompano	11	7	7	5
06-00070-W	8	Pompano	0	0	0	0
06-00070-W	9	Pompano	6	0	0	0
06-00070-W	10	Pompano	8	7	7	5
06-00070-W	11	Pompano	8	7	7	5
06-00070-W	12	Pompano	9	7	7	5
06-00070-W	13	Pompano	8	7	7	5
06-00070-W	14	Pompano	0	0	0	0
06-00070-W	15	Pompano	0	0	0	0
06-00070-W	16	Pompano	8	7	7	5
06-00070-W	17	Pompano	6	6.3	6.3	8
06-00070-W	18	Pompano	6	6.3	6.3	8
06-00070-W	19	Pompano	4	6.3	6.33	8
06-00070-W	20	Pompano	4	6.3	6.3	8
06-00070-W	21	Pompano	3	6.3	6.3	8
06-00070-W	22	Pompano	4	6.3	6.3	8
06-00070-W	fwell1	Pompano	0	6.3	6.3	8
06-00071-W	1	Tamarac	7.7	0	0	5.26
06-00071-W	2	Tamarac	7.7	0	0	5.26
06-00071-W	3	Tamarac	7.7	11.1	11.1	5.26
06-00071-W	4	Tamarac	7.7	11.1	11.1	5.26
06-00071-W	5	Tamarac	7.7	11.1	11.1	5.26
06-00071-W	6	Tamarac	7.7	11.1	11.1	5.26
06-00071-W	7	Tamarac	7.7	11.1	11.1	5.26
06-00071-W	8	Tamarac	7.7	11.1	11.1	5.26
06-00071-W	9	Tamarac	7.7	11.1	11.1	5.26
06-00071-W	10	Tamarac	7.7	11.1	11.1	5.26
06-00071-W	11	Tamarac	7.7	11.1	11.1	5.26
06-00071-W	12	Tamarac	7.7	0	0	5.26
06-00071-W	13	Tamarac	7.7	0	0	5.26
06-00071-W	14	Tamarac	0	0	0	5.26
06-00071-W	15	Tamarac	0	0	0	5.26
06-00071-W	16	Tamarac	0	0	0	5.26
06-00071-W	17	Tamarac	0	0	0	5.26
06-00071-W	18	Tamarac	0	0	0	5.26
06-00071-W	19	Tamarac	0	0	0	5.33
06-00082-W	2	Deerfield	0	0	0	0
06-00082-W	3	Deerfield	0	0	0	0
06-00082-W	4	Deerfield	0	0	0	0
06-00082-W	5	Deerfield	10	0	0	0
06-00082-W	6	Deerfield	7	0	0	0
06-00082-W	7	Deerfield	7	0	0	0
06-00082-W	8	Deerfield	7	0	0	0

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
06-00082-W	9	Deerfield	0	0	0	0
06-00082-W	10	Deerfield	7	4	4	4
06-00082-W	11	Deerfield	7	4	4	4
06-00082-W	12	Deerfield	7	4	4	4
06-00082-W	13	Deerfield	7	4	4	4
06-00082-W	14	Deerfield	7	4	4	4
06-00082-W	15	Deerfield	7	4	4	4
06-00082-W	16	Deerfield	7	4	4	4
06-00082-W	17	Deerfield	5	14.4	14.4	14.4
06-00082-W	18	Deerfield	5	14.4	14.4	14.4
06-00082-W	19	Deerfield	5	14.4	14.4	14.4
06-00082-W	20	Deerfield	5	14.4	14.4	14.4
06-00082-W	21	Deerfield	0	0	0	14.4
06-00082-W	fwell1	Deerfield	0	14.4	14.4	0
06-00100-W	1	Coral Springs I/D	10	14	14	6
06-00100-W	2	Coral Springs I/D	10	14	14	6
06-00100-W	3	Coral Springs I/D	10	14	14	6
06-00100-W	4	Coral Springs I/D	10	14	14	6
06-00100-W	5	Coral Springs I/D	26	16	16	20
06-00100-W	6	Coral Springs I/D	17	14	14	20
06-00100-W	7	Coral Springs I/D	17	14	14	16
06-00100-W	8	Coral Springs I/D	0	0	0	20
06-00101-W	1	Hillsboro Beach	48	48	48	48
06-00101-W	2	Hillsboro Beach	2	0	0	0
06-00101-W	3	Hillsboro Beach	48	48	48	48
06-00101-W	4	Hillsboro Beach	2	4	4	4
06-00102-W	1	Coral Springs City	4	0	0	0
06-00102-W	2	Coral Springs City	5	0	0	0
06-00102-W	3	Coral Springs City	5	0	0	0
06-00102-W	4	Coral Springs City	3	0	0	0
06-00102-W	5	Coral Springs City	5	0	0	0
06-00102-W	6	Coral Springs City	3	0	0	0
06-00102-W	7	Coral Springs City	3	10	10	3
06-00102-W	8	Coral Springs City	3	10	10	3
06-00102-W	9	Coral Springs City	3	10	10	3
06-00102-W	10	Coral Springs City	5	10	10	5
06-00102-W	11	Coral Springs City	4	10	10	4
06-00102-W	12	Coral Springs City	13	10	10	7.5
06-00102-W	13	Coral Springs City	10	10	10	7.5
06-00102-W	14	Coral Springs City	11	10	10	7.5
06-00102-W	15	Coral Springs City	11	10	10	7.5
06-00102-W	16	Coral Springs City	13	10	10	7.5
06-00102-W	17	Coral Springs City	0	0	0	7.5

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
06-00102-W	18	Coral Springs City	0	0	0	7.5
06-00102-W	19	Coral Springs City	0	0	0	7.5
06-00102-W	20	Coral Springs City	0	0	0	7.5
06-00102-W	21	Coral Springs City	0	0	0	7.5
06-00102-W	22	Coral Springs City	0	0	0	7.5
06-00103-W	C1	Plantation	5.9	5	5	4
06-00103-W	C2	Plantation	5.9	5	5	4
06-00103-W	C3	Plantation	5.9	5	5	4
06-00103-W	C4	Plantation	5.9	5	5	4
06-00103-W	C5	Plantation	0	5	5	4
06-00103-W	C6	Plantation	0	5	5	4
06-00103-W	C7	Plantation	0	5	5	4
06-00103-W	C8	Plantation	0	5	5	4
06-00103-W	E1	Plantation	6.9	7.5	7.5	8.5
06-00103-W	E10	Plantation	10.7	0	0	0
06-00103-W	E2	Plantation	6.9	7.5	7.5	8.5
06-00103-W	E3	Plantation	6.9	7.5	7.5	8.5
06-00103-W	E4	Plantation	7.6	7.5	7.5	8.5
06-00103-W	E5	Plantation	7.6	7.5	7.5	8.5
06-00103-W	E6	Plantation	5.4	7.5	7.5	8.5
06-00103-W	E7	Plantation	6.1	7.5	7.5	8.5
06-00103-W	E8	Plantation	7.6	7.5	7.5	8.5
06-00103-W	E9	Plantation	10.7	0	0	0
06-00120-W	1	Sunrise	0	0	0	0
06-00120-W	2	Sunrise	6	6.1	6.1	2.37
06-00120-W	3	Sunrise	6	6.1	6.1	2.37
06-00120-W	4	Sunrise	6	6.1	6.1	2.37
06-00120-W	5	Sunrise	6	6.1	6.1	2.37
06-00120-W	6	Sunrise	0	0	0	0
06-00120-W	7	Sunrise	6	6.1	6.1	2.37
06-00120-W	8	Sunrise	6	6.1	6.1	2.37
06-00120-W	9	Sunrise	0	0	0	0
06-00120-W	10	Sunrise	6	6.1	6.1	2.37
06-00120-W	11	Sunrise	6	6.1	6.1	2.37
06-00120-W	12	Sunrise	6	6.1	6.1	2.37
06-00120-W	13	Sunrise	6	6.1	6.1	2.37
06-00120-W	14	Sunrise	6	6.1	6.1	2.37
06-00120-W	15	Sunrise	6	6.1	6.1	2.37
06-00120-W	16	Sunrise	6	6.1	6.1	2.37
06-00120-W	17	Sunrise	0	0	0	2.37
06-00120-W	18	Sunrise	0	0	0	2.37
06-00120-W	19	Sunrise	0	0	0	2.37
06-00120-W	20	Sunrise	0	0	0	2.37

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
06-00120-W	21	Sunrise	0	0	0	2.37
06-00120-W	22	Sunrise	0	0	0	2.37
06-00120-W	23	Sunrise	0	3	3	0
06-00120-W	24	Sunrise	0	3	3	0
06-00120-W	25	Sunrise	4	3	3	0
06-00120-W	26	Sunrise	4	3	3	0
06-00120-W	27	Sunrise	3	3	3	0
06-00120-W	28	Sunrise	3	3	3	0
06-00120-W	29	Sunrise	7	3	3	0
06-00120-W	30	Sunrise	0	0	0	2
06-00120-W	31	Sunrise	0	0	0	2
06-00120-W	32	Sunrise	0	0	0	2
06-00120-W	33	Sunrise	0	0	0	4.37
06-00120-W	34	Sunrise	0	0	0	3.5
06-00120-W	35	Sunrise	0	0	0	4.37
06-00120-W	36	Sunrise	0	0	0	4.37
06-00120-W	37	Sunrise	0	0	0	4.37
06-00120-W	38	Sunrise	0	0	0	3.5
06-00120-W	39	Sunrise	0	0	0	3.5
06-00120-W	40	Sunrise	0	0	0	3.5
06-00120-W	41	Sunrise	0	0	0	3.5
06-00120-W	42	Sunrise	0	0	0	3.5
06-00120-W	43	Sunrise	0	0	0	3.5
06-00120-W	44	Sunrise	0	0	0	3.5
06-00120-W	45	Sunrise	0	0	0	3.5
06-00121-W	1	Margate	4	4	4	4
06-00121-W	2	Margate	5	5	5	5
06-00121-W	3	Margate	6	6	6	6
06-00121-W	4	Margate	6	6	6	6
06-00121-W	5	Margate	6	6	6	6
06-00121-W	6	Margate	6	6	6	6
06-00121-W	7	Margate	6	6	6	6
06-00121-W	8	Margate	9	9	9	9
06-00121-W	9	Margate	9	13	13	13
06-00121-W	10	Margate	13	13	13	13
06-00121-W	11	Margate	13	13	13	13
06-00121-W	12	Margate	13	13	13	13
06-00123-W	1	Ft. Lauderdale	1	0.9	0	0.8
06-00123-W	2	Ft. Lauderdale	1	0.9	0	0.8
06-00123-W	3	Ft. Lauderdale	1	0.9	0	0.8
06-00123-W	4	Ft. Lauderdale	1	0.9	0	0.8
06-00123-W	5	Ft. Lauderdale	1	0.9	0	0.8
06-00123-W	6	Ft. Lauderdale	1	0.9	0	0.8

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
06-00123-W	7	Ft. Lauderdale	1	0.9	0	0.8
06-00123-W	8	Ft. Lauderdale	1	0.9	0	0.8
06-00123-W	9	Ft. Lauderdale	1	0	0	0.8
06-00123-W	10	Ft. Lauderdale	1	0.9	0	0.8
06-00123-W	11	Ft. Lauderdale	1	0.9	0	0.8
06-00123-W	12	Ft. Lauderdale	0	0	0	0.8
06-00123-W	13	Ft. Lauderdale	0	0.9	0	0.8
06-00123-W	14	Ft. Lauderdale	0	0.9	0	0.8
06-00123-W	15	Ft. Lauderdale	0	0.9	0	0.8
06-00123-W	16	Ft. Lauderdale	0	0.9	0	0.8
06-00123-W	17	Ft. Lauderdale	0	0.9	3.25	0.8
06-00123-W	18	Ft. Lauderdale	0	0.9	0	0.8
06-00123-W	19	Ft. Lauderdale	0	0.9	0	0.8
06-00123-W	20	Ft. Lauderdale	0	0.9	0	0.8
06-00123-W	21	Ft. Lauderdale	0	0.9	0	0.8
06-00123-W	22	Ft. Lauderdale	0	0.9	0	0.8
06-00123-W	23	Ft. Lauderdale	1	0.9	0	0.8
06-00123-W	24	Ft. Lauderdale	1	0.9	0	0.8
06-00123-W	25	Ft. Lauderdale	1	0.9	0	0.8
06-00123-W	40	Ft. Lauderdale	0	0	0	0
06-00123-W	41	Ft. Lauderdale	0	0	0	0
06-00123-W	42	Ft. Lauderdale	0	0	0	0
06-00123-W	43	Ft. Lauderdale	0	0	0	0
06-00123-W	47	Ft. Lauderdale	0	0	0	0
06-00123-W	48	Ft. Lauderdale	0	0	3.48	3.2
06-00123-W	49	Ft. Lauderdale	9.55	2.93	3.48	3.2
06-00123-W	50	Ft. Lauderdale	9.55	2.93	3.48	3.2
06-00123-W	51	Ft. Lauderdale	0	2.93	3.48	3.2
06-00123-W	52	Ft. Lauderdale	0	2.93	3.48	3.2
06-00123-W	53	Ft. Lauderdale	9.55	2.93	3.48	3.2
06-00123-W	54	Ft. Lauderdale	9.55	2.93	3.48	3.2
06-00123-W	55	Ft. Lauderdale	9.55	2.93	3.48	3.2
06-00123-W	56	Ft. Lauderdale	9.55	2.93	3.48	3.2
06-00123-W	57	Ft. Lauderdale	9.55	2.93	3.48	3.2
06-00123-W	58	Ft. Lauderdale	0	2.93	3.48	3.2
06-00123-W	59	Ft. Lauderdale	0	2.93	3.48	3.2
06-00123-W	60	Ft. Lauderdale	0	2.93	3.48	3.2
06-00123-W	61	Ft. Lauderdale	9.55	2.93	3.48	3.2
06-00123-W	62	Ft. Lauderdale	0	2.93	3.48	3.2
06-00123-W	63	Ft. Lauderdale	9.55	2.93	3.48	3.2
06-00123-W	64	Ft. Lauderdale	0	2.93	3.48	3.2
06-00123-W	65	Ft. Lauderdale	0	2.93	3.48	3.2
06-00123-W	66	Ft. Lauderdale	0	2.93	3.48	3.2

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
06-00123-W	67	Ft. Lauderdale	0	2.93	3.48	3.2
06-00123-W	68	Ft. Lauderdale	0	2.93	3.48	3.2
06-00123-W	69	Ft. Lauderdale	0	2.93	3.48	3.2
06-00123-W	70	Ft. Lauderdale	0	2.93	3.48	3.2
06-00123-W	71	Ft. Lauderdale	0	2.93	3.48	3.2
06-00123-W	72	Ft. Lauderdale	0	2.93	3.48	3.2
06-00123-W	fwell1	Ft. Lauderdale	0	3.12	2.37	0
06-00123-W	fwell2	Ft. Lauderdale	0	2.93	3.63	0
06-00123-W	fwell3	Ft. Lauderdale	0	2.93	3.63	0
06-00129-W	1	Lauderhill	3	3	3	3
06-00129-W	2	Lauderhill	8	8	8	8
06-00129-W	3	Lauderhill	12	12	12	12
06-00129-W	4	Lauderhill	8	8	8	8
06-00129-W	5	Lauderhill	23	23	23	23
06-00129-W	6	Lauderhill	23	23	23	23
06-00129-W	7	Lauderhill	23	23	23	23
06-00134-W	1	Davie	14	10	10	10
06-00134-W	2	Davie	16	10	10	10
06-00134-W	3	Davie	24	10	10	10
06-00134-W	4	Davie	45	10	10	10
06-00134-W	5	Davie	0	20	20	15
06-00134-W	6	Davie	0	20	20	15
06-00134-W	7	Davie	0	20	20	30
06-00134-W	8	Davie	0	0	0	0
06-00134-W	9	Davie	0	0	0	0
06-00135-W	1	Pembroke Pines	21	12.5	12.5	6.66
06-00135-W	2	Pembroke Pines	1	12.5	12.5	6.66
06-00135-W	3	Pembroke Pines	1	12.5	12.5	6.66
06-00135-W	4	Pembroke Pines	1	12.5	12.5	5
06-00135-W	5	Pembroke Pines	1	12.5	12.5	5
06-00135-W	6	Pembroke Pines	25	12.5	12.5	17
06-00135-W	7	Pembroke Pines	25	12.5	12.5	17
06-00135-W	8	Pembroke Pines	25	12.5	12.5	17
06-00135-W	10	Pembroke Pines	0	0	0	6.34
06-00135-W	11	Pembroke Pines	0	0	0	6.34
06-00135-W	12	Pembroke Pines	0	0	0	6.34
06-00138-W	1	Hallandale	0	0	0	0
06-00138-W	2	Hallandale	0	0	0	0
06-00138-W	3	Hallandale	0	0	0	0
06-00138-W	4	Hallandale	0	0	0	0
06-00138-W	5	Hallandale	0	0	0	0
06-00138-W	6	Hallandale	0	0	0	0
06-00138-W	7	Hallandale	35	12.5	0	40

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
06-00138-W	8	Hallandale	65	12.5	0	60
06-00138-W	fwell1	Hallandale	0	12.5	0	0
06-00138-W	fwell2	Hallandale	0	12.5	0	0
06-00138-W	fwell3	Hallandale	0	12.5	25	0
06-00138-W	fwell4	Hallandale	0	12.5	25	0
06-00138-W	fwell5	Hallandale	0	12.5	25	0
06-00138-W	fwell6	Hallandale	0	12.5	25	0
06-00142-W	1 East	Broward 2A (East)	3	4.8	3.6	2
06-00142-W	10 East	Broward 2A (East)	0	4.8	3.6	17
06-00142-W	11 East	Broward 2A (East)	0	4.8	3.6	17
06-00142-W	2 East	Broward 2A (East)	10	4.8	3.6	2
06-00142-W	3 East	Broward 2A (East)	4	4.8	3.6	2
06-00142-W	4 East	Broward 2A (East)	15	4.8	3.6	11
06-00142-W	5 East	Broward 2A (East)	9	4.8	3.6	2
06-00142-W	6 East	Broward 2A (East)	10	4.8	3.6	2
06-00142-W	7 East	Broward 2A (East)	20	4.8	3.6	17
06-00142-W	8 East	Broward 2A (East)	16	4.8	3.6	11
06-00142-W	9 East	Broward 2A (East)	12	4.8	3.6	17
06-00142-W	fwell1	Broward 2A (East)	0	11	11.4	0
06-00145-W	1	Broward 3A/3C	25	8.33	8.33	0
06-00145-W	2	Broward 3A/3C	25	8.33	8.33	0
06-00145-W	3	Broward 3A/3C	25	8.33	8.33	0
06-00145-W	4	Broward 3A/3C	25	8.33	8.33	0
06-00145-W	5	Broward 3A/3C	0	8.34	8.34	5.6
06-00145-W	6	Broward 3A/3C	0	8.34	8.34	5.6
06-00145-W	17	Broward 3A/3C	0	6.25	6.25	11.1
06-00145-W	18	Broward 3A/3C	0	6.25	6.25	11.1
06-00145-W	19	Broward 3A/3C	0	6.25	6.25	11.1
06-00145-W	20	Broward 3A/3C	0	6.25	6.25	11.1
06-00145-W	21	Broward 3A/3C	0	6.25	6.25	11.1
06-00145-W	22	Broward 3A/3C	0	6.25	6.25	11.1
06-00145-W	23	Broward 3A/3C	0	6.25	6.25	11.1
06-00145-W	24	Broward 3A/3C	0	6.25	6.25	11.1
06-00146-W	1	Broward 1A, 1B	11	0	0	0
06-00146-W	2	Broward 1A, 1B	11	10	10	10
06-00146-W	3	Broward 1A, 1B	10	10	10	10
06-00146-W	4	Broward 1A, 1B	11	0	0	0
06-00146-W	5	Broward 1A, 1B	19	20	20	20
06-00146-W	6	Broward 1A, 1B	19	20	20	20
06-00146-W	7	Broward 1A, 1B	19	20	20	20
06-00146-W	8	Broward 1A, 1B	0	0	0	0
06-00146-W	9	Broward 1A, 1B	0	20	20	20

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
06-00147-W	1	Broward 3B (South System Regional)	2	0	0	0
06-00147-W	2	Broward 3B (South System Regional)	8	0	0	0
06-00147-W	3	Broward 3B (South System Regional)	11	0	0	0
06-00147-W	A	Broward 3B (South System Regional)	19	0	0	0
06-00147-W	B	Broward 3B (South System Regional)	20	13	0	0
06-00147-W	C	Broward 3B (South System Regional)	20	13	0	0
06-00147-W	D	Broward 3B (South System Regional)	20	13	0	0
06-00147-W	fwell1	Broward 3B (South System Regional)	0	15	0	0
06-00147-W	fwell2	Broward 3B (South System Regional)	0	15	33.3	0
06-00147-W	fwell3	Broward 3B (South System Regional)	0	15	33.4	0
06-00147-W	fwell4	Broward 3B (South System Regional)	0	15	33.3	0
06-00170-W	1	Ferncrest	0	0	0	0
06-00170-W	2	Ferncrest	0	0	0	0
06-00170-W	3	Ferncrest	80	50	50	50
06-00170-W	4	Ferncrest	20	50	50	50
06-00187-W	1	Dania	63	25	0	63
06-00187-W	2	Dania	37	25	0	37
06-00187-W	fwell1	Dania	0	25	50	0
06-00187-W	fwell2	Dania	0	25	50	0
06-00242-W	1	Parkland	50	50	50	50
06-00242-W	2	Parkland	50	50	50	50
06-00274-W	1	North Springs	0	0	0	6.66
06-00274-W	2	North Springs	25	25	25	6.66
06-00274-W	3	North Springs	0	0	0	6.66
06-00274-W	4	North Springs	0	0	0	6.66
06-00274-W	5	North Springs	0	0	0	6.66
06-00274-W	6	North Springs	25	25	25	6.66
06-00274-W	7	North Springs	25	25	25	6.66
06-00274-W	8	North Springs	0	0	0	6.66
06-00274-W	9	North Springs	0	0	0	6.66
06-00274-W	10	North Springs	0	0	0	6.66
06-00274-W	11	North Springs	0	0	0	6.66
06-00274-W	12	North Springs	0	0	0	6.66
06-00274-W	13	North Springs	0	0	0	6.66
06-00274-W	14	North Springs	0	0	0	6.66

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
06-00274-W	2A	North Springs	25	25	25	6.66
06-00365-W	1	Cooper City	12	10	10	0
06-00365-W	1	Cooper City	21	8	8	5
06-00365-W	2	Cooper City	12	8	8	0
06-00365-W	3	Cooper City	12	23	23	0
06-00365-W	3	Cooper City	21	18	18	15
06-00365-W	4	Cooper City	21	33	33	35
06-00365-W	5	Cooper City	0	0	0	15
06-00365-W	6	Cooper City	0	0	0	15
06-00365-W	7	Cooper City	0	0	0	15
06-00435-W	1	South Broward	33	0	0	0
06-00435-W	2	South Broward	33	0	0	0
06-00435-W	3	South Broward	33	0	0	0
06-01634-W	1 North	Broward North Regional	0	3.6	4.9	5
06-01634-W	10 North	Broward North Regional	0	3.6	4.9	5
06-01634-W	2 North	Broward North Regional	0	3.6	4.9	5
06-01634-W	3 North	Broward North Regional	0	3.6	4.9	17.5
06-01634-W	4 North	Broward North Regional	0	3.6	4.9	17.5
06-01634-W	5 North	Broward North Regional	0	3.6	4.9	17.5
06-01634-W	6 North	Broward North Regional	0	3.6	4.9	5
06-01634-W	7 North	Broward North Regional	0	3.6	4.9	5
06-01634-W	8 North	Broward North Regional	0	3.6	4.9	5
06-01634-W	9 North	Broward North Regional	0	3.6	4.9	17.5
13-00005-W	1	FCAA	8.33	0	0	0
13-00005-W	2	FCAA	8.33	0	0	0
13-00005-W	3	FCAA	8.33	0	0	0
13-00005-W	4	FCAA	8.33	6.3	6.3	7.9
13-00005-W	5	FCAA	8.33	0	0	0
13-00005-W	6	FCAA	8.33	0	0	0
13-00005-W	7	FCAA	8.33	11.6	11.6	12.8
13-00005-W	8	FCAA	8.33	6.3	6.3	7.9
13-00005-W	9	FCAA	8.33	6.3	6.3	7.9
13-00005-W	10	FCAA	0	11.6	11.6	12.8
13-00005-W	11	FCAA	0	11.6	11.6	12.8
13-00005-W	12	FCAA	0	11.6	11.6	12.8
13-00005-W	13	FCAA	0	11.6	11.6	12.8
13-00005-W	14	FCAA	0	11.6	11.6	12.8
13-00005-W	390	FCAA	8.33	0	0	0
13-00005-W	391	FCAA	8.33	0	0	0
13-00005-W	393	FCAA	8.33	0	0	0
13-00005-W	fwell1	FCAA	0	11.6	11.6	0
13-00017-W	1	Alexander Orr (WASD)	3.57	2.2	2.2	2.5
13-00017-W	2	Alexander Orr (WASD)	3.57	2.2	2.2	2.5

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
13-00017-W	3	Alexander Orr (WASD)	3.57	2.2	2.2	2.5
13-00017-W	4	Alexander Orr (WASD)	3.57	2.2	2.2	2.5
13-00017-W	5	Alexander Orr (WASD)	3.57	2.2	2.2	2.5
13-00017-W	6	Alexander Orr (WASD)	3.57	2.2	2.2	2.5
13-00017-W	7	Alexander Orr (WASD)	3.57	2.2	2.2	2.5
13-00017-W	8	Alexander Orr (WASD)	3.57	2.2	2.2	2.5
13-00017-W	9	Alexander Orr (WASD)	3.57	2.2	2.2	2.5
13-00017-W	10	Alexander Orr (WASD)	3.57	2.2	2.2	2.5
13-00017-W	11	Alexander Orr (WASD)	3.57	2.5	2.5	3.21
13-00017-W	12	Alexander Orr (WASD)	3.57	2.5	2.5	3.21
13-00017-W	13	Alexander Orr (WASD)	3.57	2.5	2.5	3.21
13-00017-W	14	Alexander Orr (WASD)	3.57	2.5	2.5	3.21
13-00017-W	15	Alexander Orr (WASD)	3.57	2.5	2.5	3.21
13-00017-W	16	Alexander Orr (WASD)	3.57	2.5	2.5	3.21
13-00017-W	17	Alexander Orr (WASD)	3.57	2.5	2.5	3.21
13-00017-W	18	Alexander Orr (WASD)	3.57	2.5	2.5	3.21
13-00017-W	19	Alexander Orr (WASD)	3.57	2.5	2.5	3.21
13-00017-W	20	Alexander Orr (WASD)	3.57	2.5	2.5	3.21
13-00017-W	21	Alexander Orr (WASD)	3.57	2.75	2.75	3.75
13-00017-W	22	Alexander Orr (WASD)	3.57	2.75	2.75	3.75
13-00017-W	23	Alexander Orr (WASD)	3.57	2.75	2.75	3.75
13-00017-W	24	Alexander Orr (WASD)	3.57	2.75	2.75	3.75
13-00017-W	25	Alexander Orr (WASD)	3.57	2.5	2.5	3.21
13-00017-W	26	Alexander Orr (WASD)	3.57	2.5	2.5	3.21
13-00017-W	27	Alexander Orr (WASD)	3.57	2.5	2.5	3.21
13-00017-W	28	Alexander Orr (WASD)	3.57	2.5	2.5	3.21
13-00017-W	29	Alexander Orr (WASD)	0	2.5	2.5	3.75
13-00017-W	30	Alexander Orr (WASD)	0	2.5	2.5	3.75
13-00017-W	31	Alexander Orr (WASD)	0	2.5	2.5	3.75
13-00017-W	32	Alexander Orr (WASD)	0	2.5	2.5	3.75
13-00017-W	FL-1	Alexander Orr (WASD)	0	0	0	0
13-00017-W	FL-2	Alexander Orr (WASD)	0	0	0	0
13-00017-W	fwell1	Alexander Orr (WASD)	0	2.5	2.5	0
13-00017-W	fwell2	Alexander Orr (WASD)	0	2.5	2.5	0
13-00017-W	fwell3	Alexander Orr (WASD)	0	2.5	2.5	0
13-00017-W	fwell4	Alexander Orr (WASD)	0	2.5	2.5	0
13-00017-W	fwell5	Alexander Orr (WASD)	0	2.5	2.5	0
13-00017-W	fwell6	Alexander Orr (WASD)	0	2.5	2.5	0
13-00017-W	fwell7	Alexander Orr (WASD)	0	2.5	2.5	0
13-00017-W	fwell8	Alexander Orr (WASD)	0	2.5	2.5	0
13-00017-W	fwell9	Alexander Orr (WASD)	0	2.5	2.5	0
13-00029-W	1	Florida City	25	16.6	16.6	25
13-00029-W	2	Florida City	25	16.6	16.6	25

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
13-00029-W	3	Florida City	25	16.6	16.6	25
13-00029-W	4	Florida City	25	16.6	16.6	25
13-00029-W	fwell1	Florida City	0	16.6	16.6	0
13-00029-W	fwell2	Florida City	0	16.6	16.6	0
13-00037-W	1	WASD-Hialeah Preston	6.33	4.48	4.48	4.31
13-00037-W	2	WASD-Hialeah Preston	6.33	4.48	4.48	4.31
13-00037-W	3	WASD-Hialeah Preston	6.33	4.48	4.48	4.31
13-00037-W	4	WASD-Hialeah Preston	6.33	4.48	4.48	4.31
13-00037-W	5	WASD-Hialeah Preston	6.33	4.48	4.48	4.31
13-00037-W	6	WASD-Hialeah Preston	6.33	4.48	4.48	4.31
13-00037-W	7	WASD-Hialeah Preston	6.33	4.48	4.48	4.31
13-00037-W	8	WASD-Hialeah Preston	6.33	4.48	4.48	4.31
13-00037-W	9	WASD-Hialeah Preston	6.33	4.48	4.48	4.31
13-00037-W	10	WASD-Hialeah Preston	6.33	4.48	4.48	4.31
13-00037-W	11	WASD-Hialeah Preston	6.33	4.48	4.48	4.31
13-00037-W	12	WASD-Hialeah Preston	6.33	4.48	4.48	4.31
13-00037-W	13	WASD-Hialeah Preston	6.33	4.48	4.48	4.31
13-00037-W	14	WASD-Hialeah Preston	6.33	4.48	4.48	4.31
13-00037-W	15	WASD-Hialeah Preston	6.33	4.48	4.48	4.31
13-00037-W	HP-11	WASD-Hialeah Preston	0.17	1.56	1.56	1.67
13-00037-W	HP-12	WASD-Hialeah Preston	0.17	1.56	1.56	1.67
13-00037-W	HP-13	WASD-Hialeah Preston	0.17	1.56	1.56	1.67
13-00037-W	JP-1	WASD-Hialeah Preston	0.17	0.67	0.67	0.72
13-00037-W	JP-2	WASD-Hialeah Preston	0.17	0.67	0.67	0.72
13-00037-W	JP-3	WASD-Hialeah Preston	0.17	0.67	0.67	0.72
13-00037-W	JP-4	WASD-Hialeah Preston	0.17	0.67	0.67	0.72
13-00037-W	JP-5	WASD-Hialeah Preston	0.17	0.67	0.67	0.72
13-00037-W	JP-6	WASD-Hialeah Preston	0.17	0.67	0.67	0.72
13-00037-W	JP-7	WASD-Hialeah Preston	0.17	0.67	0.67	0.72
13-00037-W	MS-1	WASD-Hialeah Preston	0.17	1.17	1.17	1.26
13-00037-W	MS-10	WASD-Hialeah Preston	0.17	1.17	1.17	1.26
13-00037-W	MS-14	WASD-Hialeah Preston	0.17	1.17	1.17	1.26
13-00037-W	MS-15	WASD-Hialeah Preston	0.17	1.17	1.17	1.26
13-00037-W	MS-16	WASD-Hialeah Preston	0.17	1.17	1.17	1.26
13-00037-W	MS-17	WASD-Hialeah Preston	0.17	1.17	1.17	1.26
13-00037-W	MS-18	WASD-Hialeah Preston	0.17	1.17	1.17	1.26
13-00037-W	MS-19	WASD-Hialeah Preston	0.17	1.17	1.17	1.26
13-00037-W	MS-2	WASD-Hialeah Preston	0.17	1.17	1.17	1.26
13-00037-W	MS-20	WASD-Hialeah Preston	0.17	1.17	1.17	1.26
13-00037-W	MS-21	WASD-Hialeah Preston	0.17	1.17	1.17	1.26
13-00037-W	MS-22	WASD-Hialeah Preston	0.17	1.17	1.17	1.26
13-00037-W	MS-23	WASD-Hialeah Preston	0.17	1.17	1.17	1.26
13-00037-W	MS-3	WASD-Hialeah Preston	0.17	1.17	1.17	1.26

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
13-00037-W	MS-4	WASD-Hialeah Preston	0.17	1.17	1.17	1.26
13-00037-W	MS-5	WASD-Hialeah Preston	0.17	1.17	1.17	1.26
13-00037-W	MS-6	WASD-Hialeah Preston	0.17	1.17	1.17	1.26
13-00037-W	MS-7	WASD-Hialeah Preston	0.17	1.17	1.17	1.26
13-00037-W	MS-8	WASD-Hialeah Preston	0.17	1.17	1.17	1.26
13-00037-W	MS-9	WASD-Hialeah Preston	0.17	1.17	1.17	1.26
13-00040-W	1	REX (WASD - S. Dade)	4	1.25	4	0
13-00040-W	2	REX (WASD - S. Dade)	0	15	0	0
13-00040-W	3	REX (WASD - S. Dade)	0	5	0	0
13-00040-W	4	REX (WASD - S. Dade)	11	1.25	11	0
13-00040-W	5	REX (WASD - S. Dade)	11	5	11	0
13-00040-W	6	REX (WASD - S. Dade)	11	5	11	0
13-00040-W	7	REX (WASD - S. Dade)	11	0	11	0
13-00040-W	8	REX (WASD - S. Dade)	24	15	24	0
13-00040-W	9	REX (WASD - S. Dade)	0	15	0	0
13-00040-W	10	REX (WASD - S. Dade)	23	15	23	0
13-00040-W	11	REX (WASD - S. Dade)	0	15	0	0
13-00040-W	12	REX (WASD - S. Dade)	1	1.25	1	0
13-00040-W	13	REX (WASD - S. Dade)	0	1.25	0	0
13-00040-W	14	REX (WASD - S. Dade)	4	5	4	0
13-00040-W	P-1	REX (WASD - S. Dade)	0	0	0	6.66
13-00040-W	P-10	REX (WASD - S. Dade)	0	0	0	6.66
13-00040-W	P-11	REX (WASD - S. Dade)	0	0	0	6.66
13-00040-W	P-12	REX (WASD - S. Dade)	0	0	0	6.66
13-00040-W	P-13	REX (WASD - S. Dade)	0	0	0	6.66
13-00040-W	P-14	REX (WASD - S. Dade)	0	0	0	6.66
13-00040-W	P-15	REX (WASD - S. Dade)	0	0	0	6.66
13-00040-W	P-2	REX (WASD - S. Dade)	0	0	0	6.66
13-00040-W	P-3	REX (WASD - S. Dade)	0	0	0	6.66
13-00040-W	P-4	REX (WASD - S. Dade)	0	0	0	6.66
13-00040-W	P-5	REX (WASD - S. Dade)	0	0	0	6.66
13-00040-W	P-6	REX (WASD - S. Dade)	0	0	0	6.66
13-00040-W	P-7	REX (WASD - S. Dade)	0	0	0	6.66
13-00040-W	P-8	REX (WASD - S. Dade)	0	0	0	6.66
13-00040-W	P-9	REX (WASD - S. Dade)	0	0	0	6.66
13-00046-W	1	Homestead	16.67	14.2	14.2	16.67
13-00046-W	2	Homestead	16.67	14.2	14.2	16.67
13-00046-W	3	Homestead	16.67	14.2	14.2	16.67
13-00046-W	4	Homestead	16.67	14.2	14.2	16.67
13-00046-W	5	Homestead	16.67	14.2	14.2	16.67
13-00046-W	6	Homestead	16.67	14.2	14.2	16.67
13-00046-W	fwell1	Homestead	0	14.8	14.8	0
13-00059-W	1	North Miami	12.5	12.5	12.5	20

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
13-00059-W	2	North Miami	12.5	12.5	12.5	20
13-00059-W	3	North Miami	12.5	12.5	12.5	10
13-00059-W	4	North Miami	12.5	12.5	12.5	10
13-00059-W	5	North Miami	12.5	12.5	12.5	10
13-00059-W	6	North Miami	12.5	12.5	12.5	10
13-00059-W	7	North Miami	12.5	12.5	12.5	10
13-00059-W	8	North Miami	12.5	12.5	12.5	10
13-00059-W	fwell1	North Miami	0	0	0	0
13-00060-W	1	North Miami Beach	10	9	6	6.66
13-00060-W	2	North Miami Beach	10	9	6	6.66
13-00060-W	3	North Miami Beach	10	9	6	6.66
13-00060-W	4	North Miami Beach	10	9	6	6.66
13-00060-W	5	North Miami Beach	10	9	10	6.66
13-00060-W	6	North Miami Beach	10	9	10	6.66
13-00060-W	7	North Miami Beach	10	9	10	6.66
13-00060-W	8	North Miami Beach	10	9	10	6.66
13-00060-W	9	North Miami Beach	10	9	10	6.66
13-00060-W	10	North Miami Beach	10	9	6	6.66
13-00060-W	11	North Miami Beach	0	0	0	6.66
13-00060-W	12	North Miami Beach	0	0	0	6.66
13-00060-W	13	North Miami Beach	0	0	0	6.66
13-00060-W	14	North Miami Beach	0	0	0	6.66
13-00060-W	15	North Miami Beach	0	0	0	6.66
13-00060-W	fwell1	North Miami Beach	0	9.9	20	0
13-00065-W	1	Opa Locka	100	0	0	0
13-00068-W	1	Homestead AFB	33.33	0	0	0
13-00068-W	2	Homestead AFB	33.33	0	0	0
13-00068-W	3	Homestead AFB	33.33	0	0	0
50-00010-W	1	Town of Jupiter	3.33	3.33	3.33	0
50-00010-W	2	Town of Jupiter	3.33	3.33	3.33	0
50-00010-W	3	Town of Jupiter	3.33	3.33	3.33	0
50-00010-W	4	Town of Jupiter	3.33	3.33	3.33	0
50-00010-W	5	Town of Jupiter	3.33	3.33	3.33	0
50-00010-W	6	Town of Jupiter	3.33	3.33	3.33	1.55
50-00010-W	7	Town of Jupiter	3.33	3.33	3.33	1.55
50-00010-W	8	Town of Jupiter	3.33	3.33	3.33	1.55
50-00010-W	9	Town of Jupiter	3.33	3.33	3.33	1.55
50-00010-W	10	Town of Jupiter	3.33	3.33	3.33	1.55
50-00010-W	11	Town of Jupiter	3.33	3.33	3.33	1.55
50-00010-W	12	Town of Jupiter	3.33	3.33	3.33	1.55
50-00010-W	13	Town of Jupiter	3.33	3.33	3.33	1.55
50-00010-W	14	Town of Jupiter	3.33	3.33	3.33	1.55
50-00010-W	15	Town of Jupiter	3.33	3.33	3.33	1.55

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
50-00010-W	16	Town of Jupiter	3.33	3.33	3.33	1.55
50-00010-W	17	Town of Jupiter	3.33	3.33	3.33	1.55
50-00010-W	18	Town of Jupiter	3.33	3.33	3.33	1.55
50-00010-W	19	Town of Jupiter	3.33	3.33	3.33	1.55
50-00010-W	20	Town of Jupiter	3.33	3.33	3.33	1.55
50-00010-W	21	Town of Jupiter	3.33	3.33	3.33	1.55
50-00010-W	22	Town of Jupiter	3.33	3.33	3.33	1.55
50-00010-W	23	Town of Jupiter	3.33	3.33	3.33	1.55
50-00010-W	24	Town of Jupiter	3.33	3.33	3.33	1.55
50-00010-W	25	Town of Jupiter	2.43	3.33	3.33	1.55
50-00010-W	26	Town of Jupiter	3.33	3.33	3.33	1.55
50-00010-W	27	Town of Jupiter	3.33	3.33	3.33	1.55
50-00010-W	28	Town of Jupiter	3.33	3.33	3.33	1.55
50-00010-W	29	Town of Jupiter	3.33	3.33	3.33	1.55
50-00010-W	30	Town of Jupiter	3.33	3.33	3.33	1.55
50-00010-W	31	Town of Jupiter	0	0	0	1.55
50-00010-W	32	Town of Jupiter	0	0	0	1.55
50-00010-W	33	Town of Jupiter	0	0	0	1.55
50-00010-W	34	Town of Jupiter	0	0	0	1.55
50-00010-W	35	Town of Jupiter	0	0	0	1.55
50-00010-W	36	Town of Jupiter	0	0	0	1.55
50-00010-W	37	Town of Jupiter	0	0	0	1.55
50-00010-W	38	Town of Jupiter	0	0	0	1.55
50-00010-W	39	Town of Jupiter	0	0	0	1.55
50-00010-W	40	Town of Jupiter	0	0	0	1.9
50-00010-W	41	Town of Jupiter	0	0	0	1.9
50-00010-W	42	Town of Jupiter	0	0	0	1.9
50-00010-W	43	Town of Jupiter	0	0	0	1.9
50-00010-W	44	Town of Jupiter	0	0	0	1.9
50-00010-W	45	Town of Jupiter	0	0	0	1.9
50-00010-W	46	Town of Jupiter	0	0	0	1.9
50-00010-W	47	Town of Jupiter	0	0	0	1.9
50-00010-W	48	Town of Jupiter	0	0	0	0
50-00010-W	49	Town of Jupiter	0	0	0	0
50-00010-W	50	Town of Jupiter	0	0	0	1.9
50-00010-W	51	Town of Jupiter	0	0	0	1.9
50-00010-W	52	Town of Jupiter	0	0	0	1.9
50-00010-W	53	Town of Jupiter	0	0	0	1.9
50-00010-W	54	Town of Jupiter	0	0	0	1.9
50-00010-W	55	Town of Jupiter	0	0	0	1.9
50-00010-W	56	Town of Jupiter	0	0	0	1.9
50-00010-W	57	Town of Jupiter	0	0	0	1.9
50-00010-W	58	Town of Jupiter	0	0	0	1.9

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
50-00010-W	59	Town of Jupiter	0	0	0	1.9
50-00010-W	60	Town of Jupiter	0	0	0	1.9
50-00010-W	61	Town of Jupiter	0	0	0	1.9
50-00010-W	62	Town of Jupiter	0	0	0	1.9
50-00010-W	63	Town of Jupiter	0	0	0	1.9
50-00010-W	64	Town of Jupiter	0	0	0	1.9
50-00010-W	65	Town of Jupiter	0	0	0	1.9
50-00010-W	66	Town of Jupiter	0	0	0	1.9
50-00010-W	fwell1	Town of Jupiter	0	0	0	0
50-00010-W	RO-1	Town of Jupiter	0	0	0	0
50-00010-W	RO-10	Town of Jupiter	0	0	0	0
50-00010-W	RO-11	Town of Jupiter	0	0	0	0
50-00010-W	RO-12	Town of Jupiter	0	0	0	0
50-00010-W	RO-13	Town of Jupiter	0	0	0	0
50-00010-W	RO-2	Town of Jupiter	0	0	0	0
50-00010-W	RO-3	Town of Jupiter	0	0	0	0
50-00010-W	RO-4	Town of Jupiter	0	0	0	0
50-00010-W	RO-5	Town of Jupiter	0	0	0	0
50-00010-W	RO-6	Town of Jupiter	0	0	0	0
50-00010-W	RO-7	Town of Jupiter	0	0	0	0
50-00010-W	RO-8	Town of Jupiter	0	0	0	0
50-00010-W	RO-9	Town of Jupiter	0	0	0	0
50-00030-W	1	Mangonia Park	33.33	33.3	33.3	25
50-00030-W	2	Mangonia Park	33.34	33.3	33.3	25
50-00030-W	3	Mangonia Park	33.33	33.3	33.3	25
50-00030-W	4	Mangonia Park	0	0	0	0
50-00030-W	5	Mangonia Park	0	0	0	0
50-00030-W	6	Mangonia Park	0	0	0	25
50-00036-W	ALT1-E	Palm Springs	0	0	0	7.18
50-00036-W	ALT1-W	Palm Springs	0	0	0	7.18
50-00036-W	ALT2-E	Palm Springs	0	0	0	7.18
50-00036-W	ALT2-W	Palm Springs	0	0	0	7.18
50-00036-W	E1	Palm Springs	0	0	0	0
50-00036-W	E10	Palm Springs	12.5	12.5	12.5	3
50-00036-W	E11	Palm Springs	0	0	0	0
50-00036-W	E11-E	Palm Springs	0	0	0	3
50-00036-W	E12	Palm Springs	0	0	0	7.18
50-00036-W	E13	Palm Springs	0	0	0	7.18
50-00036-W	E14	Palm Springs	0	0	0	7.18
50-00036-W	E15	Palm Springs	0	0	0	7.18
50-00036-W	E2	Palm Springs	0	0	0	0
50-00036-W	E3	Palm Springs	0	0	0	0
50-00036-W	E4	Palm Springs	0	0	0	0

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
50-00036-W	E5	Palm Springs	0	0	0	0
50-00036-W	E6	Palm Springs	0	0	0	0
50-00036-W	E7	Palm Springs	0	0	0	0
50-00036-W	E8	Palm Springs	12.5	12.5	12.5	3
50-00036-W	E9	Palm Springs	12.5	12.5	12.5	3
50-00036-W	W1	Palm Springs	12.5	12.5	12.5	3
50-00036-W	W2	Palm Springs	12.5	12.5	12.5	3
50-00036-W	W3	Palm Springs	12.5	12.5	12.5	3
50-00036-W	W4	Palm Springs	12.5	12.5	12.5	0
50-00036-W	W5	Palm Springs	12.5	12.5	12.5	7.18
50-00036-W	W6	Palm Springs	0	0	0	7.18
50-00036-W	W7	Palm Springs	0	0	0	7.18
50-00046-W	5	Tequesta	0	0	0	0
50-00046-W	10	Tequesta	0	0	0	0
50-00046-W	11	Tequesta	0	0	0	0
50-00046-W	12	Tequesta	0	0	0	0
50-00046-W	14	Tequesta	0	0	0	0
50-00046-W	15	Tequesta	0	0	0	0
50-00046-W	17	Tequesta	14.29	0	0	0
50-00046-W	18	Tequesta	14.29	5	5	5
50-00046-W	19	Tequesta	14.29	5	5	5
50-00046-W	20	Tequesta	14.29	5	5	5
50-00046-W	21	Tequesta	0	5	5	5
50-00046-W	22	Tequesta	0	0	0	0
50-00046-W	23	Tequesta	14.29	10	10	10
50-00046-W	24	Tequesta	0	10	10	10
50-00046-W	25	Tequesta	0	10	10	10
50-00046-W	26	Tequesta	0	10	10	10
50-00046-W	27	Tequesta	0	10	10	10
50-00046-W	28	Tequesta	0	10	10	10
50-00046-W	7R	Tequesta	14.29	10	10	10
50-00046-W	8R	Tequesta	14.29	10	10	10
50-00046-W	RO-1	Tequesta	0	0	0	0
50-00046-W	RO-2	Tequesta	0	0	0	0
50-00083-W	2	Atlantis	20	0	0	0
50-00083-W	3	Atlantis	20	0	0	0
50-00083-W	4	Atlantis	20	0	0	0
50-00083-W	5	Atlantis	20	0	0	0
50-00083-W	6	Atlantis	20	0	0	0
50-00135-W	1W-1	PBC 2W, 8W	0.3	0	0	0
50-00135-W	1W-10	PBC 2W, 8W	0.3	0	0	0
50-00135-W	1W-11	PBC 2W, 8W	0.3	0	0	0
50-00135-W	1W-12	PBC 2W, 8W	0.3	0	0	0

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
50-00135-W	1W-13	PBC 2W, 8W	0.3	0	0	0
50-00135-W	1W-2	PBC 2W, 8W	0	0	0	0
50-00135-W	1W-3	PBC 2W, 8W	0	0	0	0
50-00135-W	1W-4	PBC 2W, 8W	0.3	0	0	0
50-00135-W	1W-5	PBC 2W, 8W	0.3	0	0	0
50-00135-W	1W-6	PBC 2W, 8W	0.3	0	0	0
50-00135-W	1W-7	PBC 2W, 8W	0.3	0	0	0
50-00135-W	1W-8	PBC 2W, 8W	0.3	0	0	0
50-00135-W	1W-9	PBC 2W, 8W	0.3	0	0	0
50-00135-W	2W-1	PBC 2W, 8W	2.85	3	3	2.85
50-00135-W	2W-10	PBC 2W, 8W	2.85	3	3	2.85
50-00135-W	2W-11	PBC 2W, 8W	2.85	3	3	2.85
50-00135-W	2W-12	PBC 2W, 8W	2.85	3	3	2.85
50-00135-W	2W-13	PBC 2W, 8W	2.85	3	3	2.85
50-00135-W	2W-14	PBC 2W, 8W	0	0	0	2.85
50-00135-W	2W-15	PBC 2W, 8W	0	0	0	2.85
50-00135-W	2W-2	PBC 2W, 8W	2.85	3	3	2.85
50-00135-W	2W-3	PBC 2W, 8W	2.85	3	3	2.85
50-00135-W	2W-4	PBC 2W, 8W	2.85	3	3	2.85
50-00135-W	2W-5	PBC 2W, 8W	2.85	3	3	2.85
50-00135-W	2W-6	PBC 2W, 8W	2.85	3	3	2.85
50-00135-W	2W-7	PBC 2W, 8W	2.85	3	3	2.85
50-00135-W	2W-9	PBC 2W, 8W	2.85	3	3	2.85
50-00135-W	5W-1	PBC 2W, 8W	0	0	0	0
50-00135-W	5W-2	PBC 2W, 8W	0	0	0	0
50-00135-W	8W-1	PBC 2W, 8W	3.4	3.2	3.2	1.5
50-00135-W	8W-10	PBC 2W, 8W	3.4	3.2	3.2	1.5
50-00135-W	8W-11	PBC 2W, 8W	3.4	3.2	3.2	1.5
50-00135-W	8W-12	PBC 2W, 8W	3.4	3.2	3.2	1.5
50-00135-W	8W-13	PBC 2W, 8W	3.4	3.2	3.2	1.5
50-00135-W	8W-14	PBC 2W, 8W	3.4	3.2	3.2	1.5
50-00135-W	8W-15	PBC 2W, 8W	3.4	3.2	3.2	1.5
50-00135-W	8W-16	PBC 2W, 8W	3.4	3.2	3.2	1.5
50-00135-W	8W-17	PBC 2W, 8W	3.4	3.2	3.2	1.5
50-00135-W	8W-18	PBC 2W, 8W	3.4	3.2	3.2	1.5
50-00135-W	8W-2	PBC 2W, 8W	3.4	3.2	3.2	1.5
50-00135-W	8W-22	PBC 2W, 8W	0	0	0	1.5
50-00135-W	8W-23	PBC 2W, 8W	0	0	0	1.5
50-00135-W	8W-24	PBC 2W, 8W	0	0	0	1.5
50-00135-W	8W-25	PBC 2W, 8W	0	0	0	1.5
50-00135-W	8W-26	PBC 2W, 8W	0	0	0	1.5
50-00135-W	8W-27	PBC 2W, 8W	0	0	0	1.5
50-00135-W	8W-28	PBC 2W, 8W	0	0	0	1.5

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
50-00135-W	8W-29	PBC 2W, 8W	0	0	0	1.5
50-00135-W	8W-3	PBC 2W, 8W	3.4	3.2	3.2	1.5
50-00135-W	8W-30	PBC 2W, 8W	0	0	0	1.5
50-00135-W	8W-31	PBC 2W, 8W	0	0	0	1.5
50-00135-W	8W-32	PBC 2W, 8W	0	0	0	1.5
50-00135-W	8W-33	PBC 2W, 8W	0	0	0	1.5
50-00135-W	8W-34	PBC 2W, 8W	0	0	0	1.5
50-00135-W	8W-35	PBC 2W, 8W	0	0	0	1.5
50-00135-W	8W-36	PBC 2W, 8W	0	0	0	1.5
50-00135-W	8W-37	PBC 2W, 8W	0	0	0	1.5
50-00135-W	8W-38	PBC 2W, 8W	0	0	0	1.5
50-00135-W	8W-39	PBC 2W, 8W	0	0	0	1.5
50-00135-W	8W-4	PBC 2W, 8W	3.4	3.2	3.2	1.5
50-00135-W	8W-40	PBC 2W, 8W	0	0	0	1.5
50-00135-W	8W-41	PBC 2W, 8W	0	0	0	1.5
50-00135-W	8W-42	PBC 2W, 8W	0	0	0	1.5
50-00135-W	8W-5	PBC 2W, 8W	3.4	3.2	3.2	1.5
50-00135-W	8W-6	PBC 2W, 8W	3.4	3.2	3.2	1.5
50-00135-W	8W-7	PBC 2W, 8W	3.4	3.2	3.2	1.5
50-00135-W	8W-8	PBC 2W, 8W	3.4	3.2	3.2	1.5
50-00135-W	8W-MB1	PBC 2W, 8W	1.57	3.2	3.2	1
50-00135-W	8W-MB2	PBC 2W, 8W	1.57	3.2	3.2	1
50-00135-W	8W-MB3	PBC 2W, 8W	1.57	3.2	3.2	1
50-00137-W	1	Tropical MHP	50	0	0	0
50-00137-W	2	Tropical MHP	50	0	0	0
50-00177-W	1	Delray Beach	4.5	0	0	0
50-00177-W	2	Delray Beach	4.5	0	0	0
50-00177-W	3	Delray Beach	4.5	0	0	0
50-00177-W	5	Delray Beach	4.5	0	0	0
50-00177-W	6	Delray Beach	4.5	0	0	0
50-00177-W	7	Delray Beach	4.5	0	0	0
50-00177-W	8	Delray Beach	4.5	0	0	0
50-00177-W	9	Delray Beach	1.47	0	0	0
50-00177-W	10	Delray Beach	0	0	0	0
50-00177-W	11	Delray Beach	0	0	0	0
50-00177-W	12	Delray Beach	1.47	0	0	0
50-00177-W	13	Delray Beach	1.47	0	0	0
50-00177-W	14	Delray Beach	0	0	0	0
50-00177-W	15	Delray Beach	0	0	0	0
50-00177-W	16	Delray Beach	1.47	0	0	0
50-00177-W	17	Delray Beach	1.47	0	0	0
50-00177-W	21	Delray Beach	6.67	8	8	6.67
50-00177-W	22	Delray Beach	6.67	7	7	6.67

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
50-00177-W	23	Delray Beach	6.67	7	7	6.67
50-00177-W	24	Delray Beach	6.67	7	7	6.67
50-00177-W	25	Delray Beach	6.67	7	7	6.67
50-00177-W	26	Delray Beach	6.67	7	7	6.67
50-00177-W	27	Delray Beach	3.02	6.33	6.33	4.44
50-00177-W	28	Delray Beach	3.02	6.33	6.33	4.44
50-00177-W	29	Delray Beach	3.02	6.33	6.33	4.44
50-00177-W	30	Delray Beach	3.02	6.33	6.33	4.44
50-00177-W	31	Delray Beach	3.02	6.33	6.33	4.44
50-00177-W	32	Delray Beach	3.02	6.33	6.33	4.44
50-00177-W	34	Delray Beach	3.02	6.33	6.33	4.44
50-00177-W	35	Delray Beach	0	6.33	6.33	4.44
50-00177-W	36	Delray Beach	0	6.33	6.33	4.44
50-00177-W	37	Delray Beach	0	0	0	1.82
50-00177-W	38	Delray Beach	0	0	0	1.82
50-00177-W	39	Delray Beach	0	0	0	1.82
50-00177-W	40	Delray Beach	0	0	0	1.82
50-00177-W	41	Delray Beach	0	0	0	1.82
50-00177-W	42	Delray Beach	0	0	0	1.82
50-00177-W	43	Delray Beach	0	0	0	1.82
50-00177-W	44	Delray Beach	0	0	0	1.82
50-00177-W	45	Delray Beach	0	0	0	1.82
50-00177-W	46	Delray Beach	0	0	0	1.82
50-00177-W	47	Delray Beach	0	0	0	1.82
50-00178-W	1	Century Utilities/PBC	33	0	0	0
50-00178-W	2	Century Utilities/PBC	34	0	0	0
50-00178-W	3	Century Utilities/PBC	33	0	0	0
50-00179-W	1	Jamaica Bay	50	0	0	0
50-00179-W	2	Jamaica Bay	50	0	0	0
50-00234-W	fwell1	Lake Worth	0	4.15	7.78	0
50-00234-W	fwell2	Lake Worth	0	4.15	7.78	0
50-00234-W	fwell3	Lake Worth	0	4.15	7.78	0
50-00234-W	fwell4	Lake Worth	0	4.15	7.78	0
50-00234-W	fwell5	Lake Worth	0	4.15	7.78	0
50-00234-W	fwell6	Lake Worth	0	4.15	7.78	0
50-00234-W	fwell7	Lake Worth	0	4.15	7.78	0
50-00234-W	fwell8	Lake Worth	0	4.15	7.78	0
50-00234-W	fwell9	Lake Worth	0	4.15	7.78	0
50-00234-W	LW-1	Lake Worth	6.67	4.15	2	4.6
50-00234-W	LW-10	Lake Worth	6.67	4.15	2	4.6
50-00234-W	LW-11	Lake Worth	6.67	4.15	2	4.6
50-00234-W	LW-12	Lake Worth	6.67	4.15	2	10
50-00234-W	LW-13	Lake Worth	6.67	4.15	2	4.6

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
50-00234-W	LW-14	Lake Worth	6.67	4.15	2	4.6
50-00234-W	LW-15	Lake Worth	6.67	4.15	2	10
50-00234-W	LW-16	Lake Worth	0	0	0	4.6
50-00234-W	LW-17	Lake Worth	0	0	0	10
50-00234-W	LW-2	Lake Worth	6.67	4.15	2	4.6
50-00234-W	LW-3	Lake Worth	6.67	4.15	2	4.6
50-00234-W	LW-4	Lake Worth	6.67	4.15	2	4.6
50-00234-W	LW-5	Lake Worth	6.67	4.15	2	4.6
50-00234-W	LW-6	Lake Worth	6.67	4.15	2	4.6
50-00234-W	LW-7	Lake Worth	6.67	4.15	2	4.6
50-00234-W	LW-8	Lake Worth	6.67	4.15	2	4.6
50-00234-W	LW-9	Lake Worth	6.67	4.15	2	10
50-00346-W	4	Highland Beach	25	25	25	25
50-00346-W	5	Highland Beach	25	25	25	25
50-00346-W	6	Highland Beach	25	25	25	25
50-00346-W	7	Highland Beach	25	25	25	25
50-00365-W	BR21	Seacoast	2.42	2.2	2.2	2.2
50-00365-W	BR22	Seacoast	2.42	2.2	2.2	2.2
50-00365-W	BR23	Seacoast	2.42	2.2	2.2	2.2
50-00365-W	BR24	Seacoast	2.42	2.2	2.2	2.2
50-00365-W	BR25	Seacoast	2.42	2.2	2.2	2.2
50-00365-W	fwell1	Seacoast	0	0	0	0
50-00365-W	HR1	Seacoast	4.58	3.5	3.5	3.6
50-00365-W	HR10	Seacoast	4.58	3.5	3.5	3.6
50-00365-W	HR11	Seacoast	4.58	3.5	3.5	3.6
50-00365-W	HR12	Seacoast	4.58	3.5	3.5	3.6
50-00365-W	HR13	Seacoast	4.58	3.5	3.5	3.6
50-00365-W	HR14	Seacoast	4.58	3.5	3.5	3.6
50-00365-W	HR16	Seacoast	4.58	3.5	3.5	3.6
50-00365-W	HR17	Seacoast	4.58	3.5	3.5	3.6
50-00365-W	HR18	Seacoast	4.58	3.5	3.5	3.6
50-00365-W	HR5	Seacoast	4.58	3.5	3.5	3.6
50-00365-W	HR6	Seacoast	4.58	3.5	3.5	3.6
50-00365-W	HR7	Seacoast	4.58	3.5	3.5	3.6
50-00365-W	HR8	Seacoast	4.58	3.5	3.5	3.6
50-00365-W	HR9	Seacoast	4.58	3.5	3.5	3.6
50-00365-W	LSP1	Seacoast	0.49	3	3	0
50-00365-W	LSP2	Seacoast	0.49	3	3	0
50-00365-W	MT1	Seacoast	0	0	0	1.52
50-00365-W	MT2	Seacoast	0	0	0	1.52
50-00365-W	MT3	Seacoast	0	0	0	1.52
50-00365-W	MT4	Seacoast	0	0	0	1.52
50-00365-W	NPB1	Seacoast	2.42	1.6	1.6	1.4

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
50-00365-W	NPB2	Seacoast	2.42	1.6	1.6	1.4
50-00365-W	NPB4	Seacoast	2.42	1.6	1.6	1.4
50-00365-W	NPB5	Seacoast	2.42	1.6	1.6	1.4
50-00365-W	NPB6	Seacoast	2.42	1.6	1.6	1.4
50-00365-W	NPB7	Seacoast	2.42	1.6	1.6	1.4
50-00365-W	NPB8	Seacoast	2.42	1.6	1.6	1.4
50-00365-W	OD12	Seacoast	0	0	0	0
50-00365-W	OD15	Seacoast	0	0	0	0
50-00365-W	PBG10	Seacoast	0.49	3	3	3.1
50-00365-W	PBG11	Seacoast	0.49	3	3	3.1
50-00365-W	PBG4	Seacoast	0.49	3	3	3.1
50-00365-W	PBG6	Seacoast	0.49	3	3	3.1
50-00365-W	PBG7	Seacoast	0.49	3	3	3.1
50-00365-W	PBG8	Seacoast	0.49	3	3	3.1
50-00365-W	PBG9	Seacoast	0.49	3	3	3.1
50-00365-W	RR3	Seacoast	2.42	1.6	1.6	1
50-00365-W	RR9	Seacoast	0	0	0	0
50-00367-W	10-E	Boca Raton	1	0.22	0.22	0
50-00367-W	10-W	Boca Raton	0	0.5	0.5	0
50-00367-W	11-E	Boca Raton	1	0.22	0.22	0.11
50-00367-W	11-W	Boca Raton	0	0.5	0.5	0
50-00367-W	12-E	Boca Raton	0	0.22	0.22	0.11
50-00367-W	12-W	Boca Raton	0	0.5	0.5	2.64
50-00367-W	13-E	Boca Raton	1	0.75	0.75	0.59
50-00367-W	13-W	Boca Raton	4	1.5	1.5	2.64
50-00367-W	14-E	Boca Raton	1	0.75	0.75	0.59
50-00367-W	14-W	Boca Raton	4	1.5	1.5	2.64
50-00367-W	15-E	Boca Raton	1	0.75	0.75	0.59
50-00367-W	15-W	Boca Raton	4	1.5	1.5	2.64
50-00367-W	16-E	Boca Raton	0	0.75	0.75	0.59
50-00367-W	16-W	Boca Raton	4	1.5	1.5	2.64
50-00367-W	17-E	Boca Raton	1	0.75	0.75	0.59
50-00367-W	17-W	Boca Raton	4	1.5	1.5	2.64
50-00367-W	18-E	Boca Raton	1	0.75	0.75	0.59
50-00367-W	18-W	Boca Raton	4	1.5	1.5	2.64
50-00367-W	19-E	Boca Raton	1	0.75	0.75	0.59
50-00367-W	19-W	Boca Raton	4	1.5	1.5	2.64
50-00367-W	1-E	Boca Raton	1	0.22	0.22	0.11
50-00367-W	1-W	Boca Raton	2	0.97	0.97	2.64
50-00367-W	20-E	Boca Raton	1	0.75	0.75	0.59
50-00367-W	20-W	Boca Raton	4	1.5	1.5	2.64
50-00367-W	21-E	Boca Raton	1	0.75	0.75	0.59
50-00367-W	21-W	Boca Raton	4	1.5	1.5	2.64

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
50-00367-W	22-E	Boca Raton	2	0.75	0.75	0.59
50-00367-W	22-W	Boca Raton	4	1.5	1.5	2.64
50-00367-W	23-E	Boca Raton	2	0.75	0.75	0.59
50-00367-W	23-W	Boca Raton	4	1.5	1.5	2.64
50-00367-W	24-E	Boca Raton	0	0.22	0.22	0.11
50-00367-W	24-W	Boca Raton	4	1.5	1.5	2.64
50-00367-W	25-E	Boca Raton	2	0.22	0.22	2.64
50-00367-W	25-W	Boca Raton	4	1.5	1.5	2.64
50-00367-W	26-W	Boca Raton	4	1.5	1.5	2.64
50-00367-W	27-W	Boca Raton	0	1.5	1.5	2.64
50-00367-W	29-W	Boca Raton	0	1.5	1.5	2.64
50-00367-W	2-W	Boca Raton	3	0.97	0.97	2.64
50-00367-W	30-W	Boca Raton	0	1.5	1.5	2.64
50-00367-W	32-W	Boca Raton	0	1.5	1.5	2.64
50-00367-W	35-W	Boca Raton	0	1.5	1.5	2.64
50-00367-W	36-W	Boca Raton	0	1.5	1.5	2.64
50-00367-W	37-W	Boca Raton	0	1.5	1.5	2.64
50-00367-W	38-W	Boca Raton	0	1.5	1.5	2.64
50-00367-W	39-W	Boca Raton	0	1.5	1.5	2.64
50-00367-W	3-E	Boca Raton	1	0.22	0.22	0
50-00367-W	3-W	Boca Raton	0	0.97	0.97	2.64
50-00367-W	40-W	Boca Raton	0	0.97	0.97	0.88
50-00367-W	41-W	Boca Raton	0	0.97	0.97	0.88
50-00367-W	42-W	Boca Raton	0	0.97	0.97	0.88
50-00367-W	4-E	Boca Raton	0	0.22	0.22	0.11
50-00367-W	4-W	Boca Raton	4	0.97	0.97	2.64
50-00367-W	5-E	Boca Raton	0	0.22	0.22	0.11
50-00367-W	5-W	Boca Raton	4	0.97	0.97	2.64
50-00367-W	6-W	Boca Raton	4	0.97	0.97	2.64
50-00367-W	7-W	Boca Raton	4	0.97	0.97	0
50-00367-W	7-W(R)	Boca Raton	0	0.97	0.97	2.64
50-00367-W	8-W	Boca Raton	4	0.97	0.97	2.64
50-00367-W	9-E	Boca Raton	0	0.22	0.22	0.11
50-00367-W	9-W	Boca Raton	0	0.97	0.97	0
50-00367-W	9-W(R)	Boca Raton	0	0.97	0.97	2.64
50-00367-W	fwell1	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell10	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell11	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell12	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell13	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell14	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell15	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell16	Boca Raton	0	0.87	0.87	0

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
50-00367-W	fwell17	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell18	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell19	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell2	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell20	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell21	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell22	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell23	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell24	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell25	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell26	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell27	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell28	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell29	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell3	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell30	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell31	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell32	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell33	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell34	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell35	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell36	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell37	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell38	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell39	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell4	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell40	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell41	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell42	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell43	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell44	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell45	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell46	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell5	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell6	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell7	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell8	Boca Raton	0	0.87	0.87	0
50-00367-W	fwell9	Boca Raton	0	0.87	0.87	0
50-00401-W	3W-1	PBC System 3W	2.47	2.4	2.4	0
50-00401-W	3W-10	PBC System 3W	0	2.4	2.4	1.04
50-00401-W	3W-11	PBC System 3W	2.47	2.4	2.4	1.04
50-00401-W	3W-12	PBC System 3W	0	2.4	2.4	1.04
50-00401-W	3W-13	PBC System 3W	2.47	2.4	2.4	1.04

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
50-00401-W	3W-14	PBC System 3W	2.47	2.4	2.4	1.04
50-00401-W	3W-15	PBC System 3W	0	2.4	2.4	1.04
50-00401-W	3W-16	PBC System 3W	0	2.4	2.4	1.04
50-00401-W	3W-17	PBC System 3W	0	2.4	2.4	1.04
50-00401-W	3W-18	PBC System 3W	0	2.4	2.4	1.04
50-00401-W	3W-19	PBC System 3W	0	2.4	2.4	1.04
50-00401-W	3W-2	PBC System 3W	2.47	2.4	2.4	1.04
50-00401-W	3W-20	PBC System 3W	0	0	0	1.04
50-00401-W	3W-21	PBC System 3W	0	2.4	2.4	1.04
50-00401-W	3W-22	PBC System 3W	0	2.4	2.4	1.04
50-00401-W	3W-23	PBC System 3W	0	0	0	1.04
50-00401-W	3W-24	PBC System 3W	0	0	0	1.04
50-00401-W	3W-25	PBC System 3W	0	0	0	1.04
50-00401-W	3W-25	PBC System 3W	0	0	0	1.04
50-00401-W	3W-26	PBC System 3W	0	0	0	1.04
50-00401-W	3W-27	PBC System 3W	0	0	0	1.04
50-00401-W	3W-28	PBC System 3W	0	0	0	1.04
50-00401-W	3W-29	PBC System 3W	0	0	0	1.04
50-00401-W	3W-3	PBC System 3W	2.47	2.4	2.4	1.04
50-00401-W	3W-30	PBC System 3W	0	0	0	1.04
50-00401-W	3W-31	PBC System 3W	0	0	0	1.04
50-00401-W	3W-32	PBC System 3W	0	0	0	1.04
50-00401-W	3W-33	PBC System 3W	0	0	0	1.04
50-00401-W	3W-34	PBC System 3W	0	0	0	1.04
50-00401-W	3W-35	PBC System 3W	0	0	0	1.04
50-00401-W	3W-36	PBC System 3W	0	0	0	1.04
50-00401-W	3W-37	PBC System 3W	0	0	0	1.04
50-00401-W	3W-38	PBC System 3W	0	0	0	1.04
50-00401-W	3W-39	PBC System 3W	0	0	0	1.04
50-00401-W	3W-4	PBC System 3W	2.47	2.4	2.4	1.04
50-00401-W	3W-40	PBC System 3W	0	0	0	1.04
50-00401-W	3W-41	PBC System 3W	0	0	0	1.04
50-00401-W	3W-42	PBC System 3W	0	0	0	1.04
50-00401-W	3W-43	PBC System 3W	0	0	0	1.04
50-00401-W	3W-44	PBC System 3W	0	0	0	1.04
50-00401-W	3W-45	PBC System 3W	0	0	0	1.04
50-00401-W	3W-46	PBC System 3W	0	0	0	1.04
50-00401-W	3W-47	PBC System 3W	0	0	0	1.04
50-00401-W	3W-48	PBC System 3W	0	0	0	1.04
50-00401-W	3W-49	PBC System 3W	0	0	0	1.04
50-00401-W	3W-5	PBC System 3W	2.47	2.4	2.4	1.04
50-00401-W	3W-50	PBC System 3W	0	0	0	1.04
50-00401-W	3W-51	PBC System 3W	0	0	0	1.04

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
50-00401-W	3W-52	PBC System 3W	0	0	0	1.04
50-00401-W	3W-53	PBC System 3W	0	0	0	1.04
50-00401-W	3W-54	PBC System 3W	0	0	0	1.04
50-00401-W	3W-55	PBC System 3W	0	0	0	1.04
50-00401-W	3W-56	PBC System 3W	0	0	0	1.04
50-00401-W	3W-57	PBC System 3W	0	0	0	1.04
50-00401-W	3W-58	PBC System 3W	0	0	0	1.04
50-00401-W	3W-59	PBC System 3W	0	0	0	1.04
50-00401-W	3W-6	PBC System 3W	2.47	2.4	2.4	1.04
50-00401-W	3W-60	PBC System 3W	0	0	0	1.04
50-00401-W	3W-61	PBC System 3W	0	0	0	1.04
50-00401-W	3W-62	PBC System 3W	0	0	0	1.04
50-00401-W	3W-63	PBC System 3W	0	0	0	1.04
50-00401-W	3W-64	PBC System 3W	0	0	0	1.04
50-00401-W	3W-7	PBC System 3W	2.47	2.4	2.4	1.04
50-00401-W	3W-8	PBC System 3W	2.47	2.4	2.4	1.04
50-00401-W	3W-9	PBC System 3W	2.47	2.4	2.4	1.04
50-00401-W	9W-1	PBC System 9W	4.69	2.46	2.46	1.04
50-00401-W	9W-10	PBC System 9W	4.69	2.46	2.46	1.04
50-00401-W	9W-11	PBC System 9W	4.69	2.46	2.46	1.04
50-00401-W	9W-12	PBC System 9W	4.69	2.46	2.46	1.04
50-00401-W	9W-13	PBC System 9W	4.69	2.46	2.46	1.04
50-00401-W	9W-14	PBC System 9W	4.69	2.46	2.46	1.04
50-00401-W	9W-15	PBC System 9W	4.69	2.46	2.46	1.04
50-00401-W	9W-16	PBC System 9W	0	0	0	1.04
50-00401-W	9W-17	PBC System 9W	0	0	0	1.04
50-00401-W	9W-18	PBC System 9W	0	0	0	1.04
50-00401-W	9W-19	PBC System 9W	0	0	0	1.04
50-00401-W	9W-2	PBC System 9W	4.69	2.46	2.46	1.04
50-00401-W	9W-20	PBC System 9W	0	0	0	1.04
50-00401-W	9W-21	PBC System 9W	0	0	0	1.04
50-00401-W	9W-22	PBC System 9W	0	0	0	1.04
50-00401-W	9W-23	PBC System 9W	0	0	0	1.04
50-00401-W	9W-24	PBC System 9W	0	0	0	1.04
50-00401-W	9W-26	PBC System 9W	0	0	0	1.04
50-00401-W	9W-27	PBC System 9W	0	0	0	1.04
50-00401-W	9W-28	PBC System 9W	0	0	0	1.04
50-00401-W	9W-29	PBC System 9W	0	0	0	1.04
50-00401-W	9W-3	PBC System 9W	4.69	2.46	2.46	1.04
50-00401-W	9W-30	PBC System 9W	0	0	0	1.04
50-00401-W	9W-31	PBC System 9W	0	0	0	1.04
50-00401-W	9W-32	PBC System 9W	0	0	0	1.04
50-00401-W	9W-33	PBC System 9W	0	0	0	1.04

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
50-00401-W	9W-34	PBC System 9W	0	0	0	1.04
50-00401-W	9W-4	PBC System 9W	4.69	2.46	2.46	1.04
50-00401-W	9W-5	PBC System 9W	4.69	2.46	2.46	1.04
50-00401-W	9W-6	PBC System 9W	4.69	2.46	2.46	1.04
50-00401-W	9W-7	PBC System 9W	4.69	2.46	2.46	1.04
50-00401-W	9W-8	PBC System 9W	4.69	2.46	2.46	1.04
50-00401-W	9W-9	PBC System 9W	4.69	2.46	2.46	1.04
50-00401-W	fwell1	PBC System 3W/9W	0	2.4	2.4	0
50-00401-W	fwell2	PBC System 3W/9W	0	2.4	2.4	0
50-00401-W	fwell3	PBC System 3W/9W	0	2.4	2.4	0
50-00401-W	fwell4	PBC System 3W/9W	0	2.4	2.4	0
50-00401-W	fwell5	PBC System 3W/9W	0	2.4	2.4	0
50-00444-W	1	Royal Palm Beach	14.29	0	0	6.12
50-00444-W	2	Royal Palm Beach	14.29	0	0	6.12
50-00444-W	3	Royal Palm Beach	14.29	0	0	6.12
50-00444-W	4	Royal Palm Beach	14.29	0	0	6.12
50-00444-W	5	Royal Palm Beach	14.29	0	0	6.12
50-00444-W	6	Royal Palm Beach	14.29	0	0	6.12
50-00444-W	7	Royal Palm Beach	14.29	0	0	6.12
50-00444-W	8	Royal Palm Beach	0	0	0	6.12
50-00444-W	9	Royal Palm Beach	0	0	0	6.12
50-00444-W	10	Royal Palm Beach	0	0	0	2.64
50-00444-W	11	Royal Palm Beach	0	0	0	2.64
50-00444-W	12	Royal Palm Beach	0	0	0	2.64
50-00444-W	13	Royal Palm Beach	0	0	0	2.64
50-00444-W	14	Royal Palm Beach	0	0	0	2.64
50-00444-W	15	Royal Palm Beach	0	0	0	2.64
50-00444-W	19	Royal Palm Beach	0	0	0	2.64
50-00444-W	20	Royal Palm Beach	0	0	0	2.64
50-00444-W	22	Royal Palm Beach	0	0	0	2.64
50-00444-W	23	Royal Palm Beach	0	0	0	2.64
50-00444-W	24	Royal Palm Beach	0	0	0	2.64
50-00444-W	25	Royal Palm Beach	0	0	0	2.64
50-00444-W	26	Royal Palm Beach	0	0	0	2.64
50-00444-W	HLJ-1	Royal Palm Beach	0	0	0	2.64
50-00444-W	HLJ-2	Royal Palm Beach	0	0	0	2.64
50-00444-W	HLJ-3	Royal Palm Beach	0	0	0	2.64
50-00444-W	HLJ-4	Royal Palm Beach	0	0	0	2.64
50-00460-W	1	Riviera Beach	3.85	3.85	3.85	1.54
50-00460-W	2	Riviera Beach	3.85	3.85	3.85	1.54
50-00460-W	4	Riviera Beach	3.85	3.85	3.85	1.54
50-00460-W	6	Riviera Beach	3.85	3.85	3.85	1.54
50-00460-W	7	Riviera Beach	3.85	3.85	3.85	1.54

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
50-00460-W	11	Riviera Beach	3.85	3.85	3.85	1.54
50-00460-W	13	Riviera Beach	3.85	3.85	3.85	1.54
50-00460-W	14	Riviera Beach	3.85	3.85	3.85	1.54
50-00460-W	15	Riviera Beach	3.85	3.85	3.85	1.54
50-00460-W	16	Riviera Beach	3.85	3.85	3.85	1.54
50-00460-W	17	Riviera Beach	3.85	3.85	3.85	1.54
50-00460-W	18	Riviera Beach	3.85	3.85	3.85	1.54
50-00460-W	21	Riviera Beach	3.85	3.85	3.85	4
50-00460-W	802	Riviera Beach	3.85	3.85	3.85	4.62
50-00460-W	804	Riviera Beach	3.85	3.85	3.85	4.62
50-00460-W	851	Riviera Beach	3.85	3.85	3.85	4.62
50-00460-W	852	Riviera Beach	3.85	3.85	3.85	4.62
50-00460-W	862	Riviera Beach	3.85	3.85	3.85	4.62
50-00460-W	871	Riviera Beach	3.85	3.85	3.85	4.62
50-00460-W	10A	Riviera Beach	3.85	3.85	3.85	4
50-00460-W	12A	Riviera Beach	3.85	3.85	3.85	4
50-00460-W	5A	Riviera Beach	3.85	3.85	3.85	1.54
50-00460-W	801A	Riviera Beach	3.85	3.85	3.85	4
50-00460-W	803A	Riviera Beach	3.85	3.85	3.85	4.62
50-00460-W	805A	Riviera Beach	3.85	3.85	3.85	7.5
50-00460-W	9A	Riviera Beach	3.85	3.85	3.85	4
50-00460-W	I-1	Riviera Beach	0	0	0	0
50-00460-W	II-2	Riviera Beach	0	0	0	0
50-00460-W	PWS100	Riviera Beach	0	0	0	4.62
50-00460-W	PWS101	Riviera Beach	0	0	0	4.62
50-00460-W	PWS102	Riviera Beach	0	0	0	4.62
50-00460-W	PWS103	Riviera Beach	0	0	0	4.62
50-00460-W	PWS104	Riviera Beach	0	0	0	4.62
50-00464-W	1	ACME (Wellington)	7.69	6.25	6.25	0
50-00464-W	2	ACME (Wellington)	0	0	0	0
50-00464-W	3	ACME (Wellington)	0	0	0	4.16
50-00464-W	4	ACME (Wellington)	7.69	6.25	6.25	4.16
50-00464-W	5	ACME (Wellington)	7.69	6.25	6.25	4.16
50-00464-W	6	ACME (Wellington)	7.69	6.25	6.25	4.16
50-00464-W	7	ACME (Wellington)	7.69	6.25	6.25	4.16
50-00464-W	8	ACME (Wellington)	7.69	6.25	6.25	4.16
50-00464-W	9	ACME (Wellington)	0	0	0	4.16
50-00464-W	10	ACME (Wellington)	0	0	0	4.16
50-00464-W	11	ACME (Wellington)	0	0	0	4.16
50-00464-W	12	ACME (Wellington)	0	0	0	4.16
50-00464-W	13	ACME (Wellington)	7.69	6.25	6.25	4.16
50-00464-W	14	ACME (Wellington)	0	0	0	4.16
50-00464-W	15	ACME (Wellington)	7.69	6.25	6.25	4.16

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
50-00464-W	17	ACME (Wellington)	7.69	6.25	6.25	0
50-00464-W	18	ACME (Wellington)	7.69	6.25	6.25	4.16
50-00464-W	19	ACME (Wellington)	7.69	6.25	6.25	4.16
50-00464-W	20	ACME (Wellington)	7.69	6.25	6.25	4.16
50-00464-W	21	ACME (Wellington)	7.69	6.25	6.25	4.16
50-00464-W	22	ACME (Wellington)	0	6.25	6.25	4.16
50-00464-W	23	ACME (Wellington)	0	6.25	6.25	4.16
50-00464-W	24	ACME (Wellington)	0	6.25	6.25	4.16
50-00464-W	25	ACME (Wellington)	0	0	0	4.16
50-00464-W	26	ACME (Wellington)	0	0	0	4.16
50-00464-W	27	ACME (Wellington)	0	0	0	4.16
50-00464-W	28	ACME (Wellington)	0	0	0	4.16
50-00499-W	1	Boynton Beach	1.67	2	2	0
50-00499-W	2	Boynton Beach	1.67	2	2	0
50-00499-W	3	Boynton Beach	1.67	2	2	0
50-00499-W	4	Boynton Beach	3.89	2	2	1.5
50-00499-W	5	Boynton Beach	3.89	2	2	1.5
50-00499-W	6	Boynton Beach	3.89	2	2	1.5
50-00499-W	7	Boynton Beach	3.89	2	2	1.5
50-00499-W	8	Boynton Beach	3.89	2	2	0
50-00499-W	9	Boynton Beach	3.89	2	2	0
50-00499-W	10	Boynton Beach	3.89	2	2	0.22
50-00499-W	11	Boynton Beach	3.89	2	2	0.22
50-00499-W	12	Boynton Beach	3.89	2	2	0.22
50-00499-W	13	Boynton Beach	7.5	2	2	0
50-00499-W	14	Boynton Beach	7.5	2	2	0
50-00499-W	15	Boynton Beach	7.5	2	2	4.25
50-00499-W	16	Boynton Beach	7.5	2	2	4.25
50-00499-W	17	Boynton Beach	7.5	2	2	4.25
50-00499-W	18	Boynton Beach	7.5	2	2	4.25
50-00499-W	19	Boynton Beach	7.5	2	2	4.25
50-00499-W	20	Boynton Beach	7.5	2	2	4.25
50-00499-W	21	Boynton Beach	0	4.66	4.66	4.25
50-00499-W	22	Boynton Beach	0	4.66	4.66	0
50-00499-W	23	Boynton Beach	0	4.66	4.66	0
50-00499-W	24	Boynton Beach	0	4.66	4.66	0
50-00499-W	25	Boynton Beach	0	4.66	4.66	10.6
50-00499-W	26	Boynton Beach	0	4.66	4.66	10.6
50-00499-W	27	Boynton Beach	0	4.66	4.66	10.6
50-00499-W	28	Boynton Beach	0	4.66	4.66	10.6
50-00499-W	29	Boynton Beach	0	4.66	4.66	10.6
50-00499-W	30	Boynton Beach	0	4.66	4.66	10.6
50-00499-W	31	Boynton Beach	0	4.66	4.66	0

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
50-00499-W	23E	Boynton Beach	0	0	0	0
50-00499-W	24E	Boynton Beach	0	0	0	0
50-00499-W	2W	Boynton Beach	0	4.66	4.66	0
50-00499-W	3W	Boynton Beach	0	4.66	4.66	0
50-00501-W	1	United Technologies	16.67	0	0	0
50-00501-W	2	United Technologies	16.67	25	25	25
50-00501-W	3	United Technologies	16.67	25	25	25
50-00501-W	4	United Technologies	16.67	0	0	0
50-00501-W	5	United Technologies	0	0	0	0
50-00501-W	6	United Technologies	0	0	0	0
50-00501-W	7	United Technologies	16.67	25	25	25
50-00501-W	8	United Technologies	16.67	25	25	25
50-00506-W	1	Manalapan	14.29	5	5	8.3
50-00506-W	2	Manalapan	14.29	5	5	8.3
50-00506-W	3	Manalapan	14.29	0	0	0
50-00506-W	4	Manalapan	14.29	5	5	8.3
50-00506-W	5	Manalapan	14.29	5	5	8.3
50-00506-W	6	Manalapan	14.29	5	5	16.6
50-00506-W	7	Manalapan	14.29	5	5	16.6
50-00506-W	8	Manalapan	0	0	0	16.8
50-00506-W	9	Manalapan	0	0	0	16.8
50-00506-W	fwell1	Manalapan	0	35	35	0
50-00506-W	fwell2	Manalapan	0	35	35	0
50-00572-W	1	Nat'l MHP (Worth Village)	50	50	50	50
50-00572-W	2	Nat'l MHP (Worth Village)	50	50	50	50
50-00575-W	3	Lantana	25	10	10	15
50-00575-W	4	Lantana	25	10	10	15
50-00575-W	5	Lantana	25	10	10	15
50-00575-W	6	Lantana	25	10	10	15
50-00575-W	7	Lantana	0	10	0	15
50-00575-W	8	Lantana	0	10	0	25
50-00575-W	9	Lantana	0	10	0	0
50-00575-W	fwell1	Lantana	0	10	20	0
50-00575-W	fwell2	Lantana	0	10	20	0
50-00575-W	fwell3	Lantana	0	10	20	0
50-00605-W	1	Lion Country Safari	33	50	50	50
50-00605-W	2	Lion Country Safari	34	50	50	50
50-00605-W	3	Lion Country Safari	33	0	0	0
50-00612-W	1	Village of Golf	33.33	45	45	45
50-00612-W	2	Village of Golf	33.34	10	10	10
50-00612-W	3	Village of Golf	33.33	45	45	45
50-00615-W	1	City of West Palm Beach	0	0	0	0
50-00615-W	2	City of West Palm Beach	0	0	0	0

Table B-12. Wells Used in the Simulations and the Percentage of Estimated and Projected Demand. (Continued)

CUP Permit Number	Well Number	Utility/Wellfield	Percentage of Estimated and Projected Demand			
			1995 Base Case	2020 Base Case	2020 with Restudy	LEC-1
50-00615-W	3	City of West Palm Beach	0	0	0	0
50-00615-W	4	City of West Palm Beach	0	0	0	0
50-00615-W	5	City of West Palm Beach	0	0	0	0
50-00615-W	6	City of West Palm Beach	0	0	0	0
50-00615-W	7	City of West Palm Beach	0	0	0	0
50-00615-W	8	City of West Palm Beach	0	0	0	0
50-00615-W	9	City of West Palm Beach	0	0	0	0
50-00615-W	10	City of West Palm Beach	0	0	0	0
50-00615-W	A	City of West Palm Beach	50	50	50	50
50-00615-W	B	City of West Palm Beach	50	50	50	50
50-00615-W	fwell1	City of West Palm Beach	0	0	0	0
50-00653-W	1	Good Samaritan Hospital	33	33	33	33
50-00653-W	2	Good Samaritan Hospital	34	34	34	34
50-00653-W	3	Good Samaritan Hospital	33	33	33	33
50-01007-W	1	Seminole Manor	33	0	0	0
50-01007-W	2	Seminole Manor	33.33	0	0	0
50-01007-W	3	Seminole Manor	33.33	0	0	0
50-01092-W	1	AG Holley (St of FL)	16.67	100	100	100
50-01092-W	2	AG Holley (St of FL)	16.67	0	0	0
50-01092-W	3	AG Holley (St of FL)	16.67	0	0	0
50-01092-W	4	AG Holley (St of FL)	16.67	0	0	0
50-01092-W	5	AG Holley (St of FL)	16.67	0	0	0
50-01092-W	6	AG Holley (St of FL)	16.67	0	0	0
50-01283-W	1	Arrowhead	50	0	0	0
50-01283-W	2	Arrowhead	50	0	0	0
50-01528-W	1	PB Park Commerce	33.34	33.34	33.34	33.34
50-01528-W	2	PB Park Commerce	33.33	33.33	33.33	33.33
50-01528-W	3	PB Park Commerce	33.33	33.33	33.33	33.33
50-02096-W	1	Okeelanta	0	0	0	0
50-02096-W	2	Okeelanta	0	0	0	0
50-02096-W	3	Okeelanta	0	0	0	0
50-02096-W	4	Okeelanta	0	0	0	0
50-02096-W	5	Okeelanta	0	0	0	0

**Figure B-11.
Removed for Security Purposes**

**Figure B-12.
Removed for Security Purposes**

**Figure B-13.
Removed for Security Purposes**

**Figure B-14.
Removed for Security Purposes**

**Figure B-15.
Removed for Security Purposes**

**Figure B-16.
Removed for Security Purposes**

**Figure B-17.
Removed for Security Purposes**

**Figure B-18.
Removed for Security Purposes**

Figure B-19. Removed for Security Purposes

**Figure B-20.
Removed for Security Purposes**

**Figure B-21.
Removed for Security Purposes**

**Figure B-22.
Removed for Security Purposes**

CALOOSAHATCHEE BASIN WATER DEMANDS

Water demand for the Caloosahatchee Basin must be considered in the development of the LEC Regional Water Supply Plan since Lake Okeechobee is the basin's main source of water. The C-43 Canal (Caloosahatchee River) is the most significant source of surface water in the Caloosahatchee Basin. The C-43 Canal receives water from Lake Okeechobee, runoff within the basin, and base flow from the Surficial Aquifer System. The river supplies water for public supply, agriculture, and natural systems.

The Lake Okeechobee Demand (Service) Area, which is defined as the area that is or could be supplied by surface water from the Caloosahatchee River, is the primary source for agricultural irrigation and potable surface water in the Caloosahatchee Basin. This area extends from the Franklin Lock (S-798) eastward to the Moore Haven Lock (S-77) and includes land in Lee, Glades, and Hendry counties.

Nonenvironmental surface water demands within the basin are primarily agricultural with some public water supply and commercial/industrial uses. Commercial and industrial demand is relatively small (one percent) and difficult to generalize, so an average demand is not calculated for this category.

Public Water Supply

Metered data of withdrawals from the C-43 Canal by the primary public water supply utilities within the basin, the City of Fort Myers and Lee County Utilities, were obtained from records to estimate public water supply demands for 1995. Both utilities withdraw water from the river at Olga. The City of Fort Myers uses this water to recharge the surficial aquifer at its wellfield and then pumps it from the surficial aquifer for treatment using membrane-softening technology. Lee County Utilities treats the water using lime softening technology at its Olga water treatment plant. In 1995, the combined surface water usage by both utilities was approximately 10.5 MGD for average daily usage and approximately 16.0 MGD for maximum daily usage.

The City of Fort Myers is moving to a Floridan aquifer source by 2020 and withdrawals from the C-43 Canal are not expected to continue. Therefore, the City of Fort Myers surface water withdrawals were not included in the future demands on the surface water of the C-43 Canal. Lee County Utilities projects its 2020 maximum daily use rate of C-43 Canal water to be 22.0 MGD. **Table B-13** compares the 1995 estimated demands and the 2020 projected demands from the C-43 Canal.

Table B-13. Estimated 1995 and Projected 2020 Public Water Supply Demand from the C-43 Canal.

Utility	1995		2020	
	Average Daily Use (MGD)	Maximum Daily Use (MGD)	Average Daily Use (MGD)	Maximum Daily Use (MGD)
City of Fort Myers	7.3	12.2	0.0	0.0
Lee County Utilities	3.1	4.1	16.0	22.0
Total Water Demand from the C-43 Canal	10.4	16.3	16.0	22.0

Agricultural Self-Supplied

Irrigated Acreage

Three crop types are grown within the Caloosahatchee Water Management Planning Area: citrus, sugarcane, and vegetables. Citrus, which occupies more than 91,000 acres, is the dominant irrigated crop in the basin. Citrus acreage has increased in the Caloosahatchee Basin during the past two decades. This growth is associated with the movement of citrus southward from Central Florida following several severe winter freezes in the 1980s. The basin has 75,000 acres in sugarcane production. It is primarily grown in close vicinity to the Everglades Agricultural Area (EAA), in Hendry and Glades counties. Sugarcane acreage has continued to increase since 1995, and is expected to continue in the future.

The Southwest Florida Regional Planning Council (SWFRPC) has estimated that total agricultural acreage will increase between three and seven percent between 1995 and 2020. The council estimates that citrus acreage will increase between 54 and 81 percent and sugarcane between 62 and 190 percent. This large increase in citrus and sugarcane acreage is mainly due to the conversion of existing irrigated acreage from other crop types to citrus and sugarcane. The agricultural industry, in concurrence with the Caloosahatchee Advisory Committee, has projected that citrus and sugarcane will each have 125,000 acres in production by 2020.

Water Demands

Because measured withdrawal data were not available, different methods were used for estimating agricultural self-supplied water demand for the *Caloosahatchee Water Management Plan* (SFWMD, 2000b). The procedure used estimated current water use based on three approaches: evaluation of permitted water use allocation records, Agricultural Field Scale Irrigation Requirements Simulation (AFSIRS) water demand modeling, and integrated surface water/ground water modeling using MIKE SHE. In each approach, the demand was related to current land use. The resulting demands from each approach were reviewed to evaluate reasonableness.

The first method, Permit Allocation, determines water usage based on the permit allocation information. In this method, the permitted water use was reviewed to determine how much water had been allocated. This value would indicate the amount of water that had been requested, but not necessarily currently used. Water use demands were then applied to the District's 1995 land use coverage.

The second method, AFSIRS, is a simple water budget model for estimating irrigation demands that estimates demand based on basin specific data. This model coupled with a water balance component (WATBAL) allows representation of irrigation demands and runoff from irrigated and nonirrigated lands within the basin.

The third method, MIKE SHE, is an integrated surface water/ground water model, which includes a module for estimating supplemental irrigation requirements based upon land use, soil type, crop type, rainfall, and evapotranspiration. It has the capability to utilize a vast amount of raw and processed data to estimate crop needs.

The three methods show some differences in the estimated irrigation requirements for the 1995 period. These differences are a function of the degree of averaging that each model utilizes and the assumptions of each method. **Table B-14** summarizes these results.

The MIKE SHE method was selected as the preferred approach for projecting the 2020 water demand, because it has the advantage of a spatially distributed estimate of demands and run time response to changes in hydrology, land use, and management practices. In addition, MIKE SHE computes the demand for the entire Caloosahatchee Water Management Planning Area and incorporates both surface and ground water interactions that impact the systems capability to satisfy irrigation demands within the study area. **Table B-14** illustrates the agricultural demands that were projected for the year 2020 using the MIKE SHE model.

Table B-14. Summary of Estimated 1995 and Projected 2020 Water Demands for Agricultural Land Use Categories.

Crop Type	Estimated 1995 Water Use (1,000 acre-feet/year)			
	1995			2020
	Permit Allocation	AFSIRS	MIKE SHE	MIKE SHE
Citrus	226		143	242
Sugarcane	216		110	181
Vegetables	32		36	27
Total	474	225	289	450

REFERENCES

- SFWMD. 1998. *Districtwide Water Supply Assessment*. Planning Department, South Florida Water Management District, West Palm Beach, FL.
- USACE and SFWMD. 1999. *The Central and Southern Florida Flood Control Project Comprehensive Review Study Final Integrated Feasibility Report and Programmatic Environmental Impact Statement*. U.S. Army Corps of Engineers, Jacksonville District, Jacksonville, FL, and South Florida Water Management District, West Palm Beach, FL.
- SFWMD. 2000a. *Lower West Coast Water Supply Plan*. Water Supply Department, Water Resources Management, South Florida Water Management District, West Palm Beach, FL.
- SFWMD. 2000b. *Caloosahatchee Water Management Plan*. Water Supply Department, Water Resources Management, South Florida Water Management District, West Palm Beach, FL.

Appendix C
DESCRIPTION OF RESTUDY/COMPREHENSIVE
EVERGLADES RESTORATION PLAN
COMPONENTS

TABLE OF CONTENTS

Overview	C-7
Lake Okeechobee	C-19
1. Lake Okeechobee Water Supply and Environmental Schedule	C-19
2. Lake Okeechobee Aquifer Storage and Recovery	C-20
Lake Okeechobee Service Area	C-21
3. Lake Okeechobee Watershed Water Quality Treatment Facilities.....	C-21
4. North of Lake Okeechobee Storage Reservoir	C-22
5. C-44 Basin Storage Reservoir.....	C-23
6. C-43 Basin Storage Reservoir with Aquifer Storage and Recovery.....	C-24
7. L-8 Project	C-25
8. Lake Okeechobee Tributary Sediment Dredging	C-27
9. Taylor Creek/Nubbin Slough Storage Reservoir and Stormwater Treatment Area.....	C-28
10. Caloosahatchee Backpumping with Stormwater Treatment Area.....	C-29
Estuaries	C-30
11. Environmental Water Supply Deliveries to the Caloosahatchee Estuary	C-30
12. Environmental Water Supply Deliveries to the St. Lucie Estuary	C-31
13. C-23/C-24/Northfork and Southfork Storage Reservoirs	C-32
Everglades Agricultural Area	C-33
14. Everglades Agricultural Area Storage Reservoir.....	C-33
15. Revised Holey Land Wildlife Management Area Operation Plan	C-35
16. Modified Rotenberger Wildlife Management Area Operation Plan.....	C-36
North Palm Beach Service Area	C-37
17. C-17 Backpumping and Treatment.....	C-37
18. Pal-Mar and J.W. Corbett Wildlife Management Area Hydropattern Restoration	C-38
19. C-51 and Southern L-8 Reservoir.....	C-39

Lower East Coast Service Area 1 C-41

20. Hillsboro (Site 1) Impoundment and Aquifer Storage and Recovery	C-41
21. Acme Basin B Discharge	C-42
22. C-51 Backpumping and Treatment	C-43
23. C-51 Regional Ground Water Aquifer Storage and Recovery	C-44
24. Lake Worth Lagoon Restoration	C-45
25. Winsburg Farms Wetland Restoration	C-46
26. Protect and Enhance Existing Wetland Systems along Loxahatchee National Wildlife Refuge including the Strazzulla Tract	C-47
27. Palm Beach County Agricultural Reserve Reservoir and Aquifer Storage and Recovery	C-48
28. Change Coastal Wellfield Operations	C-49

Lower East Coast Service Area 2 C-50

29. Western C-11 Diversion Impoundment and Canal	C-50
30. C-9 Stormwater Treatment Area/Impoundment	C-51
31. Broward County Secondary Canal System	C-52

Lower East Coast Service Area 3 C-53

32. North Lake Belt Storage Area	C-53
33. Central Lake Belt Storage Area	C-55
34. C-4 Control Structures	C-57
35. Pineland and Hardwood Hammocks Restoration	C-58
36. Bird Drive Recharge Area	C-59
37. L-31N Levee Improvements for Seepage Management	C-60
38. Dade-Broward Levee/Pennsuco Wetlands	C-61
39. Modification to South Dade Conveyance System in Southern Portion of L-31N and C-111 Canals	C-62
40. Reroute Miami-Dade County Water Supply Deliveries	C-63
41. C-111N Spreader Canal	C-64
42. South Miami-Dade County Reuse (South District Reclaimed Water Treatment Plant)	C-65
43. West Miami-Dade County Reuse	C-66

Water Conservation Areas and Everglades National Park C-67

44. Loxahatchee National Wildlife Refuge Internal Canal Structures	C-67
45. Everglades Rain-Driven Operations	C-68
46. Divert Flows from Water Conservation Area 2 to Central Lake Belt Storage Area.....	C-70
47. Water Conservation Area 3A and 3B Levee Seepage Management	C-71
48. Additional S-345 Structures.....	C-72
49. Construction of S-356 Structures and Relocation of a Portion of L-31N Borrow Canal	C-73
50. Decompartmentalize Water Conservation Area 3	C-74
51. Flow to Northwest and Central Water Conservation Area 3A	C-75
52. Divert Flows from Water Conservation Area 3 to Central Lake Belt Storage Area.....	C-76
53. Divert Flows from Central Lake Belt Storage Area to Water Conservation Area 3B	C-77
54. G-404 Pump Station Modification.....	C-78

Bays C-79

55. Biscayne Bay Coastal Wetlands	C-79
---	------

Florida Keys C-80

56. Florida Keys Tidal Restoration.....	C-80
---	------

Big Cypress Basin C-81

57. Big Cypress/L-28 Interceptor Modifications	C-81
58. Miccosukee Tribe Water Management Plan.....	C-82
59. Seminole Tribe Big Cypress Reservation Water Conservation Plan.....	C-83

Systemwide C-84

60. Melaleuca Eradication Project and Other Exotic Plants	C-84
---	------

References C-85

OVERVIEW

This appendix provides a detailed description of the water resource development projects developed as part of the *Central and Southern Florida Project Comprehensive Review Study Final Integrated Feasibility Report and Programmatic Environmental Impact Statement* (Restudy) (USACE and SFWMD, 1999) and after intensive review have been incorporated into the *Lower East Coast Regional Water Supply Plan 2020* (LEC Plan) (See **Chapter 5** and **Chapter 6**). They will be implemented through the Comprehensive Everglades Restoration Plan (CERP).

Projects are presented within this appendix by geographic area (**Figure C-1**). These areas are as follows:

- Lake Okeechobee
- Lake Okeechobee Service Area
- Estuaries
- Everglades Agricultural Area
- North Palm Beach Service Area
- Lower East Coast Service Area 1
- Lower East Coast Service Area 2
- Lower East Coast Service Area 3
- Water Conservation Areas (WCAs) and Everglades National Park
- Bays
- Florida Keys
- Big Cypress Basin
- Systemwide

These components fall into one or more of the following categories:

- Operational Changes (**Figure C-2**)
- Aquifer Storage and Recovery (ASR) (**Figure C-3**)
- Surface Water Storage Reservoirs (**Figure C-4**)
- Stormwater Treatment Areas (STAs) (**Figure C-5**)
- Reuse of Reclaimed Water (**Figure C-6**)
- Removing of Barriers to Sheetflow (**Figure C-7**)
- Seepage Management (**Figure C-8**)
- Natural System Protection and Restoration (**Figure C-9**)
- Water Supply (**Figure C-10**)
- Water Quality (**Figure C-11**)

The components assigned to the last four categories, Seepage Management, Natural System Protection and Restoration, Water Supply, and Water Quality, are those that either do not fall into any of the first six categories or have at least one subproject within the component that does not fit into the first six categories. The first six categories may also provide seepage management, natural systems restoration and protection, water supply, and/or water quality benefits. The specific benefits provided by each component are discussed later in this appendix. **Figures C-2 through C-11** show the location of the components by category. Some components contain multiple projects which fall into different categories and, therefore, are on more than one map.

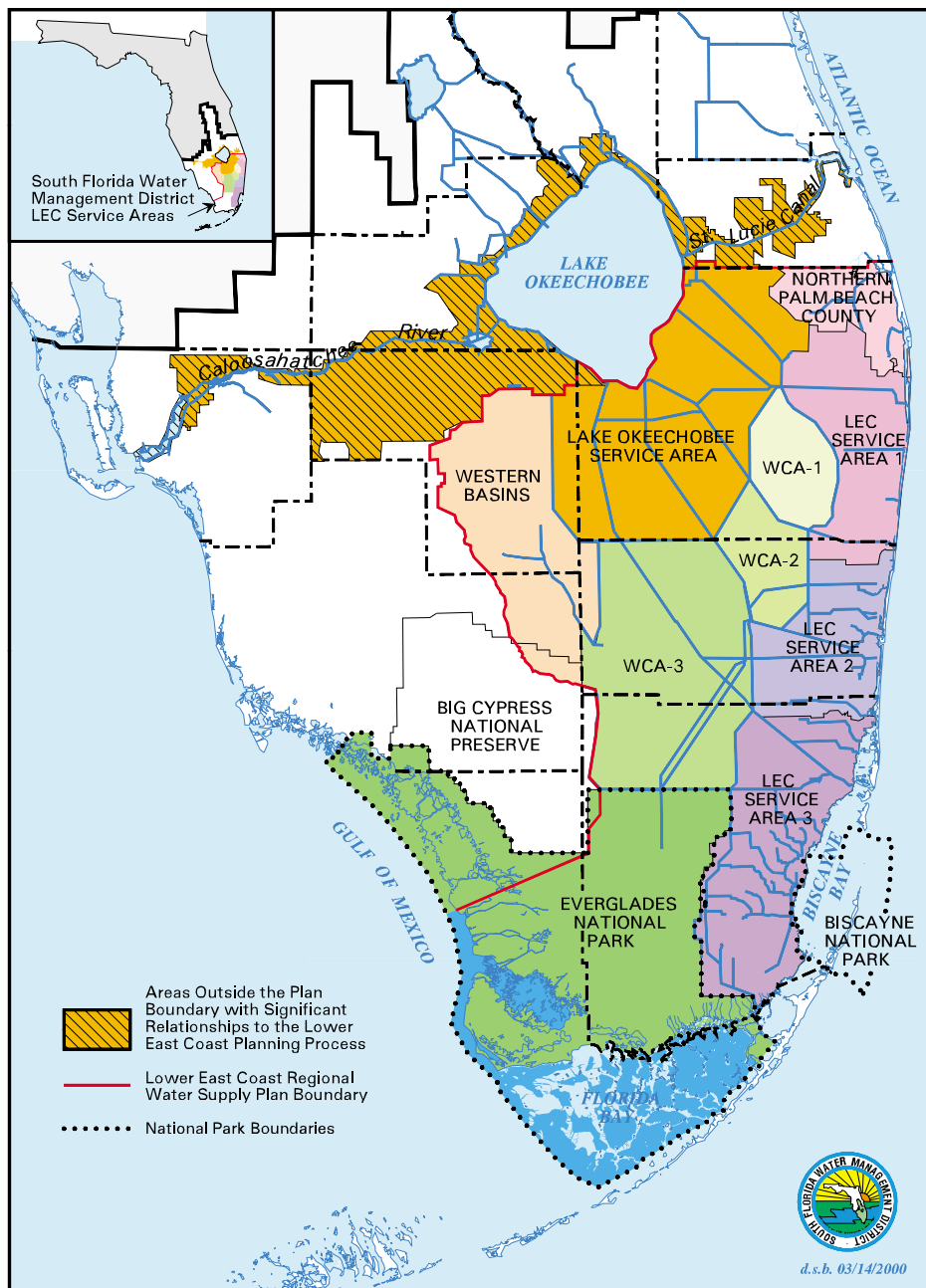


Figure C-1. Geographic Areas of the Lower East Coast Planning Area.

**Figure C-2.
Removed for Security Purposes**

**Figure C-3.
Removed for Security Purposes**

Figure C-4. Removed for Security Purposes

**Figure C-5.
Removed for Security Purposes**

**Figure C-6.
Removed for Security Purposes**

**Figure C-7.
Removed for Security Purposes**

**Figure C-8.
Removed for Security Purposes**

**Figure C-9.
Removed for Security Purposes**

**Figure C-10.
Removed for Security Purposes**

**Figure C-11.
Removed for Security Purposes**

LAKE OKEECHOBEE

1. Lake Okeechobee Water Supply and Environmental Schedule

Restudy Component Letter: This component is the LEC Plan's recommended replacement for the Restudy's Lake Okeechobee Regulation Schedule component (F)

Geographic Region: Lake Okeechobee

Purpose: Operating criteria for Lake Okeechobee that includes flood control, water supply (including releases to the Water Conservation Areas (WCAs) to meet estimated natural system needs), and lake littoral zone and estuary protection.

Operation. The schedule was derived by integrating climate-based forecasts of inflows and tributary basin rainfall with the operating rules of the existing Lake Okeechobee schedule. This new Water Supply and Environmental (WSE) schedule meets water supply requirements as effectively as the current operational schedule. In addition, model simulations indicated that stress to the littoral zone was reduced, the number of discharge events that adversely impact the St. Lucie and Caloosahatchee estuaries decreased, and hydroperiods for the Everglades were enhanced.

The WSE schedule is based on the use of operational decision trees that determine when water should be discharged from Lake Okeechobee to the WCAs or the estuaries. In addition to evaluating water levels in the lake, the new features of this schedule give formal consideration to water conditions in tributary basins on a weekly basis and to multiseason climate outlooks on a monthly basis. Analyses of water conditions in the tributary basins are based on regional excess or deficit of net rainfall during the past four weeks, and average S-65E inflow for the past two weeks. Climate predictions are based on the official seasonal forecasts from the National Center of Environmental Predictions Climate Prediction Center (CPC) for wet season (May-October) and dry season (November-April) conditions.

Discharges to WCAs are discontinued if a particular WCA or any downstream WCAs are more than 0.25 feet above schedule. For WCA-2A, the maximum of the current drawdown schedule replaced the WCA-2A regulatory schedule. The WSE operational schedule illustrated the following favorable performance measure trends:

- The number of undesirable Lake Okeechobee water level events for the littoral zone were decreased by three.
- The Lake Okeechobee Service Area (LOSA) water supply needs being met during drought years was increased by four percent.
- Hydropattern matches to Natural System Model (NSM) simulations were improved in the WCAs.
- The number of times that high discharge criteria were exceeded for the estuaries was decreased.
- The number of days that lake stages were greater than 16.5 feet during the peak of the hurricane season (August 1-September 15) was reduced from 47 days in the base condition to six days with the WSE Operational Schedule.
- The maximum water level for this same critical period of the year was reduced from 17.46 feet in the base condition to 16.91 feet with the WSE operational guidelines.

In addition, the decision features of the WSE schedule have been incorporated into the analyses of future scenarios that were conducted for the Restudy and the LEC Plan.

Location: Lake Okeechobee (Figure C-2)

2. Lake Okeechobee Aquifer Storage and Recovery

Restudy Component Letter: GG

Geographic Region: Lake Okeechobee

Purpose:

- Provide additional regional storage while reducing both evapotranspiration losses and the amount of land removed from current land use (e.g. agriculture) that would normally be associated with construction and operation of aboveground storage facilities (reservoirs)
- Increase the lake's water storage capability to better meet regional water supply demands for agriculture, lower east coast urban areas, and the Everglades
- Manage a portion of regulatory releases from the lake primarily to improve Everglades hydropatterns, meet environmental targets within the WCAs, and meet the supplemental water supply demands of the lower east coast
- Reduce harmful regulatory discharges to the St. Lucie and Caloosahatchee estuaries
- Maintain the existing level of flood protection

Operation: Water from Lake Okeechobee is to be pumped into the Lake Okeechobee ASR wells when the climate-based inflow forecast projects that the lake water level will rise significantly above those levels that are desirable for the lake littoral zone (15.25 - 14.85 ft NGVD). During the dry season, flow may be made back to the lake from the ASR wells either when the lake water level is projected to fall to within three-quarters of a foot of the supply-side management line during the same dry season, or below 11.75 ft NGVD during the upcoming wet season. During the wet season, flow is allowed from the ASR wells to the lake when climate-based inflow forecast projects less than 1.5 million acre-feet (ac-ft) of inflow during the next six months, and the lake water level is either below 11.75 ft NGVD during the current wet season, or is projected to be in supply-side management during the upcoming dry season.

Design: 200 five-MGD ASR wells (1,000 MGD total) and associated infrastructure

Location: Lake Okeechobee peripheral levee (**Figure C-3**)

Assumptions and Related Considerations:

- Current United States Environmental Protection Agency (USEPA) and Florida Department of Environmental Protection (FDEP) regulations require that ASR source water meet primary drinking water standards before injection. Lake Okeechobee water is assumed to meet these standards.
- ASRs will have an approximate recovery rate of 70 percent, i.e. 30 percent of water injected to the deep wells is lost due to transmission (injection and recovery) and storage (mixing with deep aquifer saline water and migration of ASR storage flume) losses.

LAKE OKEECHOBEE SERVICE AREA

3. Lake Okeechobee Watershed Water Quality Treatment Facilities

Restudy Component Letter: OPE

Geographic Region: Lake Okeechobee Service Area

Purpose: To restore the hydrology of selected isolated and riverine wetlands in the region. A two-pronged approach will be taken to this project: 1) restoring hydrology of isolated wetlands by plugging the connection to drainage ditches; and 2) diversion of canal flows through constructed STAs to attenuate peak flows and retain phosphorus. The plugged drainage ditches will result in restoration of approximately 3,500 acres of wetlands throughout the Lake Okeechobee Watershed Basin.

Design:

- 1,755-acre facility in the S-154 Basin in Okeechobee County
- 2,600-acre facility in the S-65D Subbasin in the Kissimmee River Basin

Location: S-154 Basin and S-65D Subbasin of the Kissimmee River Basin (**Figures C-9 and C-11**)

Counties. Highlands and Okeechobee

4. North of Lake Okeechobee Storage Reservoir

Restudy Component Letter: A

Geographic Region: Lake Okeechobee Service Area

Purpose: To increase the capacity of the hydrologic system to better meet the water management objectives associated with flood protection, water supply, and environmental enhancement. The additional water storage capacity allows for greater detention of water during wet periods for subsequent use during dry periods. It is also anticipated that this increased storage capacity will shorten the duration and frequency of both high water levels in the lake that are stressful to the lake littoral ecosystems and large discharges from the lake that are disruptive to the downstream estuary ecosystems.

Operation: Water from Lake Okeechobee is to be pumped into the north storage reservoir when the climate-based inflow forecast projects that the lake water level will rise significantly above those levels that are desirable for the lake littoral zone (14.35-14.75 ft NGVD). During the dry season, flows will be allowed back into the lake from the reservoir when the lake level is projected to fall to within three-quarters of a foot of the supply-side management line in the same dry season, or below 11.75 ft NGVD in the upcoming wet season. During the wet season, flow is allowed from the reservoir to the lake when climate-based inflow forecast projects less than 1.5 million ac-ft of inflow to the lake during the next six months and the water level is either currently below 11.75 ft NGVD or projected to be in supply-side management during the upcoming dry season.

Design:

- 20,000 acres at 10-feet maximum depth
- Inflow pump capacity = 4,800 cubic feet per second (cfs)
- Outflow structure = 4,800 cfs

Location: To be determined – specific site not necessary for South Florida Water Management Model (SFWMM) simulation (**Figure C-4**)

Counties: Glades, Highlands, Okeechobee, Osceola, and Polk

Assumptions and related considerations:

- Land availability is uncertain
- An alternative to capturing lake water would be to attenuate flood waters before reaching the lake. This could be done north of the Kissimmee River which could have positive impacts to the Kissimmee River Restoration Project or within the Taylor Creek/Nubbin Slough which would improve water quality entering the lake.
- Stage duration of Lake Okeechobee have the potential to increase
- Maximum stages of Lake Okeechobee have the potential to decrease

5. C-44 Basin Storage Reservoir¹

Restudy Component Letter: B

Geographic Region: Lake Okeechobee Service Area

Purpose: Storage reservoir to capture local runoff from the C-44 Basin. The reservoir will be designed for flood flow attenuation to the estuary, water supply benefits including environmental water supply deliveries to the estuary, and water quality benefits to reduce salinity and nutrient impacts of runoff to the estuary.

Operation: Inflows from C-44 Basin runoff (and only when lake stage is greater than 14.5 ft NGVD)

Design:

- 10,000 acres at four-feet maximum depth
- Inflow pump capacity = to be determined (initially assumed to not constrain performance)
- Outflow structure capacity = to be determined (initially assumed to not constrain performance)

Location: To be determined – specific site not necessary for SFWMM simulation (**Figure C-4**)

Counties: Martin

Assumptions and related considerations:

- Uncertainty in land availability
- Potential water quality benefits by reducing nutrient loading to the estuary

1. Costs of this project are not included in **Table 93** in **Chapter 6** of the LEC Plan Planning Document. They will be included in the next update of the Upper East Coast Water Supply Plan.

6. C-43 Basin Storage Reservoir with Aquifer Storage and Recovery

Restudy Component Letter: D

Geographic Region: Lake Okeechobee Service Area

Purpose: Storage reservoir(s) with ASR to capture basin runoff and releases from Lake Okeechobee. These facilities will be designed for water supply benefits, some flood attenuation, and to provide environmental water supply deliveries to the Caloosahatchee Estuary.

Operation: Excess runoff from the C-43 Basin and Lake Okeechobee flood control discharges will be captured by the proposed C-43 Reservoir(s). Water from the reservoir(s) will be used to provide environmental deliveries to the Caloosahatchee Estuary, to meet demands in the Caloosahatchee Basin and to inject water into the ASR wellfield for long-term (multiseason) storage. Water from the ASR facilities will be used to meet environmental demand of the estuary and meet basin demands. Any estuarine demands not met by basin runoff, the reservoir, and the ASR system will be met by Lake Okeechobee, as long as lake stage is above 11.5 ft NGVD. Lake water is also used to meet the remaining basin demands subject to supply-side management.

The C-43 Reservoir is operated in conjunction with the Caloosahatchee Backpumping Facility which includes an STA for water quality treatment. If the levels of water in the reservoir exceed 6.5 feet and Lake Okeechobee is below the pulse release zone, then water is released and sent to the backpumping/treatment facility at 2000 cfs.

Design:

- Reservoir(s) total of 20,000 acres at eight-feet maximum depth.
- ASR wellfields total of 22 10-MGD wells
- Reservoir(s) Inflow pump capacity = to be determined (assumed not to constrain performance)
- ASR inflow capacity = limited to 220 MGD
- Reservoir(s) outflow structure capacity = to be determined (assumed not to constrain performance)
- ASR outflow capacity = limited to 220 MGD

Location: To be determined - specific site not necessary for simulations (**Figures C-3 and C-4**)

Counties: Hendry, Glades, and Lee

Assumptions and related considerations:

- Uncertainty in land availability
- Potential water quality benefits by reducing nutrient loadings
- Raw water ASR injection permittable
- 70 percent recovery for injected ASR water
- Size of injection bubble not limited
- ASR facility sized to slightly exceed minimum flows to estuary

7. L-8 Project

Restudy Component Letter: K

Geographic Region: Lake Okeechobee Service Area

Purpose: Reduce water supply restrictions in the Northern Palm Beach County Service Area by capturing more of the annual discharges from portions of the southern L-8, C-51, and C-17 basins and route this water to the West Palm Beach Water Catchment Area. Intent is to increase water supply availability and provide pass through flow to enhance hydroperiods in Loxahatchee Slough and increase base flows to the Northwest Fork of the Loxahatchee River.

Operation: Capture excess L-8, C-51, and C-17 basins water to meet urban water supply demands in the Northern Palm Beach County Service Area and enhance hydroperiods in the Loxahatchee Slough. Water would be diverted through the M Canal to the water catchment area. STAs will be provided to meet all water quality standards required if necessary.

Design:

- Added 48,000 ac-ft reservoir. The reservoir covers an area of approximately 1,200 acres and is located immediately west of the L-8 Canal and north of the C-51 Canal.
- Add 50-MGD ASR wells to provide water during regionally triggered droughts and as a means of reducing withdrawals from the West Palm Beach Water Catchment Area when the water levels are substantially below the target hydrograph. The majority or all of the 50 MGD ASR well clusters will be located in the vicinity of the city of West Palm Beach Water Treatment Plant (Clear Lake). However, for modeling purposes, the ASR wells will be located in the West Palm Beach Water Catchment Area. During periods when the West Palm Beach Water Catchment Area is above 18.0 ft NGVD, an additional (above the flow rate required to supply the water treatment plant) 50 MGD (78 cfs) will be sent to Lake Mangonia for subsequent storage through the ASR clusters (surficial well discharging into a Floridan well). The ASR wells will provide water directly to Lake Mangonia when water levels in the West Palm Beach Water Catchment Area are within 0.2 feet of the level that triggers regional supply to the West Palm Beach Water Catchment Area.
- Increase the pumping capacity from the L-8 Tieback into the M Canal to 300 cfs to increase the volume of water captured from the southern L-8 Canal and deliver it to the West Palm Beach Water Catchment Area. This pump has dual purposes: 1) to capture L-8 Basin runoff when available and 2) to deliver regional deliveries when needed.
- Assume that the Indian Trail Improvement District will adopt an operation plan which promotes water conservation by prioritizing discharge so that excess storm water is first offered to the West Palm Beach Water Catchment Area through installation of two pumps (300 cfs and 200 cfs) and secondarily discharged through off-peak releases to the C-51 Canal via the M-1 Canal. Pumping from Indian Trail Improvement District into the M Canal for subsequent discharge into the West Palm Beach Water Catchment Area will be assumed to occur under the following conditions:
 - When the City of West Palm Beach Water Catchment Area has sufficient need for imported water as defined by being below 18.2 ft NGVD.
 - When water levels in the lower M-1 Basin exceed 14.0 ft NGVD during the wet season (June 1-October 31) or 16.0 ft NGVD during the dry season (November 1-May 31) the lower M-1 Basin may discharge up to 200 cfs for subsequent storage.
 - When water levels in the upper M-1 Basin exceed 15.0 ft NGVD during the wet season or 16.0 ft NGVD during the dry season) the upper M-1 Basin may discharge up to 300 cfs for subsequent storage.
- Increase conveyance of the M Canal between the pump and the West Palm Beach Water Catchment Area to accommodate the increased inflow from the L-8 Canal and the Indian Trail Improvement District.
- Install a new structure in the south leg of C-18 just south of the west leg to facilitate better management of water levels and discharges from the Loxahatchee Slough. The new gravity structure would consist of a variable discharge up to 400 cfs and emergency overflow weirs.

- 50-cfs pump for water supply deliveries to utilities. A recharge canal may be improved to convey deliveries to utilities.
- STA(s) may be needed upstream of the water catchment area to attain acceptable water quality standards and to accommodate future degradation of water quality. The size and location of the STA(s) will be determined if treatment is required.
- New culverts under the Bee Line Highway for up to 100-cfs deliveries to the Loxahatchee Slough.
- Eliminate ASR component described in the Future Without Project Condition.

Location: Southern L-8 Basin including the Indian Trail Improvement District, West Palm Beach Water Catchment Area, and the Loxahatchee Slough (**Figures C-3, C-4, and C-5**)

Counties: Palm Beach

Assumptions and related considerations:

- This project should help maintain stages in the Loxahatchee Slough and reduce high discharges to the southwest fork of the Loxahatchee River.
- STA upstream of the West Palm Beach Water Catchment Area may be needed to accommodate future degradation of water quality.
- Secondary structures (recharge canals) may be needed downstream of the West Palm Beach Water Catchment Area to provide water to achieve the desired result.

8. Lake Okeechobee Tributary Sediment Dredging

Restudy Component Letter: OPE

Geographic Region: Lake Okeechobee Service Area

Purpose: Removal of phosphorous in canals located in areas of the most intense agricultural use in the Lake Okeechobee watershed. These sediments presently contribute to the excessive phosphorus loading to Lake Okeechobee.

Operation: Canals will be dredged and a partnership with local landowners will be pursued for the disposal of the dredged material on uplands. The South Florida Water Management District (District, SFWMD) has programmed a demonstration project to be implemented in 1999. Findings from this demonstration project will be used for detailed planning and design of this construction feature.

Design: This feature includes the dredging of sediments from 10 miles of primary canals within an eight-basin area in the northern watershed of Lake Okeechobee. The initial design assumes that the dredged material will contain approximately 150 tons of phosphorus.

Location: Northern watershed of Lake Okeechobee (**Figure C-11**)

Counties: Martin, Okeechobee, and Glades

Assumptions and related considerations: This feature is consistent with the water quality restoration goals for the lake included in the Lake Okeechobee Surface Water Improvement Management (SWIM) Plan and subsequently developed by the Lake Okeechobee Issue Team. Implementation of this feature will also complement other activities associated with pollution reduction for the lake.

9. Taylor Creek/Nubbin Slough Storage Reservoir and Stormwater Treatment Area

Restudy Component Letter: W

Geographic Region: Lake Okeechobee Service Area

Purpose: Storage reservoir to provide flood protection, water quality treatment, estuary protection, and water supply benefits.

Operation: Local runoff from the Taylor Creek/Nubbin Slough basins to be pumped into a 5,000-acre reservoir and then into a 5,000-acre STA. The STA will reduce phosphorus concentrations in the runoff from approximately 0.528 mg/L to 0.107 mg/L. Treated water will then be pumped into Lake Okeechobee when the lake stage is falling and is at least 0.5 feet below the bottom pulse release zone.

Design:

Storage Reservoir

- 5,000-acres at 10-feet maximum depth
- Inflow pump capacity = 2,500 cfs
- Outflow pump capacity = 1,000 cfs

Stormwater Treatment Area:

- 5,000-acres at four-feet maximum depth
- Inflow pump capacity = 1,000 cfs (same structure as reservoir outflow)
- Outflow pump capacity = 1,000 cfs

Location: North of Lake Okeechobee (**Figures C-4 and C-5**)

Counties: Okeechobee, St. Lucie

Assumptions and related considerations:

- Uncertainty in land availability
- Potential increase in stage duration of Lake Okeechobee
- Potential decrease in maximum stages of Lake Okeechobee.
- Phosphorus inflow concentrations (flow-weighted) for the Taylor Creek (S-191) and Nubbin Slough (S-133) basins obtained from five-year rolling averages (1991-1995)
- Average annual discharge rates determined from the period of record (1965-1990)

10. Caloosahatchee Backpumping with Stormwater Treatment Area

Restudy Component Letter: DDD

Geographic Region: Lake Okeechobee Service Area.

Purpose: Capture excess C-43 Basin runoff to augment the regional system. These facilities will be designed to backpump excess water from the C-43 Basin to Lake Okeechobee after treatment through a STA.

Operation: This component operates after estuary, agricultural, and urban demands have been met in the C-43 Basin and when water levels in the C-43 Storage Reservoir exceed 6.5 feet. When this situation occurs, water will be released from the reservoir and delivered to the STA at the capacity of the treatment system (2,000 cfs). The STA water is then backpumped to Lake Okeechobee. An additional requirement for the backpumping to take place is that Lake Okeechobee must be considered to have available storage, i.e. when its levels are below the pulse release zone line.

Design: The key components in the design are pumps and a STA. For the design it has been assumed that the STA is located adjacent to Lake Okeechobee. Because it is not known where the reservoir will be located relative to the STA, it has been assumed that water to be delivered to the STA will be released from the reservoir to the Caloosahatchee River and then pumped from the river into the STA. Since no pump to bring water from the lower basin (below the S-78 Structure) to the upper basin has been included in the reservoir design and since most of the basin runoff is generated in the lower basin, a pump to bring the water from the lower Caloosahatchee Basin to the upper basin has also been included. The STA has been included to meet the anticipated need to improve the quality of the water before it enters Lake Okeechobee. Finally, a pump station will be used to lift the water from the STA to Lake Okeechobee.

Pumps

- One 2,000-cfs capacity pump to take water from the lower Caloosahatchee Basin to the upper Caloosahatchee Basin
- One 2,000-cfs capacity pump to take water from the Caloosahatchee River into the STA
- One 2,000-cfs capacity pump to discharge water from the STA to Lake Okeechobee

Stormwater Treatment Area

- An STA of approximately 5,000 acres is proposed to achieve water quality improvements.

Location: To be determined - specific site not necessary for simulations (**Figure C-5**)

Counties: Hendry, Glades

Assumptions and related considerations:

- Land availability is uncertain.
- The component will provide water quality benefits to the lake.
- The Franklin Lock and Dam S-79 time series flow demand for the Caloosahatchee Estuary has been reduced.
- The performance measures were not changed.
- The model assumes that the backpumping/treatment facility, primarily the STA, functions as a flow-through system.

ESTUARIES

11. Environmental Water Supply Deliveries to the Caloosahatchee Estuary

Restudy Component Letter: E

Geographic Region: Estuaries

Purpose: To provide freshwater deliveries to the Caloosahatchee Estuary to establish desirable salinity regimes at locations of key estuarine biota

Operation: Deliver (revised) desired estuary target flow through S-79 in priority order, from basin runoff, from the C-43 Storage Reservoir, from the C-43 Basin ASR system and from Lake Okeechobee when the lake stage exceeds 15 ft NGVD

Design: (Operational changes only) The time series of estuary target flows was revised. The revised series changes the timing and total amounts in a way that assures that desirable salinity patterns will be achieved and at the same time makes some water available for capture and utilization in the regional system. The capture of the excess runoff is accomplished by the C-43 Basin Storage Reservoir(s) with ASR component (**Component 6**) and by Caloosahatchee Backpumping with STA component (**Component 10**).

Location: C-43 Basin and Caloosahatchee Estuary (**Figure C-2**)

Assumptions and related considerations:

- Estuary deliveries are made to maintain salinity conditions in the estuary that support a range of aquatic vegetation, seagrass, invertebrates, and fish communities.
-

12. Environmental Water Supply Deliveries to the St. Lucie Estuary

Restudy Component Letter: C

Geographic Region: Estuaries

Purpose: Environmental Water Supply Deliveries to the St. Lucie Estuary will provide freshwater deliveries to the St. Lucie Estuary to protect and restore more natural estuarine conditions. The target estuarine time series was revised because, under current policy, the C-44 Basin does not discharge water to the St. Lucie Estuary when Lake Okeechobee is below 14.5 ft NGVD and also because such discharges are generally undesirable from an estuarine management viewpoint.

Operation: Deliver revised estuary target discharge through S-80 from the reservoir when water is available or from the lake when the lake stage exceeds 11.5 ft NGVD

Design: Operational changes only

Location: C-44 Basin and St. Lucie Estuary (**Figure C-2**)

Counties: Martin and St. Lucie

Assumptions and related considerations: Estuary deliveries are based on maintaining salinity conditions in the estuary to support a range of aquatic vegetation seagrass, invertebrates, and fish communities.

13. C-23/C-24/Northfork and Southfork Storage Reservoirs¹

Restudy Component Letter: UU

Geographic Region: Lake Okeechobee Service Areas and Estuaries

Purpose: Storage reservoirs to capture local runoff from the C-23, C-24, Northfork, and Southfork basins of the St. Lucie River Estuary. The reservoirs will be designed for flood flow attenuation to the estuary; water supply benefits, including environmental water supply deliveries to the estuary; and water quality benefits to reduce salinity and nutrient impacts of runoff to the estuary. A reservoir is located within each basin.

Operation: Inflows from the C-23, C-24, Northfork, and Southfork basins of the St. Lucie River

Design:

- A total of 26,200 acres at eight-feet maximum depth distributed as follows among these basins:
 - The C-23 Basin will have a 8,400-acre reservoir.
 - The C-24 Basin will have a 6,000-acre reservoir.
 - The Northfork Basin will have a 11,800-acre reservoir.
 - The Southfork Basin will have a 9,350-acre, four-feet maximum depth reservoir.
- Inflow pump capacity = 1.0 to 1.5 inches per day
- Outflow structure capacity = to be determined (initially assumed to not constrain performance)

Location: To be determined – specific site not necessary for SFWMM simulation (**Figure C-4**)

Counties: Martin and St. Lucie

Assumptions and related considerations:

- Uncertainty in land availability
- Potential water quality benefits by reducing nutrient and sediment loading to the estuary

1. Costs of this project are not included in **Table 93** in **Chapter 6** of the LEC Plan Planning Document. They will be included in the next update of the Upper East Coast Water Supply Plan.

EVERGLADES AGRICULTURAL AREA

14. Everglades Agricultural Area Storage Reservoir

Restudy Component Letter: G

Geographic Region: Everglades Agricultural Area

Purpose: Storage reservoir improves timing of environmental deliveries to the WCAs including reducing damaging flood releases from the Everglades Agricultural Area (EAA) to the WCAs; reduces Lake Okeechobee regulatory releases to estuaries; meets supplemental agricultural irrigation demands; and increases flood protection within the EAA. Conveyance capacity of the Miami and North New River Canals between Lake Okeechobee and the storage reservoir(s) is increased to convey additional Lake Okeechobee flood control releases that would have otherwise been discharged to the Caloosahatchee and St. Lucie estuaries. Conveyance capacity of the Bolles and Cross canals between the Miami and Hillsboro canals is increased to facilitate interbasin transfers for storage and flood protection.

Operation: Inflows are from Lake Okeechobee regulatory discharges and runoff from Miami and North New River and canal basins. The reservoir will be divided into three compartments:

Compartment 1:

- 20,000 acres which meets EAA irrigation demands only.
- The source of water is excess EAA runoff. Inlet capacities for excess runoff are 2,700 and 2,300 cfs, for the Miami Canal and the North New River Canal basins, respectively.
- Outlet capacities for EAA demands are 3,000 and 4,400 cfs, for the Miami Canal and the North New River Canal basins, respectively.
- Overflow to Compartment 2A occurs when the depth of water approaches the six-foot maximum and Lake Okeechobee regulatory discharges are not occurring or impending.
- Excess EAA runoff is diverted to Compartment 2A only if WCA-3A is too deep.

Compartment 2A:

- 20,000 acres which meets environmental demands as a priority, but can supply a portion of EAA irrigation demands if environmental demands equal zero.
- The sources of water are overflow from Compartment 1 and Lake Okeechobee regulatory releases including the weather forecasting to initiate storage usage
- Compartment 2A will be operated as a dry storage reservoir and discharges made down to 18 inches below ground level.

Compartment 2B:

- 20,000-acres which meets environmental demands as a priority.
- The sources of water are overflow from Compartments 1 and 2A and Lake Okeechobee regulatory releases during extreme wet events.
- Compartment 2B will be operated as a dry storage reservoir and discharges made down to 18 inches below ground level.

The conveyance of the northern reaches of the Miami and North New River Canals in the EAA are tripled (200 percent increase) for Lake Okeechobee regulatory releases. Structures with a capacity of 4,500 cfs for diversion of regulatory releases through the Miami Canal and 3,000 cfs for diversion of regulatory releases through the North New River Canal are added to Compartments 2A and 2B. When the reservoir depth falls below 1.5 feet, Lake Okeechobee is used for meeting supplemental irrigation and environmental demands. The flows will be delivered to the WCAs through STA-3/4.

Design:

Compartment 1:

- 20,000-acre reservoir at six-feet maximum depth

- Inflow structure capacity: inflow pumps of 2,700 cfs for Miami Canal Basin and 2,300 cfs for North New River Canal Basin for diversion of EAA runoff
- Outflow structure capacity: one 3,000-cfs structure for the Miami Canal Basin and one 4,400-cfs structure for North New River and Hillsboro basins to EAA (initially assumed to not constrain performance)

Compartment 2A:

- One 20,000-acre reservoir at six-feet maximum depth
- Inflow structure capacity: Inflow pumps of 4,500 cfs and 3,000 cfs for diversion of Lake Okeechobee regulatory releases from the Miami and North New River canals, respectively
- Outflow structure capacity: 3,600 cfs at six-feet head to STA-3/4. Increase in Miami, North New River, Bolles, and Cross canal capacities is 200 percent. Outflows to Miami Canal and North New River Canal will be 4,500 cfs and 3,000 cfs, respectively.

Compartment 2B:

- One 20,000-acre reservoir at six-feet maximum depth.
- Inflow structure capacity: inflow pumps of 4,500 cfs and 3,000 cfs for diversion of Lake Okeechobee regulatory releases from the Miami and North New River canals, respectively.

Location: To be determined - conceptually located in Palm Beach County between the Miami and North New River canals for SFWMM simulation purposes only (**Figure C-4**)

Assumptions and related considerations:

- Land Availability
- Modifications to STAs if needed for Everglades water deliveries to meet the appropriate water quality

15. Revised Holey Land Wildlife Management Area Operation Plan

Restudy Component Letter: DD

Geographic Region: Everglades Agricultural Area

Purpose: Improve timing and location of water depths within the Holey Land Wildlife Management Area (WMA) based on rain-driven operations

Operation: Rain-driven modified operational rules with NSM-like hydrologic conditions triggering deliveries. Rain-driven inflows are driven by target water depths in cell R45C18. Outflows are based on target water depths in R42C20.

Design: Operational changes only

Location: Southern portion of the EAA, north of WCA-3A (**Figure C-2**)

Counties: Palm Beach

Assumptions and related considerations:

- Water deliveries made to the Holey Land WMA through G-200A or from STA-3/4 if Rotenberger WMA flows are insufficient. The deliveries are assumed to be of acceptable water quality from either the Rotenberger WMA or Lake Okeechobee through STA-3/4.

16. Modified Rotenberger Wildlife Management Area Operation Plan

Restudy Component Letter: EE

Geographic Region: Everglades Agricultural Area

Purpose: Improve timing and location of water depths within the Rotenberger WMA based on rain-driven operations.

Operation: Rain-driven operational rules with NSM-like hydrologic conditions triggering deliveries. Rain-driven inflows and outflows are driven by the average of target water depths in cells R46C15 and R43C16.

Design: Operational changes only

Location: Southern portion of the EAA, north of WCA-3A (**Figure C-2**)

Counties: Palm Beach

Assumptions and related considerations:

- Water deliveries made to the Rotenberger WMA from STA-5 are assumed to be of acceptable water quality.

NORTH PALM BEACH SERVICE AREA

17. C-17 Backpumping and Treatment

Restudy Component Letter: X

Geographic Region: North Palm Beach Service Area

Purpose: Reduce water supply restrictions in the Northern Palm Beach County Service Area by providing additional flows from the C-17 Basin to the West Palm Beach Water Catchment Area and enhance hydroperiods in the Loxahatchee Slough.

Operation: Capture excess C-17 Canal water to meet urban water supply demands in North Palm Beach Service Area. Water would be diverted through existing canals to a STA and ultimately to the West Palm Beach Water Catchment Area.

Design:

- 200-cfs pump in the existing Northern Palm Beach County Improvement District Canal at its intersection with the Turnpike Canal to pull flows west and direct them south into the east Turnpike Canal
- Culvert under Forty-Fifth Street (north-south) to connect the east Turnpike Canal
- 150-cfs capacity culvert and pump from the Turnpike Canal to direct flows into the proposed STA
- 550-acre STA at four-feet maximum depth
- 200-cfs culvert to connect STA under Florida's Turnpike to allow nonrestrictive flows
- 100-cfs gravity discharge structure into West Palm Beach Water Catchment Area

Location: 550 acres located east of the West Palm Beach Water Catchment Area (**Figures C-5 and C-10**)

Counties: Palm Beach

Assumptions and related considerations:

- Water quality of the C-17 Canal water similar to C-51 Canal water quality
- Location of STA south of existing landfill
- Improve conveyance in the Northern Palm Beach County Improvement District and Turnpike canals, as necessary, to pass flows

18. Pal-Mar and J.W. Corbett Wildlife Management Area Hydropattern Restoration

Restudy Component Letter: OPE

Geographic Region: Lake Okeechobee and North Palm Beach service areas

Purpose: The purpose of this feature is to provide hydrologic connections between the J.W. Corbett WMA and (1) the Moss Property, (2) the C-18 Canal, (3) the Indian Trail Improvement District, and (4) the L-8 Borrow Canal, in addition to extending the spatial extent of protected natural areas.

Operation: These connections would relieve the detrimental effects on native vegetation frequently experienced during the wet season and form an unbroken 126,000-acre greenbelt extending from the Dupuis Reserve near Lake Okeechobee across the J.W. Corbett WMA and south to Jonathan Dickinson State Park.

Design:

- Water control structures and canal modifications
- Acquisition of 3,000 acres located between Pal-Mar and the J.W. Corbett WMA

Location: East of Lake Okeechobee along State Road 710 (**Figures C-7 and C-9**)

Counties: Martin and Palm Beach

19. C-51 and Southern L-8 Reservoir

Restudy Component Letter: GGG

Geographic Region: Lower East Coast Service Area 1 and Lake Okeechobee Service Area

Purpose: Storage reservoir managed for the environmental and water supply goals listed below

- Reduce the number of events when discharges to the Lake Worth Lagoon exceed the desired daily average flow rate of 500 cfs
- Reduce the magnitude of events exceeding the desired flow rate of 500 cfs
- Reduce the average annual volume discharged to tide (over the S-155 Structure) by detaining storm water runoff for subsequent environmental needs (routing from the West Palm Beach Water Catchment Area to the northwest fork of the Loxahatchee River) and water supply needs (providing water to the Lake Worth Drainage District and the West Palm Beach Water Catchment Area).
- Provide increased drainage to the C-51 Basin and the Southern L-8 Basin by lowering the average stages in the C-51 Canal

Operation: The reservoir will be filled with excess water from the Southern L-8 Basin and the C-51 Basin when flows over the S-155 Structure exceed 300 cfs during the wet season from excess water in the C-51 Canal and Southern L-8 (backpumped) canals. Water will be released back to the C-51 Canal to help maintain canal stages during the dry season.

Design:

- 1,200 acres of usable area with a 100-foot deep, two-foot thick slurry wall for seepage control along the approximate perimeter length of six miles (this depth assumes a 170-foot surficial aquifer thickness, a 20-foot embankment, and 10 feet of embedment of the slurry into the confining layer). The reservoir will have a total storage depth of 40 feet (30 feet below grade and 10 feet above grade).
- Inflow pump capacity will be 1,500 cfs at the reservoir.
- Emergency outflow structure will have a capacity of 1,500 cfs for when the water level exceeds the maximum operation depth of 40 feet by two feet.
- Pumped outflow will have a maximum rate of 400 cfs at 40 feet and will use the discharge schedule shown in **Table C-1**.
- This component includes a 1,000-cfs pump at the S-155A Structure, which will be operated when flows through S-155 exceed 300 cfs, and there is capacity in the reservoir.

Table C-1. Discharge Schedule for the Pumped Outflow.

Depth (feet)	Discharge Rate (cfs)	Storage Volume (ac-ft)
42	1,500	50,400
41	415	49,200
40	400	48,000
30	300	36,000
20	300	24,000
10	300	12,000
0	300	0

Location: Immediately west of the L-8 Canal and north of the C-51 Canal (**Figure C-4**)

Counties: Palm Beach

Assumptions and related considerations:

- This parcel is owned by Palm Beach Aggregate and is currently an active mining operation with a nominal excavation depth of 40 feet.
- Slurry wall surrounding perimeter will be built to address seepage and water quality issues due to ancient or connate water with a chloride content of 500 mg/L.
- The component will include telemetry control and monitoring.

LOWER EAST COAST SERVICE AREA 1

20. Hillsboro (Site 1) Impoundment and Aquifer Storage and Recovery

Restudy Component Letter: M

Geographic Region: Lower East Coast Service Area 1

Purpose: Water supply storage reservoir to supplement water deliveries to the Hillsboro Canal during the dry season.

Operation: The reservoir will be filled during the wet season from excess water backpumped from the Hillsboro Canal. Water will be released back to the Hillsboro Canal to help maintain canal stages during the dry season. If water is not available in the reservoir, existing rules for water delivery to this region will be applied. ASR wells are being proposed to improve water supply during dry seasons and droughts. Thirty-five-MGD capacity ASR wells will be sited around the reservoir (total injection and recovery capacity is 150 MGD or about 230 cfs). Water from the Hillsboro Impoundment will be injected into the ASR wells when stages in the impoundment are greater than 12.0 ft NGVD (0.5 feet of depth). Water will be recovered from the ASR wells when stages in the Hillsboro Canal are less than seven ft NGVD.

Design:

- 2,460 acres with a maximum depth of six feet located north and south of the Hillsboro Canal. The portion of the canal that is located within the proposed reservoir will be incorporated into the reservoir.
- Inflow pump capacity is 700 cfs and is relocated to the eastern end of the Hillsboro Canal.
- Outflow structure capacity is 200 cfs at four feet of head.
- Emergency outflow structure is 700 cfs.
- Thirty five-MGD ASR wells (total capacity 150 MGD or about 230 cfs).

Location: See **Figures C-3** and **C-4**

Counties: Palm Beach

Assumptions and related considerations:

- If a treatment facility could be added to meet Everglades' water quality standards, excess storage could be discharged to WCA-2A
- The recovery rate for water stored by ASR is 70 percent.

21. Acme Basin B Discharge

Restudy Component Letter: OPE

Geographic Region: Lower East Coast Service Area 1

Purpose: Provide water quality treatment and storm water attenuation for runoff from Acme Basin “B” prior to discharge to the Arthur R. Marshall Loxahatchee National Wildlife Refuge (WCA-1) or alternative locations described below. Excess available water may be used to meet water supply demands in central and southern Palm Beach County.

Operation: If water quality treatment criteria is met, storm water runoff from Acme Basin B will be pumped into the wetland treatment area and then into the storage reservoir until such time as the water can be discharged into the Arthur R. Marshall Loxahatchee National Wildlife Refuge (WCA-1). If water quality treatment criteria is not met, storm water runoff will be pumped into one of two alternative locations: the Palm Beach County Agricultural Reserve Reservoir (**Component 27**) or the combination aboveground and in-ground reservoir area located adjacent to the L-8 Borrow Canal and north of the C-51 Canal.

Design: This feature includes the construction of a wetland or chemical treatment area and a storage reservoir with a combined storage capacity of 3,800 ac-ft. The initial design for the treatment area and reservoir assumed 310 acres with the water level fluctuating up to 4 feet above grade and 620 acres with the water level fluctuating up to 8 feet above grade. The final size, depth, and configuration of these facilities will be determined through more detailed planning and design.

Location: Adjacent to the Arthur R. Marshall Loxahatchee National Wildlife Refuge (WCA-1) (**Figures C-4 and C-5**)

Counties: Palm Beach

22. C-51 Backpumping and Treatment

Restudy Component Letter: Y

Geographic Region: Lower East Coast Service Area 1

Purpose: Reduce water supply restrictions in Northern Palm Beach County Service Area by providing additional flows from the C-51 West Basin to the West Palm Beach Water Catchment Area and enhance hydroperiods in Loxahatchee Slough.

Operation: Capture excess C-51 Canal water to meet urban water supply demands in the North Palm Beach Service Area. Water would be diverted from C-51 to a water treatment area and then into the West Palm Beach Water Catchment Area.

Design:

- 600 acres at four-feet maximum depth to be used for storm water treatment.
- Relocate the S-155A structure east of the intersection of Lake Worth Drainage District's E-1 Canal and the C-51 Canal and increase the capacity of S-155A as necessary to pass the additional inflows
- Improve conveyance between the C-51 Canal and the STA as necessary
- 450-cfs inflow pump to STA
- 100-cfs gravity discharge structure into West Palm Beach Water Catchment Area

Location: 600 acres located southwest of West Palm Beach Water Catchment Area (**Figures C-5 and C-10**)

Counties: Palm Beach

Assumptions and related considerations:

- Uncertainty in land availability
- Connection of the L-8 and C-51 basins

23. C-51 Regional Ground Water Aquifer Storage and Recovery

Restudy Component Letter: LL

Geographic Region: Lower East Coast Service Area 1

Purpose: This is a regional ground water ASR system which will capture and store excess water during wet periods and recover the water for utilization during dry periods. The ability to use the recovered water during dry periods will increase regional water resources.

Operation: Water will be captured and stored when water is being discharged out of S-155 to tide. Water will be recovered during dry periods based on canal elevations.

Design: This component consists of 34 well clusters located along the West Palm Beach Canal (C-51 Canal), each being composed of two surficial aquifer wells and one upper Floridan aquifer ASR well. The surficial aquifer wells will each have a 2.5-MGD withdrawal capacity and be located in proximity to the canal so that the water withdrawn would result in the interception of water that would otherwise go to tide during wet periods. Each upper Floridan aquifer ASR well will have a capacity of five MGD (the total injection and recovery capacity of the ASR system is 170 MGD or about 264 cfs). Water will be injected when stages in the C-51 Canal are above 8.0 ft NGVD. Water will be retrieved from the ASR wells when canal stages are below 7.8 ft NGVD. Recovered water will be discharged to the C-51 Canal.

Location: Along the C-51 Canal in eastern Palm Beach County, east of U.S. 441 (**Figure C-3**)

Counties: Palm Beach

Assumptions and related considerations: It is assumed that ground water ASR in proximity to the C-51 Canal is permissible without treatment.

24. Lake Worth Lagoon Restoration

Restudy Component Letter: OPE

Geographic Region: Lower East Coast Service Area 1

Purpose: Improve water quality and allow for the reestablishment of sea grasses and benthic communities. The elimination of the organically enriched sediment from the C-51 Canal discharge will provide for long-term improvements to Lake Worth Lagoon and enable success for additional habitat restoration and enhancement projects planned by Palm Beach County.

Operation: A prototype project will be conducted to determine if the lagoon sediments will either be removed or trapped.

Design: This feature includes sediment removal and trapping within the C-51 Canal and sediment removal or trapping within a 2.5-mile area downstream of the confluence of the C-51 Canal and the Lake Worth Lagoon.

Location: C-51 Canal/Lake Worth Lagoon (**Figures C-9** and **C-11**)

Counties: Palm Beach

25. Winsburg Farms Wetland Restoration

Restudy Component Letter: OPE

Geographic Region: Lower East Coast Service Area 1

Purpose: To create a wetland from water, which would normally be lost to deep well injection and any future beneficial use. The wetland will reuse a valuable resource, recharge the local aquifer system, create a new ecologically significant wildlife habitat, and extend the function of the nearby Wakodahatchee Wetland.

Operation: The feature will reduce the amount of treated water from the Southern Region Water Reclamation Facility wasted in deep injection wells by further treating and recycling the water.

Design: Construction of a 175-acre wetland

Location: East of Loxahatchee Wildlife Preserve (**Figures C-9** and **C-10**)

Counties: Palm Beach

26. Protect and Enhance Existing Wetland Systems along Loxahatchee National Wildlife Refuge including the Strazzulla Tract

Restudy Component Letter: OPE

Geographic Region: Lower East Coast Service Area 1

Purpose: Provide a hydrological and ecological connection to the Arthur R. Marshall Loxahatchee National Wildlife Refuge (WCA-1) and expand the spatial extent of protected natural areas. This increase in spatial extent will provide vital habitat connectivity for species that require large, unfragmented tracts of land for survival. It also contains the only remaining cypress habitat in the eastern Everglades and one of the few remaining sawgrass marshes adjacent to the coastal ridge. This is a unique and endangered habitat that must be protected. This area provides an essential Everglades landscape heterogeneity function

Operation: This land will act as a buffer between higher water stages to the west and lands to the east that must be drained.

Design: Water control structures and the acquisition of 3,335 acres

Location: East of Arthur R. Marshall Loxahatchee National Wildlife Refuge (WCA-1) (**Figure C-9**)

Counties: Palm Beach

27. Palm Beach County Agricultural Reserve Reservoir and Aquifer Storage and Recovery

Restudy Component Letter: VV

Geographic Region: Lower East Coast Service Area 1

Purpose: Increase water supply for central and southern Palm Beach County by capturing and storing water currently discharged to tide.

Operation: The reservoir will be filled during the wet season from excess water backpumped out of the western portions of the Lake Worth Drainage District (LWDD). Water will be released back to LWDD to maintain canal stages during the dry season. Regional water will be supplied to the LWDD when water level fall below 15.8 ft NGVD. Water will be backpumped into the reservoir when water levels are above 16.0 ft NGVD.

ASR capacity was added to improve supply during dry seasons and droughts. Fifteen five-MGD capacity ASR wells (total injection and recovery capacity of 75 MGD or about 116 cfs) were added. Water from the reservoir will be injected when depths in the impoundment are above one foot. The water supplied from the reservoir will be maximized (up to the outflow capacity) before water is supplied from ASR storage.

Design:

- 1,660 acres with a maximum depth of 12 feet (volume of 19,920 ac-ft)
- Inflow pump capacity = 500 cfs (provided by two 250-cfs pumps)
- Outflow structure capacity = 500 cfs at four-feet head
- Emergency outflow structure = 300 cfs

Location: The western portion of central Palm Beach County (**Figures C-3 and C-4**)

Counties: Palm Beach

Assumptions and related considerations:

- Excess storage could be discharged to the LWDD during off peak times
- Canal conveyance improvements for two laterals from LWDD's E-1 to the E-2.
- No operation changes in the LWDD

28. Change Coastal Wellfield Operations

Restudy Component Letter: L

Geographic Region: Lower East Coast Service Area 1

Purpose: Shift demands from eastern wellfields to western facilities away from the saltwater interface to reduce impact of saltwater intrusion.

Operation: For coastal utilities in the Lower East Coast Service Area which are experiencing an increased threat of saltwater intrusion, demands will be shifted from the eastern facilities to the western facilities away from the saltwater interface. The volume shifted is dependent upon the degree of saltwater intrusion, but is generally proportional to the increase in demands between the 1995 existing conditions and the 2020 future without-project conditions unless otherwise noted.

Design:

- The following utilities have a portion of their demands shifted inland: Riviera Beach, Lake Worth, Lantana, Manalapan, Boca Raton, Hollywood (including Broward County 3B and 3C), Dania, Miramar, Broward County 3A, Hallandale, and Florida City.
- Redistribution of demands for Lake Worth, Lantana, Manalapan, Boca Raton and Florida City are generally consistent with the LEC Plan.
- For Riviera Beach, demands will be shifted from the eastern facilities to the western facilities, with the western facilities absorbing the increased demand between the 1995 and 2020 conditions.
- Miramar's eastern wellfield will be placed on standby and all demands will be met from the western wellfield.
- The Hollywood, Hallandale, Dania, Broward County 3A, and Broward County 3B/3C wellfields will be placed on standby and the entire demand (with the exception of four MGD from the Floridan aquifer for Hollywood) will be met from the South Broward County Regional Wellfield.
- Recharge to the regional wellfield will be met through the existing canal system supplied from locally captured runoff from the C-9 Basin.

Location: Lower East Coast Service Area (**Figure C-2**)

Counties: Broward, Miami-Dade, and Palm Beach

Assumptions and related considerations:

- It is assumed that the western facilities of the individual utilities have sufficient capacity to meet the increased demands.

LOWER EAST COAST SERVICE AREA 2

29. Western C-11 Diversion Impoundment and Canal

Restudy Component Letter: Q

Geographic Region: Lower East Coast Service Area 2

Purpose: Divert untreated runoff from western C-11 that is presently discharged into WCA-3A through the C-11 STA and Impoundment to the North Lake Belt Storage Area (NLBSA).

Operation: Runoff in the western C-11 Canal that was previously backpumped into WCA-3A will be diverted to the C-11 STA and Impoundment and then to the NLBSA. If storage capacity is not available in the impoundment or NLBSA then the S-9 pump will be used for flood protection for the western C-11 Basin, which pumps to WCA-3A. To improve ground water elevations in the eastern C-11 Basin, the S-9 seepage divide structure will be operated to maintain the western C-11 Canal stage at an elevation of 3.0 ft NGVD.

Design:

- 2,500-cfs diversion canal west of U.S. 27 between the C-11 and C-9 canals and a 2,500-cfs conveyance capacity improvements to the C-9 Canal between S-30 and the NLBSA.
- Intermediate 2,500-cfs pump station in the C-11 Canal to direct runoff to the C-11 STA and Impoundment
- 1,600-acre STA and Impoundment with a maximum depth of four feet.
- Seepage collection canal and pump for C-11 STA and Impoundment
- 2,200-cfs structure to discharge from the Impoundment to the C-11 Canal, west of U.S. 27, to the diversion canal

Location: The diversion canal is located west of U.S. 27 between C-11 and C-9 canals. The C-11 STA and Impoundment is located northwest of the intersection of U.S. 27 and the C-11 Canal (**Figure C-5**).

Counties: Broward and Miami-Dade

Assumptions and related considerations:

- Flood protection component for Florida Power and Light (FPL) substation and mobile home park may be needed.
- Telemetry systems will be required for all operable structures and pump stations.

30. C-9 Stormwater Treatment Area/Impoundment

Restudy Component Letter: R

Geographic Region: Lower East Coast Service Area 2

Purpose: Treatment of water supply deliveries from North Lake Belt Storage Area (NLBSA) to the C-9, C-6/C-7, and C-2/C-4 canals. NLBSA is used to capture runoff from western C-9 and C-11 West basins by backpumping into the curtain-walled reservoir area. The C-9 Impoundment will provide treatment of runoff stored in NLBSA, ground water recharge within the basin, and seepage control of WCA-3 and buffer areas to the west.

Operation: Water supply deliveries from NLBSA to C-9, C-6/C-7 and C-2/C-4 canals will be pumped into the C-9 STA and Impoundment for treatment of the storm water runoff stored in the NLBSA. Seepage from the C-9 Impoundment will be collected and returned to the impoundment.

Design:

- 2,500 acres with a maximum depth of four feet.
- Inflow structure: 1,500-cfs pump (NLBSA) (to be resized as needed)
- Outflow structure: Gravity structure with 1,500-cfs capacity at four-foot head. Discharge C-9 Impoundment to the C-9, C-6/C-7, and C-2/C-4 canals for water supply deliveries.
- Seepage Collection: 200 cfs recycled into the impoundment area.

Location: See **Figure C-5**

Counties: Broward

Assumptions and related considerations:

- Additional treatment facility needed if stored water is backpumped into WCA-3A.
- Telemetry systems will be required for all operable structures and pump stations.

31. Broward County Secondary Canal System

Restudy Component Letter: CC

Geographical Region: Lower East Coast Service Area 2

Purpose: Increase pump capacity of existing facilities and construct additional canal and pump facilities for the Broward Secondary Canal System to provide recharge to wellfields located in central and southern coastal Broward County, stabilize the saltwater interface, and reduce storm water discharges to tide.

Operation: When excess water is available in the basin, water is pumped into the coastal canal systems to maintain canal stages. When local water is not sufficient to maintain canal stages, canals are maintained first from local sources and then from Lake Okeechobee and the WCAs. Local sources include the Hillsboro Impoundment and the North Lake Belt Storage Area. Secondary canals maintained are as follows:

- Broward County's C-2 Canal from the Hillsboro Canal
- North secondary canal from the C-13 Canal
- South secondary canal from the C-13 Canal
- Turnpike Canal south from the C-12 Canal
- Canals north from the C-9 Canal at levels discussed below

Design:

Canal conveyance:

- The canal conveyance of the secondary canal located east of the Florida Turnpike from the C-12 Canal south to the Fort Lauderdale Golf and Country Club will be improved. The design includes routing of water eastward to recharge the aquifer and help stabilize the saltwater interface at Fort Lauderdale. Canal conveyance improvements may also be necessary for the Old Plantation Water Control District's eastern canal and in southeastern Broward County.

Pump capacities and maintenance levels:

- 100-cfs pump from the Hillsboro Canal to the Broward County Secondary Canal
- 100-cfs pump from the C-13 Canal north to the Broward County Secondary Canal
- 100-cfs pump from the C-13 Canal south to the Broward County Secondary Canal
- 100-cfs pump on the East Turnpike Canal withdrawing water from the C-12 Canal
- 150-cfs pump on the C-9 Canal for maintaining water in southeastern Broward County

Canal improvements and control elevations:

- Improve East and West Turnpike canals and golf course lake system between the C-12 Canal and the North New River to achieve an average top width of 200 feet.
- The Turnpike canals shall be maintained at a minimum elevation of 4.0 ft NGVD.
- Improve canal/lake systems in southeastern Broward County and the Orangebrook Golf Course to have an average canal top width of 30 feet.
- The southeastern Broward Canal System shall be maintained at a minimum elevation of 2.5 ft NGVD.

Location. Broward County Secondary Canal System (**Figure C-10**)

County: Broward

Assumptions and related considerations:

- Canal levels are maintained from local basin runoff and sources. When water is not available from local sources, water is supplied to the canal systems from the regional system.
- Canal operations do not impact existing flood control levels.

LOWER EAST COAST SERVICE AREA 3

32. North Lake Belt Storage Area

Restudy Component Letter: XX

Geographic Region: Lower East Coast Service Area 3

Purpose: In-ground reservoir to capture a portion of runoff from the C-6, western C-11, and the C-9 basins. The in-ground reservoir with perimeter seepage barrier will allow storage of untreated runoff without concerns of ground water contamination. The stored water will be used to maintain stages during the dry season in the C-9, C-6, C-7, C-4, and C-2 canals and to provide deliveries to Biscayne Bay to aid in meeting salinity targets.

Operation:

- Inflows from the C-6 (west of the Turnpike), western C-11, and C-9 basins runoff are pumped and gravity fed into the in-ground reservoir. Inflow ceases when stages reach approximately 5.0 ft NGVD.
- Outflows for water supply are pumped to the C-9 STA/Impoundment prior to delivery to the C-9, C-6, C-7, C-4, and C-2 canals.
- Water from the reservoir can be withdrawn down to a stage of -15 ft NGVD (up to 20 feet of working storage and maximum head on seepage barrier). Land elevation is 5.0 ft NGVD.
- Prioritization of outflows:
 - If water levels in North Lake Belt Storage Area (NLBSA) are from between +5.0 ft NGVD and 0.0 ft NGVD, flows will be discharged to Biscayne Bay via the C-2 Canal.
 - If water levels in NLBSA are from between -10.0 ft NGVD and 0.0 ft NGVD, flows will be discharged to the C-9, C-6, C-7, C-4, and C-2 canals only to prevent saltwater intrusion.
 - If water levels in NLBSA drop to levels between -15.0 ft NGVD and -10.0 ft NGVD, flows will be limited to discharge to the C-9 Canal only to avoid water shortage restrictions.

Design:

Reservoir:

- Reservoir will be approximately 1,900 acres with subterranean seepage barrier around perimeter to enable drawdown during dry periods, prevent seepage, and to prevent water quality impacts. The total acreage in the Restudy (USACE and SFWMD, 1999) is approximately 4,500 acres which is expected to be completed by 2050. The targeted acreage to be completed by 2020 is 1,900 acres.

Inflow Structures:

- 2,500-cfs gravity structure at 0.5-feet head, from the western C-11 Basin
- 600-cfs pump from the C-9 Basin
- 300-cfs pump from the C-6 Basin, west of the divide structure

Outflow Structures:

- 1,000-cfs pump to the C-9 STA/Impoundment for treatment prior to deliveries to the C-6, C-7, C-2, C-4, and C-9 canals to prevent saltwater intrusion in coastal canals.
- STA detention time requirements need to be addressed. Pretreatment in reservoir may reduce size requirements of treatment area.

Canal:

- Water supply discharges are routed to the C-4/C-2 canals via a canal to be located east of the Snapper Creek Canal (Northwest Wellfield Protection Canal System). Canal capacity will be 800 cfs.
- Two 1,400-cfs delivery structures will be built at the new canal's confluences with the C-6 and the C-4 canals.

Location: Reservoir would be located within the area proposed for rock mining by the Lake Belt Issue Team. It would be located north of the Miami Canal (C-6) and south of the C-9 Canal to minimize impacts to the Northwest Wellfield (**Figure C-4**).

Counties: Miami-Dade

Assumptions and related considerations:

- The subterranean wall will have no adverse effect on Miami-Dade County's Northwest Wellfield.
- A treatment facility will be needed if stored water is backpumped to the Everglades
- All water quality considerations will be addressed regarding releases from the reservoir to the water supply wellfields.
- Impacts on the cone of influence of the Northwest Wellfield and its effect on wetland mitigation around the wellfield.
- Limestone filter treatment system within the reservoir may be developed through use of compartmentalization of rock mining excavation patterns.
- Telemetry systems will be required for all operable structures and pump stations.
- Any specific water quality considerations regarding capture of C-6 Basin runoff will be addressed during the detailed design stage.
- Increased drawdown will be investigated in a pilot study to assess surcharge of connate water, sheer stress on impermeable barrier, and other uncertainties regarding the Lake Belt storage areas.

33. Central Lake Belt Storage Area

Restudy Component Letter: S

Geographic Region: Lower East Coast Service Area 3

Purpose: In-ground reservoir to receive excess water from WCA-2B, WCA-3A, and WCA-3B. This in-ground reservoir, the Central Lake Belt Storage Area (CLBSA), will have a perimeter seepage barrier, that will allow storage of large quantities of water without ground water seepage losses in this highly transmissive region. The water stored in CLBSA will be provided to 1) Northeast Shark River Slough, 2) WCA-3B, and 3) to supply flows to Biscayne Bay when available.

Operation:

- Inflows from the L-33 Canal are through a 1,500-cfs pump. Inflow ceases when stage reaches approximately five ft NGVD (16 feet above adjacent land elevation). Inflows from the L-33 Canal are diverted to CLBSA when flows are available from WCA-2B, WCA-3A, and WCA-3B, and when deliveries are not desired to meet targets in Northeast Shark River Slough.
- Outflows for water deliveries are pumped through a polishing marsh cell prior delivery to Northeast Shark River Slough via the L-30 Canal and a reconfigured L-31 N Canal.
- Deliveries of water to Northeast Shark River Slough to maintain inundation will occur when Northeast Shark River Slough dries below trigger levels and target hydroperiods simulations call for Northeast Shark River Slough to be inundated. CLBSA delivers water to WCA-3B through polishing marsh cells via the L-30 Canal to inundate the eastern area of WCA-3B to a six-inch depth when triggers call for deliveries. This delivery occurs when WCA-3B dries below six inches above ground and target hydroperiods simulations indicate inundation in WCA-3B. When available, outflows will be directed to Biscayne Bay through discharges to Snapper Creek at the Turnpike.
- Water supply from the reservoir can be withdrawn for stages down to -15 ft NGVD (up to 20 feet of working storage and maximum head on seepage barrier). Land elevation is 5.0 ft NGVD.
- Full excavation of CLBSA will be 5,200 acres with subterranean seepage barrier around the perimeter to enable drawdown during dry periods and to prevent seepage losses. By 2020, 2,600 acres will have been excavated within the CLBSA boundary.

Design

Reservoir

- 2,600 acres with subterranean seepage barrier to enable drawdown during dry periods, prevent seepage, and to prevent water quality impacts (Restudy design includes 5,200 acres of in-ground reservoirs which are expected to be completed by 2050; targeted acreage to be completed by 2020 is 2,600 acres)

Inflow Structures:

- 1,500-cfs pump from the L-33 Borrow Canal
- 500-cfs structure at the S-9 Pump Station to gravity discharge from WCA-3A to the L-33 Canal
- 700-cfs structure (Existing S-31) for WCA-3B to CLBSA via the C-6 Canal

Outflow Structures:

- 800-cfs pump to polishing cell to make deliveries to Northeast Shark River Slough and WCA-3B
- 500-cfs pump off the L-30 Canal to deliver to WCA-3B
- 300-cfs pump to make deliveries for Snapper Creek Canal
- 1,100-cfs structure at 0.5-foot head to provide regional system deliveries to the Snapper Creek Canal via the C-6 Canal if the CLBSA is out of water

Location: Reservoir would be located within the area proposed for rock mining by the Lake Belt Issue Team. It would be sited south of Miami Canal (C-6) and north of the Northwest Wellfield Delivery Canal to minimize impacts to the Northwest Wellfield (**Figure C-4**).

Counties: Miami-Dade

Assumptions and related considerations:

- The subterranean wall will have no adverse effect on Miami-Dade County's Northwest Wellfield.
- A treatment facility will be needed if stored water is backpumped to the Everglades (640-acre STA).
- All water quality considerations will be addressed regarding releases from the reservoir to the water supply wellfields.
- Impacts on the cone of influence of the Northwest Wellfield and its effect on wetland mitigation around the wellfield.
- Limestone filter treatment system within the reservoir may be developed through use of compartmentalization of rock mining excavation pattern.
- Telemetry systems will be required for all operable structures and pump stations.
- Increased drawdown will be investigated in a pilot study to assess surcharge of connate water, sheer stress on impermeable barrier, and other uncertainties regarding the Lake Belt storage areas.

34. C-4 Control Structures

Restudy Component Letter: T

Geographic Region: Lower East Coast Service Area 3

Purpose: The proposed structures (East and West) would provide two separate benefits. The West Structure would control water levels in the C-4 Canal at higher elevation to reduce seepage losses from the Pennsuco Wetlands and areas to the west of the structure. The East Structure would reduce regional system deliveries by diverting dry season storm water flows to the C-2 Canal to increase recharge to several nearby coastal wellfields.

Operation: The West Structure would maintain water levels at 6.5 ft NGVD for seepage control purposes and be capable of passing flood flows with a minimum of head loss and supplying water to the C-4 Basin to meet demands. The East Structure would divert dry season storm water flows from the western C-4 Basin to the C-2 Canal to recharge the wellfields in the eastern C-2 Basin.

Design:

- East Structure - Operable liftgate with 4.5 ft NGVD overflow and approximately 400-cfs capacity (final design specifications will be determined in the future in detailed design and hydrologic and hydraulic modeling).
- West Structure - Operable liftgate with 6.5 ft NGVD overflow and approximately 600-cfs capacity (final design specifications will be determined in the future in detailed design and hydrologic and hydraulic modeling).

Location: East Structure will be located just downstream of the Dade-Broward Levee in the C-4 Canal (**Figure C-10**) and the West Structure will be in the C-4 Canal, just downstream of the confluence of the C-2 and C-4 canals (**Figure C-8**).

Assumptions and related considerations:

- Benefits to WCA-3B associated with improved C-4 Canal seepage control are directly related to the proposed G-356 pumpage (Modified Water Deliveries).
- Head losses across the proposed structures will not inhibit passing flood releases when they are necessary.
- A pump may be associated with the West Structure if backpumping the C-4 Basin runoff to the Bird Drive Recharge Area becomes a Water Resource Project.

35. Pineland and Hardwood Hammocks Restoration

Restudy Component Letter: OPE

Geographic Region: Lower East Coast Service Area 3

Purpose: The purpose of this feature is to restore hammocks to a portion of the Frog Pond which has been purchased by the District as part of the C-111 Project to restore the Taylor Slough portion of the Everglades.

Operation: This feature will provide some water quality treatment for runoff passing through the hammocks and will demonstrate the techniques required to reestablish native conifer and hardwood forests on land that has been rock plowed.

Design: This feature includes restoring South Florida slash pine and hardwood hammock species on a 200-foot wide strip on each side of two miles of State Road 9336 from the C-111 Canal to the L-31W Borrow Canal (approximately 50 acres) and the establishment of two one-acre hammocks in low lying areas on each side of the road.

Location: Each side of two miles of State Road 9336 from the C-111 Canal to the L-31W Borrow Canal (Figure C-9)

Counties: Miami-Dade

36. Bird Drive Recharge Area

Restudy Component Letter: U

Geographic Region: Lower East Coast Service Area 3

Purpose: Captures runoff from the western C-4 Basin and accepts inflows from the West Dade Wastewater Treatment Plant (WTP) to recharge ground water and reduce seepage from the Everglades National Park buffer areas by increasing water table elevations east of Krome Avenue. The facility will also provide C-4 Basin flood peak attenuation and water supply deliveries to the South Dade Conveyance System and Northeast Shark River Slough.

Operation: Inflows from the western C-4 Basin and the West Dade WTP will be pumped into the proposed recharge area. C-4 runoff in excess of 200 cfs will be discharged eastward. Inflows from the West Dade WTP will be continuous when the recharge area depth is equal to or less than three feet above ground. West Dade WTP discharges will be to deep injection wells if the depth is greater than three feet. A seepage management system will be operated around the eastern and southern perimeters of the recharge area. Recharge area outflows will be prioritized to meet 1) ground water recharge demands, 2) South Dade Conveyance System demands, and 3) Northeast Shark River Slough demands, when supply is available. Regional system deliveries will also be routed through the seepage collection canal system of the Bird Drive Recharge Area to the South Dade Conveyance System, which should reduce seepage from areas west of Krome Avenue.

Design: Approximately 2,877 acres with a maximum depth of four feet

Inflow structure

- 200-cfs pump (to be resized as needed) from the C-4 Basin

Outflow structure

- Water supply - Gravity structure with 200-cfs capacity at two feet of head
- Seepage Collection System - up to 500-cfs pump to control seepage collection canal at 5.0 ft NGVD; seepage is returned to Bird Drive Recharge Area

Delivery System

- 800-cfs pump to provide regional system deliveries to the South Dade Conveyance System
- 800-cfs canal capacity, in addition to the canal required for the Bird Drive seepage collection system, to pass the regional system deliveries to the South Dade Conveyance System
- Five miles of canal with 800-cfs capacity between the Bird Drive seepage collection system to the C-1W Canal, just east of Krome Avenue
- Relocate S-338 east of Krome Avenue and delivery canal

Location: Located in the northwestern four sections of the Bird Drive Basin (**Figure C-4**).

Counties: Miami-Dade

Assumptions and related considerations:

- Treatment facility will be needed if seepage collected does not meet Everglades standards.
- Telemetry systems will be required for all operable structures and pump stations.
- Flood protection in the basin will not be removed by the introduction of the West Dade WTP inflows.
- Regional-scale simulation using SFWMM, 2 mile by 2 mile resolution is rather coarse for this local-scale feature. Specific land elevations in the Bird Drive Recharge Area are not precisely mimicked due to location and scale considerations in the SFWMM.
- In the south Miami-Dade County ground water model, elevations have been modified to more accurately reflect current conditions.

37. L-31N Levee Improvements for Seepage Management

Restudy Component Letter: V

Geographic Region: Lower East Coast Service Area 3

Purpose: Levee seepage management along the eastern edge (L-31N) of Everglades National Park to eliminate losses due to levee seepage to the east coast of Florida. An additional feature has been added to reduce all wet season seepage/ground water flows to the east. This feature will help restore hydropatterns in Everglades National Park.

Operation: 100 percent reduction in levee seepage flow from Everglades National Park year-round. Further 100 percent reduction in all ground water flows during the wet season. Bird Drive Recharge Area and North Lake Belt Storage Area will be used to recharge aquifers to the east.

Design:

- Levee seepage will be managed by relocating and enhancing the L-31N Canal, ground water wells, and the sheetflow delivery system adjacent to Everglades National Park
- Wet season ground water seepage will be managed by distributing ground water wells adjacent to the L-31N Levee and returning flows to Everglades National Park
- If needed, aquifer recharge will occur from deliveries from the Bird Drive Recharge Area and the North Lake Belt Storage Area.

Location: Along the existing eastern protective levee (L-31N) adjacent to Everglades National Park (Figure C-8)

Counties: Miami-Dade

38. Dade-Broward Levee/Pennsuco Wetlands

Restudy Component Letter: BB

Geographic Region: Lower East Coast Service Area 3

Purpose: Reduce seepage to the east from the Pennsuco wetlands and southern WCA-3B and enhance hydroperiods in the Pennsuco. Also an improved Dade-Broward Levee will enhance recharge to Miami-Dade County's Northwest Wellfield.

Operation: Improvements to the Dade-Broward Levee and associated conveyance system will reduce seepage losses to the east and provide recharge to Miami-Dade County's Northwest Wellfield. Seepage reduction will enhance hydroperiods in Pennsuco wetlands and hold stages higher along southeastern WCA-3B. Recharging the conveyance features of the Dade-Broward levee from the regional system deliveries provides recharge to Miami-Dade County's Northwest Wellfield. Treatment areas will be provided, if necessary, to meet all water quality standards required.

Design: Improve the Dade-Broward Levee by doing the following:

- Construct or improve existing levee to five-foot height with two-foot top width, while creating or improving existing conveyance to a capacity of up to 300 cfs
- 150-cfs bypass structure and canal from C-6 Canal to Dade-Broward Levee to provide recharge from the regional system via the improved U.S. 27 Borrow Canal
- 150-cfs gravity structure in the Dade-Broward Levee borrow canals due west of the southern end of the Northwest Wellfield
- When the Conveyance Channel is below 5.0 ft NGVD at the C-4 structure located at the southern end of the Dade-Broward Levee

Location: Dade-Broward Levee, Pennsuco Wetlands, WCA-3B, the Central Lake Belt Storage Area, and Miami-Dade County's Northwest Wellfield (**Figure C-8**)

Counties: Miami-Dade

Assumptions and related considerations:

- Wellfield protection must be maintained through recharge of acceptable water quality.
- Secondary structures within the recharge canals may be needed to provide seepage reduction and desired wellfield recharge.
- The stage maintained in the Dade-Broward Levee conveyance is subject to change.

39. Modification to South Dade Conveyance System in Southern Portion of L-31N and C-111 Canals

Restudy Component Letter: OO

Geographic Region: Lower East Coast Service Area 3

Purpose: To improve deliveries to Everglades National Park and decrease potential flood risk in the Lower East Coast Service Area 3.

Operation:

- Modify C-111 Canal operations

Design:

- S-332D Pump Station at 500 cfs
- Remove S-332B Pump Station
- Add 100 cfs to S-332C Pump Station (keep total of S-332 A-D pump stations less than 1,200 cfs)
- Remove S-332 Pump Station
- Remove S-332D Tieback Canal which provides flow from the C-111 Canal to the S-332 Pump Station

Location: South Dade Conveyance System (**Figure C-7**)

Counties: Miami-Dade

Assumptions and related considerations:

- This component will not cause adverse impacts to Everglades National Park and south Dade agricultural lands.
- This component is dependent on construction of the S-356 A and B structures (**Component 49**).

40. Reroute Miami-Dade County Water Supply Deliveries

Restudy Component Letter: SS

Geographic Region: Everglades Agricultural Areas and Lower East Coast Service Area 3

Purpose: Reroute water supply deliveries made to Miami-Dade County from the Miami and Tamiami Canals and WCA-3, to the North New River Canal due to the backfilling of the Miami Canal as part of the decompartmentalization of WCA-3.

Operation: Send water supply deliveries from Lake Okeechobee to Miami-Dade County southeast through the North New River Canal in the EAA (L-20, L-19, and L-18 canals) to the S-150 Structure. From the S-150 Structure, send deliveries into the L-38W Canal and at the southern terminus of the L-38W Canal south through a 1,500-cfs pump to the borrow canal along the west side of U.S. 27.

Design:

- Double the capacity of the North New River Canal south of the proposed EAA Storage Reservoir to convey additional water supply deliveries to Miami-Dade County, as necessary
- Double the capacity of S-351 and S-150 to pass additional water supply deliveries to Miami-Dade County, as necessary
- Improve conveyance in the borrow canal on the west side of U.S. 27 between the L-38W Canal and the Miami Canal, as necessary to pass the additional flows
- Pump intake at the S-7 Structure will be lowered to 8.0 ft NGVD

Location: EAA and WCA-3 (**Figure C-7**)

Counties: Palm Beach, Broward, and Miami-Dade

Assumptions and related considerations: Operational flexibility is reduced since there is only one delivery route to Miami-Dade County (backup routes have been eliminated).

41. C-111N Spreader Canal

Restudy Component Letter: WW

Geographic Region: Lower East Coast Service Area 3

Purpose: To reduce wet season flows in the C-111 Canal, improve deliveries to Model Lands and Southern Glades, and decrease potential flood risk in the lower south Miami-Dade area.

Operation: Water is pumped from the C-111 and C-111E canals into a STA prior to pumping through the S-332E Pump Station into the C-111N Spreader Canal to Southern Glades and Model Lands. The S-197 and S-18C structures are removed and the C-111 Canal is backfilled.

Design:

- Increase the S-332E Pump Station to 500 cfs from 50 cfs (pump when available)
- Relocate the C-111N Spreader Canal to SW 440th Street (approximately one section north)
- Culvert under U.S. 1
- Culvert under Card Sound Road
- Canal through triangle area of Model Lands, east of Card Sound Road
- Fill in the C-111 Canal south of confluence with the C-111N Spreader Canal to the S-197 Structure
- Remove levees and access roads
- Completely backfill the C-110 Canal
- Create a STA in the triangle of land between the C-111 Canal and the C-111E Canal to clean water prior to putting in Model Lands STA

Location: South Dade Conveyance System (**Figure C-5**)

Counties: Miami-Dade

Assumptions and related considerations:

- This component will not cause adverse impacts to south Dade agricultural and urban lands.
- The water discharged from the C-111 and C-111E canals is assumed to be clean.

42. South Miami-Dade County Reuse (South District Reclaimed Water Treatment Plant)

Restudy Component Letter: BBB

Geographic Region: Lower East Coast Service Area 3

Purpose: The existing South District Reclaimed Wastewater Treatment Plant located north of the C-1 Canal will provide wastewater treatment coupled with superior treatment technology to supply reclaimed water to the South Biscayne Bay and Coastal Wetlands Enhancement Project. The water will be provided upon demand throughout the year to augment water supply to the project. This supplemental water will restore overland flow in the coastal area and recharge ground water to enhance ground water discharge to Biscayne Bay. Saltwater intrusion benefits to the southern part of Dade County are anticipated.

Operation: The South District Reclaimed Water Treatment Plant, with superior treatment technology, will be operated when the additional water is needed to supply the South Biscayne Bay and Coastal Wetlands Enhancement Project. When water is not needed, the water treatment plant will stop treatment beyond secondary treatment standards and will dispose of the secondary treated effluent into the existing deep injection wells.

Design: The South District Reclaimed Water Treatment Plant will be designed to add on a pretreatment and membrane treatment system to the existing secondary treatment facility. The plant will have a capacity of 131 MGD. It is anticipated that phosphorus will be the constituent of concern in the reclaimed water. Therefore, the treatment will be designed to remove total phosphorous to acceptable levels.

The reclaimed water will be discharged to the C-1 Canal (Black Creek), upstream of the S-21A Structure, and then delivered southward towards the C-102 and C-103 canals, and northward towards the C-100 Canal. The wastewater treatment facility will provide advanced treated water to the L-31E Canal. Flow southward in the L-31E Canal towards the C-102 and C-103 canals shall be 202 ac-ft per day. Flow northward in the L-31E Canal towards the C-100 Canal shall be 200 ac-ft per day (through a canal extension). The combined inflow into the L-31E Canal shall be 402 ac-ft per day for every day of the simulation. Flows will reach the C-102 and C-100 canals via modifications to the L-31E Canal.

Location: The South District Reclaimed Water Treatment Plant will be located at, or in the vicinity of, the existing South District Wastewater Treatment Plant (**Figure C-6**).

County. Miami-Dade County

Assumptions and other considerations:

- The reuse facility uses advanced treatment resulting in water quality acceptable to the Biscayne Bay.
- No adverse impacts will occur to adjacent agricultural or urban areas.
- Discharge capacity at the S-123, S-20F, S-21, and S-21A structures is sufficient to pass basin runoff and inflows from the reuse facility during storm events.

43. West Miami-Dade County Reuse

Restudy Component Letter: HHH

Geographic Region: Lower East Coast Service Area 3.

Purpose: The future West Miami-Dade Wastewater Treatment Plant, will be located immediately south of the Bird Drive Recharge Area and east of the relocated L-31 North Protective Levee. It will provide wastewater treatment coupled with superior treatment technology to supply reclaimed water to the Bird Drive Recharge Area. The water will be supplied year-round, as needed, to enhance ground water recharge. Excess water, when available, will be sent as a second priority to the South Dade Conveyance System, to Northeast Shark River Slough as a third priority, and to deep injection wells when there are no demands from the three designated priorities.

Operation: The proposed reclaimed water production facility will be operated by Miami-Dade County and has the potential to discharge 100 MGD. As stated previously, the water will be provided to three prioritized demands: Bird Drive Recharge Area, South Dade Conveyance System, and Northeast Shark River Slough. When all demands have been met, the West Miami-Dade Wastewater Treatment Plant will stop treatment beyond secondary treatment standards and will dispose of the secondary treated effluent into deep injection wells.

Design:

- Treatment will be biological nutrient removal advanced wastewater treatment followed by a superior treatment technology using iron salts to lower phosphorus to levels required for Everglades discharges.
- The iron salt coagulation system would be designed for a constant flow rate of 100 MGD.
- The West Miami-Dade Wastewater Treatment Plant will pump superior, advanced treated water at a rate of 155 cfs (100 MGD) to the Bird Drive Recharge Area when the elevation of the recharge area is equal to or below three ft NGVD.

Location: South of the Bird Drive Recharge Area and east of the relocated L-31 North Protective Levee (Figure C-6)

Counties: Miami-Dade

Assumptions and related considerations: The superior treatment technology will be able to treat the advanced wastewater treatment effluent to remove phosphorous and nitrogen to the low levels desired to meet state water quality standards and provide an acceptable water quality for the above priorities.

WATER CONSERVATION AREAS AND EVERGLADES NATIONAL PARK

44. Loxahatchee National Wildlife Refuge Internal Canal Structures

Restudy Component Letter: KK

Geographic Region: Arthur R. Marshall Loxahatchee National Wildlife Refuge (WCA-1)

Purpose: Improve timing and location of water depths in the Arthur R. Marshall Loxahatchee National Wildlife Refuge (WCA-1)

Operation: Structures would remain closed except to pass STA-1 East and STA-1 West outflow and water supply deliveries.

Design:

- L-7 Borrow Canal structure: 1,500-cfs gravity structure at 0.5-foot head.
- L-40 Borrow Canal structure: 1,500-cfs gravity structure at 0.5-foot head.

Location: The L-7 Structure is located at cell R28C50 in the L-7 Borrow Canal within the Arthur R. Marshall Loxahatchee National Wildlife Refuge (WCA-1). The L-40 Structure is located at cell R34C50 in the L-40 Borrow Canal within the refuge (**Figure C-9**).

Counties: Palm Beach

Assumptions and related considerations: STA discharges to the Arthur R. Marshall Loxahatchee National Wildlife Refuge (WCA-1) are assumed to be of acceptable water quality.

45. Everglades Rain-Driven Operations

Restudy Component Letter: H

Geographic Region: Water Conservation Areas and Everglades National Parks

Purpose: Improve timing and location of water depths in the WCAs and Everglades National Park. The rain-driven operational concept is a basic shift from the current operational practice, which uses calendar based regulation schedules for the WCAs. Regulation schedules, also referred to as flood control schedules, typically specify the release rules for a WCA based on the water level at one or more key gages. Regulation schedules do not typically contain rules for importing water from an upstream source. The schedules also repeat every year and make no allowance for interannual variability. The rain-driven operational concept includes rules for importing and exporting water from the WCAs to mimic a desired target stage hydrograph at key locations within the Everglades system. The target stage hydrographs mimic an estimate of the predrainage Everglades water level response to rainfall.

Operation: Note that for the description below, the term trigger level means the water level used to trigger action at an upstream or downstream structure. Trigger levels are related to the target stage hydrographs by simple offsets which typically range less than plus or minus one foot. One trigger level is usually associated with the import rules and two trigger levels are associated with the exportation of water. The two export trigger levels define two release zones. The lower zone is a conditional release zone and releases are made only if the downstream area needs the water. The upper zone is an unconditional release, or flood control, release zone and releases are made in this zone even if the downstream area does not need the water.

WCA-1:

- No rain-driven operations (use 1995 interim regulation schedule)

WCA-2 Import Rules:

- Import water from Lake Okeechobee via STA-2 if water levels fall below trigger levels in northern WCA-2A (SFWMM grid cell R45C28).

WCA-2 Export Rules:

- Export water from WCA-2A to WCA-2B via S-144, S-145, and S-146, if levels at 2A-17 exceed trigger levels.
- Export water from WCA-2A via the S-11 Structure if levels at 2A-17 exceed triggers.
- Export water from WCA-2B to Everglades National Park via new structures at the south end of WCA-2B if levels at central WCA-2B (R36C30) exceed trigger levels.

WCA-3 Import Rules:

- Import water from EAA storage and/or Lake Okeechobee via STA-3/4 to the following:
 - Northeast WCA-3A if levels fall below trigger levels at 3A-NE.
 - Northwest WCA-3A (via L-5/L-4, S8, G404, and a spreader along L-4) if levels fall below trigger levels at 3A-NW.
 - Central WCA-3A, via an improved S-140 and a spreader along the southernmost eight miles of L-28 (north reach), if levels fall below trigger levels at 3A-4.
 - Import water from WCA-2A via S-11 Structures if levels fall below trigger levels at 3A-3 (and WCA-2 has excess water [levels at 2A-17 significantly exceed targets]).

WCA-3 Export Rules:

- Export water from WCA-3A to WCA-3B via proposed L-67 weir structures if water levels upstream of weirs exceed their respective crest elevations (passive structures).
- Export water from WCA-3A to WCA-3B via proposed S-345 and S-349 structures if water levels at R33C26 exceed trigger levels.
- Export water from WCA-3A to Central Lake Belt Storage Area, via proposed gravity structure near S-9, if water levels at R26C33 exceed trigger levels.
- Export water from WCA-3B to Central Lake Belt Storage Area, via S-31, if water levels at R30C27 exceed trigger levels.

Everglades National Park Import Rules:

- Import water from WCA-3A via proposed S-345 and S-349 structures if average water levels at NESRS-1 and NESRS-2 fall below trigger levels.
- Import water from Central Lake Belt Storage Area via proposed S-356A and S-356B structures if levels at G-1502 fall below trigger levels.
- Import excess water from WCA-2B, via improved L-37 and L-33 canals and S-356A and S-356B.

Design:

- Deliveries from upstream sources (EAA runoff, EAA storage area, and/or Lake Okeechobee) through the STAs prior to release into the WCAs.
- Distribution of STA outflow designed to improve hydropatterns.
- Flows to Everglades National Park from WCA-3A and WCA-3B are uncontrolled since the S-355 and S-12 structures, the L-29 Canal, and the L-29 Borrow Canal are removed to allow overland flow from WCA-3A and WCA-3B to Everglades National Park.

Location: Within the existing boundaries of the WCAs and Everglades National Park (**Figure C-2**)

Counties: Broward, Miami-Dade, Monroe, and Palm Beach

Assumptions and related considerations:

- Consideration given to tree islands and minimum floor levels consistent with the District's proposed minimum flows and levels for these areas.
- Potential increases in hydropatterns in relatively overdrained areas (e.g., northern WCA-3A) and decreases in hydropatterns in deep water areas (e.g., southern WCA-3A).

46. Divert Flows from Water Conservation Area 2 to Central Lake Belt Storage Area

Restudy Component Letter: YY

Geographic Region: Water Conservation Area 2 and Lower East Coast Service Area 3.

Purpose: Capture excess water in WCA-2B to reduce stages above desired target levels in WCA-2B and to divert water through improved L-37 and L-33 borrow canals to Northeast Shark River Slough to meet targets or to the Central Lake Belt Storage Area (CLBSA).

Operation: Surface water in WCA-2B above Natural System Model (NSM) levels will overflow through three structures along the L-35 and L-35A borrow canals to the North New River Canal along with seepage from WCA-2B and be pumped to the L-37 Borrow Canal. The North New River Canal and the L-37 and L-33 borrow canals will be improved to accept this additional flow along with the seepage collected from WCA-3. This water will be pumped to Northeast Shark River Slough if the slough is below target levels or into a lined reservoir, referred to as the CLBSA, located south of the confluence of the L-33 and the C-6 canals.

Design:

- Three diversion structures with 120-cfs capacity at 0.5 feet of head and 350-cfs capacity at 4.0 feet of head along the southern perimeter of WCA-2B
- Intermediate 1,500-cfs pump station to divert overflow and seepage from the North New River Canal to the L-37 Borrow Canal
- Inverted siphon with 1,500-cfs capacity to pass water supply deliveries from the L-38 Borrow Canal to the U.S. 27 West Borrow Canal
- Improved conveyance of the L-37 and L-33 borrow canals to 3,000 cfs to handle WCA-2B flows plus seepage from WCA-3
- Remove S-9XN and S-9XS or improve structures to accommodate increased flows

Location: The overflow structures are located along the southern levee of WCA-2B. The L-37 and L-33 borrow canal improvements are located east of the protective levees and 0.5 miles west of U.S. 27 between the North New River and Miami canals (**Figure C-7**).

Counties: Broward

Assumptions and related considerations:

- Prioritization of use of CLBSA water
- Telemetry systems will be required for all operable structures and pump stations

47. Water Conservation Area 3A and 3B Levee Seepage Management

Restudy Component Letter: O

Geographic Region: Water Conservation Area 3

Purpose: Reduce seepage from WCA-3A and WCA-3B to improve hydropatterns within the WCAs by allowing higher water levels in the borrow canals and longer inundation durations within the marsh areas that are located east of the WCAs and west of U.S. 27. Seepage from the WCAs and marshes will be collected and directed south into the Central Lake Belt Storage Area. This will maintain flood protection and the separation of seepage water from urban runoff originating in the C-11 Basin and Lake Okeechobee water supply deliveries.

Operation: The L-37 and L-33 borrow canals will be held at higher stages as part of the WCA-2 seepage collection and conveyance system. Seepage collected in the L-37 and L-33 borrow canals and from the marsh areas will be directed into the WCA-2 seepage collection and conveyance system and directed south into the Central Lake Belt Storage Area or directly to Northeast Shark River Slough.

Design:

- New levees will be constructed west of U.S. 27 from the North New River Canal to the Miami (C-6) Canal to separate seepage water from the urban runoff in the C-11 Diversion Canal.
- The L-37 and L-33 borrow canals will be controlled at higher stages, as will the marshes located east of the WCAs.
- A divide structure will be added to the C-11 Canal west of U.S. 27 to maintain the separation of seepage water from urban runoff.
- Water from the C-11 West Canal will be diverted to the North Lake Belt Storage Area.

Location: Seepage will be collected in borrow canals along the existing eastern protective levees adjacent to WCA- 3. The divide structure will be located in C-11 Canal east of U.S. 27 (**Figure C-8**).

Counties: Broward

Assumptions and related considerations:

- It is assumed that the seepage from the WCAs meets the water quality standards necessary to achieve ecosystem restoration.

48. Additional S-345 Structures

Restudy Component Letter: AA

Geographic Region: Central and southern Everglades, Water Conservation Areas, and Everglades National Park

Purpose: The compartmentalization of the WCAs has contributed to the loss of historic overland flows of the central Everglades slough system. This alteration of flows has resulted in temporal changes in hydropatterns and hydroperiods in the historic deep water, central axis of the Shark Slough system. This component adds conveyance to WCA-3B to help in reestablishing NSM-like hydroperiods and hydropatterns in WCA-3B and Northeast Shark River Slough.

Operation: The addition of a Northeast Shark River Slough rainfall trigger well and modification of western Shark Slough Basin rainfall triggers deliver additional flows to the basin. Modification of the L-67A Borrow Canal decreases downstream conveyance to the S-12 Structure required to promote surface water flows to WCA-3B and to Northeast Shark River Slough.

Design: Triple the total discharge capacity of the S-345 Structure to 4,500 cfs and the addition of associated plugs (S-349).

Location: The additional structures and plugs are to be spaced evenly along the southern half of the L-67A Borrow Canal (**Figure C-7**).

Assumptions and related concerns: The emphasis is in reestablishing the historic, persistent, deep water slough that existed in WCA-3B and Northeast Shark River Slough.

49. Construction of S-356 Structures and Relocation of a Portion of L-31N Borrow Canal

Restudy Component Letter: FF

Geographic Region: Everglades National Park and Lower East Coast Service Area 3

Purpose: To improve deliveries to Northeast Shark River Slough in Everglades National Park and reduce seepage to Lower East Coast Service Area 3.

Operation:

- Redirect the S-357 Structure outflow from the L-31N Borrow Canal to the midpoint of the Modified Water Deliveries (MWD) Mitigation Canal northwest of the 8.5-Square Mile Area
- Operate new S-356 pumps to direct seepage collection from the WCAs and water deliveries from the Central Lake Belt Storage Area to Northeast Shark River Slough

Design:

- Remove MWD S-356
- Relocate MWD S-357
- Add S-356A and S-365B structures (900 cfs each) at locations along the modified L-31N Borrow Canal between G-211 and Tamiami Trail
- Reroute the L-31N Borrow Canal to east side of the buffer cell
- Relocate the L-31N Borrow Canal to east side of the buffer cell
- Backfill portion of the L-31N Borrow Canal where levee has been moved
- Five-foot levee along west side of existing lakes

Location: The L-31N Borrow Canal, along the east side of Northeast Shark River Slough (**Figures C-7 and C-8**)

Counties: Miami-Dade

Assumptions and related considerations:

- Water quality is not a problem
- No adverse impacts to areas east of the L-31N Borrow Canal

50. Decomartmentalize Water Conservation Area 3

Restudy Component Letter: QQ

Geographic Region: Water Conservation Areas and Everglades National Park

Purpose: Remove most flow obstructions to achieve unconstrained or passive flow between WCA-3A and WCA-3B and Northeast Shark River Slough and reestablish the ecological and hydrologic connection between these areas

Operation: Rain-driven trigger gages in northwest Shark River Slough and sheetflow to Everglades National Park (referred to as Everglades Rain-Driven Operations)

Design:

Structural Changes:

- Backfill the Miami Canal in WCA-3 from the east coast protective levee to one to two miles south of the S-8 Pump Station to maintain flood discharge capability. Water supply deliveries previously made through the Miami Canal will be delivered through the North New River Canal and improved U.S. 27 Borrow Canal.
- Remove the L-68A Levee (this feature is outside SFWMM model detail).
- Degrade the L-67C Levee and backfill the adjacent borrow canal.
- Backfill the L-67A Canal from Tamiami Trail approximately 7.5 miles north.
- Relocate a single S-349 structure at the downstream end of the L-67A Borrow Canal (upstream of the S-345 structures).
- Remove the L-29 Levee and Borrow Canal (south of WCA-3A and WCA-3B) to restore sheetflow into Everglades National Park.
- Remove the L-28 and the L-28 Tieback levee and borrow canals and from the L-28 Tieback Canal south to the L-29 Canal.
- Elevate Tamiami Trail (U.S. 41) through the installation of a series of bridges between the L-31N and L-28 canals, consistent with conveyance capacities determined at I-75 and any increases required due to inflows downstream of I-75 and upstream of Tamiami Trail.
- Remove the S-344, S-343A, S-343B, and S-12 structures.
- Construct eight passive weir structures along the entire length of the L-67A Borrow Canal to promote sheetflow during high flow conditions and locate the S-345 structures just downstream of the new termination of the L-67A Canal.

Operational Changes

- Operate the WCA-2A import trigger using only the 2A-N gage as the trigger rather than using the average of the 2A-N and 2A-17 gages.
- The time series target at 2A-N was truncated at 1.25 feet above and 0.5 feet below land surface elevation.
- The time series target at 3A-NE was truncated at 1.0 feet above and 0.5 feet below land surface elevation.
- S-345 structures operations are now based on triggers at R33C26 and the NESRS-1 and NESRS-2 gages (the 3A-4 gage is no longer used).
- S-349 Structure operations are the same as the S-345 structure's operations.

Location: Within the existing boundaries of the WCAs and Everglades National Park (**Figure C-7**)

Counties: Broward, Miami-Dade

Assumptions and related considerations:

- Hydropatterns in dry areas and may potentially increase and decrease in deep water areas.
- A trade-off exists between water levels and hydroperiods in central and south central WCA-3A and Everglades National Park.
- Additional S-345 structures are needed to ensure that significant dry season flows into WCA-3B, and ultimately Everglades National Park, can be achieved.
- Miccosukee Tribal Lands adjacent to the L-29 Canal and Tamiami Trail will not be impacted.

51. Flow to Northwest and Central Water Conservation Area 3A

Restudy Component Letter: RR

Geographic Region: Water Conservation Area 3

Purpose: To increase depths and extend hydroperiods in central WCA-3A.

Operation: The S-140 Pump Station will be relocated and flows will be distributed into central WCA-3A. The operation of the pump will be driven by target stages at the 3A-4 gage.

Design: The S-140 Pump Station will be relocated approximately eight miles south of its current location and its capacity will increase from 1,300 cfs to 2,000 cfs. A spreader system will be needed to distribute the S-140 discharge via sheetflow.

Location: Within the existing boundaries of the WCAs (**Figure C-7**)

Counties: Broward

Assumptions and related considerations:

- Hydropatterns may potentially increase in dry areas and decrease in deep water areas.
- A trade-off exists between water levels in Indicator Regions 18 and 17 in central WCA-3A.
- May require increased flows from Lake Okeechobee to achieve the desired hydropatterns in central WCA- 3A.
- A spreader mechanism is required at the point where flows will be introduced into WCA-3.

52. Divert Flows from Water Conservation Area 3 to Central Lake Belt Storage Area

Restudy Component Letter: ZZ

Geographic Region: Water Conservation Area 3 and Lower East Coast Service Area 3

Purpose: Capture excess water in WCA-3A and WCA-3B to reduce above target stages in WCA-3 and to divert water through modified structures at S-9 and S-31 to the Central Lake Belt Storage Area via the L-33 Borrow Canal.

Operation: When surface water in WCA-3B exceeds target depths by 0.10 feet it will be diverted to the Central Lake Belt Storage Area via the L-33 Canal. When surface water in WCA-3A near the S-9 Structure exceeds target depths by one foot, water will be diverted to the Central Lake Belt Storage Area via the L-33 Canal.

Design:

- 500-cfs outflow structure at 2.0 feet of head (new structure) at S-9 (WCA-3A)
- 700-cfs outflow structure (modify existing S-31 if necessary) (WCA-3B)

Location: The eastern levees of WCA-3 (**Figure C-7**)

Counties: Broward and Miami-Dade

Assumptions and related considerations:

- Prioritization of use of the Central Lake Belt Storage Area water
- Telemetry systems will be required for all operable structures and pump stations

53. Divert Flows from Central Lake Belt Storage Area to Water Conservation Area 3B

Restudy Component Letter: EEE

Geographic Region: Water Conservation Area 3 and Lower East Coast Service Area 3

Purpose: Capture excess surface water and seepage from WCA-2B, WCA-3A, and WCA-3B in the Central Lake Belt Storage Area (CLBSA) and deliver it to eastern WCA-3B during dry-outs

Operation: Deliveries will be made to maintain six-inch depths in WCA-3B if NSM hydroperiod indicates WCA-3B water levels should be at or above six inches and water is available in the CLBSA. Deliveries from CLBSA will occur through a wetland treatment cell and the L-30 Borrow Canal to a spreader swale system in the eastern areas of WCA-3B.

Design:

- 500-cfs pump from the L-30 Borrow Canal to eastern portion of WCA-3B
- Spreader swale along eastern WCA-3B to convert 500 cfs to sheetflow
- Upgrade 1,500-cfs deliveries from the CLBSA to Northeast Shark River Slough to 2,000 cfs to accommodate additional flows to WCA-3B.

Location: The discharge point from L-30 Borrow Canal to WCA-3B is at the bend in the canal and is approximately 4.5 miles south of the intersection of the L-30 Borrow Canal and the C-6 Canal (**Figure C-7**).

Counties: Miami-Dade

Assumptions and related considerations:

- Prioritization of use of Central Lake Belt Storage Area water
- Telemetry systems will be required for all operable structures and pump stations

54. G-404 Pump Station Modification

Restudy Component Letter: II

Geographic Region: Everglades Agricultural Area

Purpose: Increase the capacity of the proposed Everglades Construction Project (ECP) G-404 Pump Station to improve the hydropattern restoration in the northwest corner of WCA-3A and increase the amount of water available in the west-central region of WCA-3A to reduce dry out periods.

Operation: Pump the maximum possible treated discharge from STA-3/4 across the Miami Canal from the L-5 Borrow Canal to the L-4 Borrow Canal to the northwest corner of WCA-3A. The treated discharge will sheet flow across the northern reach of WCA-3A between the Miami Canal and the L-28 Canal and flow down the L-28 Borrow Canal through the S-140 Structure. This additional water should improve the hydropattern restoration and reduce the number of dry out periods in the central region of WCA-3A. This diversion of water from the northeast section of WCA-3A should reduce the inundation duration and extreme high water depths in this sector of the WCA.

Design: Increase the capacity from 1,000 cfs to 2,000 cfs on this proposed vertical, axial flow, low head, high capacity pump station (may be slightly resized after further hydraulic analyses)

Location: Confluence of the Miami Canal, the L-5 Borrow Canal, and the L-4 Borrow Canal north of the S-8 Pump Station (**Figure C-7**).

Counties: Palm Beach

Assumptions and related considerations:

- Land availability
- Compatibility with proposed G-404 Pump Station design
- Modifications to the L-4 and L-5 borrow canals, if needed, to increase the conveyance capacities to handle the additional conveyance
- Preliminary analyses indicate the pump intake elevation for G-404 and S-8 should be about 8.0 ft NGVD to facilitate water supply deliveries west through G-404 and south through S-8.

BAYS

55. Biscayne Bay Coastal Wetlands

Restudy Component Letter: FF

Geographic Region: Biscayne Bay coastal canals and coastal wetlands

Purpose: To rehydrate wetlands, reduce point source discharge to Biscayne Bay, and to maintain higher stages in the C-102 and C-103 canals for urban and environmental water supply

Operation: The proposed project will replace lost overland flow and partially compensate for the reduction in ground water seepage by redistributing, through a spreader system, available surface water entering the area from regional canals. The proposed redistribution of freshwater flow across a broad front is expected to restore or enhance freshwater wetlands, tidal wetlands, and nearshore bay habitat. Sustained lower-than-seawater salinities are required in tidal wetlands and the nearshore bay to provide nursery habitat for fish and shellfish. This project is expected to create conditions that will be conducive to the reestablishment of oysters and other components of the oyster reef community. Diversion of canal discharges into coastal wetlands is expected not only to reestablish productive nursery habitat all along the shoreline but also to reduce the abrupt freshwater discharges that are physiologically stressful to fish and benthic invertebrates in the bay near canal outlets.

More detailed analyses will be required to define target freshwater flows for Biscayne Bay and the wetlands within the redistribution system. The target(s) will be based upon the quality, quantity, timing, and distribution of flows needed to provide and maintain sustainable biological communities in Biscayne Bay, Biscayne National Park, and the coastal wetlands. Additionally, potential sources of water for providing freshwater flows to Biscayne Bay will be identified and evaluated to determine their ability to provide the target flows.

The Biscayne Bay Coastal Canals component was incorporated into this component. The Biscayne Bay Coastal Canal component will maintain canal stages in the C-102 and C-103 canals with water provided from local sources. Wet season operation for the C-102 Canal between the S-21A and S-195 structures (open at 2.2 ft NGVD, close at 2.0 ft NGVD) and for the C-103 Canal between the S-20F and S-179 structures (open at 2.2 ft NGVD, close at 2.0 ft NGVD) will remain unchanged. Dry season operation of these sections of canals will both change from opening at 1.4 ft NGVD and closing at 1.2 ft NGVD to opening at 1.6 ft NGVD and closing at 1.5 ft NGVD.

Design: The feature includes pump stations, spreader swales, STAs, flowways, levees, culverts, the backfilling of canals, and the construction of 3.5 miles of connection canal.

Location: 3,600 acres from the Deering Estate at the C-100C Canal, south to the Florida Power and Light Turkey Point power plant, generally along the L31E Canal in southeast Miami-Dade County (**Figures C-9 and C-10**)

Counties: Miami-Dade

Assumptions and related considerations:

- The component Biscayne Bay Coastal Canals as modeled in D-13R and the Critical Project on the L-31E Flowway Redistribution are smaller components of the Biscayne Bay Coastal Wetlands feature.
- Local water source is tied to south Miami-Dade County water reuse (**Component 42**).
- Component simulates overland flow to Biscayne Bay. Since their effect is not measurable with current modeling technique, South Biscayne Bay Coastal Wetlands Components will be included as part of other project elements. The intent of these components is to restore overland flow and ground water seepage to Biscayne Bay while reducing the frequency of point-source discharges.

FLORIDA KEYS

56. Florida Keys Tidal Restoration

Restudy Component Letter: OPE

Geographic Region: Florida Bay

Purpose: The purpose of this feature is to restore the tidal connection that was eliminated in the early 1900s during the construction of Flagler's railroad. Restoring the circulation to areas of surface water that have been impeded and stagnant for decades will significantly improve water quality, benthic, floral, and faunal communities, larval distribution of both recreational and commercial species (i.e. spiny lobster), and the overall hydrology of Florida Bay.

Design: Bridges or culverts will be used to restore the tidal connection between Florida Bay and the Atlantic Ocean

Location: (Figure C-9)

- Tarpon Creek, just south of Mile Marker 54 on Fat Deer Key (width 150 feet)
- Unnamed creek between Fat Deer Key and Long Point Key, south of Mile Marker 56 (width 450 feet)
- Tidal connection adjacent to Little Crawl Key (width 300 feet)
- Tidal connection between Florida Bay and Atlantic Ocean at Mile Marker 57 (width 2,400 feet)

Counties: Monroe

BIG CYPRESS BASIN

57. Big Cypress/L-28 Interceptor Modifications

Restudy Component Letter: CCC

Geographic Region: Big Cypress Basin

Purpose: Alleviate overdrainage in northeastern Big Cypress and the Kissimmee Billy and Mullet Slough area and ensure that inflows meet applicable water quality standards.

Operation: Reroute water from the West and North Feeder canals to wetlands in northeastern Big Cypress. Allow flow along the south side of the West Feeder Canal at designated locations and through a new S-190 Pump Station, while maintaining flood protection on tribal lands and consistency with the Seminole Tribe of Florida's Conceptual Water Conservation System Master Plan. Establish sheetflow south of the West Feeder Canal across the native area of the Big Cypress Reservation. Establish sheetflow south of the reservation in the Big Cypress National Preserve Addition. Operate pumps for approximate equalization of flows.

Design:

- Degrade the levee on the southwest side of the L-28 Interceptor Canal below the S-190 structure
- Backfill the L-28 Interceptor Canal at a point south of the boundary between the Big Cypress Seminole Reservation and the Big Cypress National Preserve Addition
- Retain the levee on the northeast side of the L-28 Interceptor Canal through the Big Cypress Seminole Reservation
- Develop sheetflow along the south side of the West Feeder Canal through three pump stations and spreader canals; the pump station locations shall be adjacent to the discharge points from Water Resource Areas (WRA) 1, 2, and 3 of the Seminole Conceptual Water Conservation System
- Pump station at WRA 1 discharge: 250 cfs
- Pump station at WRA 2 discharge: 500 cfs
- Pump station at WRA 3 discharge: 750 cfs
- Replace the S-190 gated structure (existing capacity of 2,960 cfs) with a 1,460-cfs pump station
- North Feeder STA: 1,100 acres at a four-foot maximum depth
- Inflow pump station: 270 cfs
- Outflow structure: 100 cfs
- West Feeder STA: 800 acres at four-foot maximum depth
- Inflow pump station: 430 cfs
- Outflow structure: 150 cfs

Location: Western Basin, Big Cypress Seminole Reservation, and Big Cypress National Preserve Addition (Figures C-9 and C-11)

Counties: Hendry, Collier, and Broward

Assumptions and Related Considerations:

- Water quality treatment for runoff entering the West and North Feeder canals is provided by STAs, if necessary, to meet applicable water quality standards.
- The design shall be consistent with the Seminole Tribe's Conceptual Water Conservation System Master Plan.
- The existing flood protection shall be maintained.
- The evaluation of flow changes in the area south of the West Feeder Canal.
- S-190 shall be accomplished by assessing impacts on Seminole Tribe's passive use rights.
- Flow changes will be evaluated reflects minimal impact.
- Component construction will occur after completion of the Seminole Conceptual Water Conservation System.

58. Miccosukee Tribe Water Management Plan

Restudy Component Letter: OPE

Geographic Region: Big Cypress Basin

Purpose: Provide water storage capacity and water quality enhancement for tribal reservation waters which discharge from tribal lands and downstream into the Everglades Protection Area.

Design:

- 900-acre wetland retention/detention area
- Pump station, levees, trenches, and culverts to create the inflow and outflow facilities for the retention/detention area

Location: Miccosukee Tribe's Alligator Alley Reservation (**Figures C-4 and C-11**)

Counties: Broward and Collier

59. Seminole Tribe Big Cypress Reservation Water Conservation Plan

Restudy Component Letter: OPE

Geographic Region: Big Cypress Basin

Purpose: Improve the quality of water and runoff from phosphorus generating agricultural sources within the reservation. This comprehensive watershed management system is designed to achieve environmental restoration on the reservation, as well as in the Big Cypress Basin and the Everglades Protection Area. In addition, the project will reduce flood damage and promote water conservation.

Operation: The removal of pollutants will be achieved using natural treatment processes in pretreatment cells and water storage areas. A phosphorus level of 50 parts per billion is the goal, which is the current level to be achieved by the STAs of the Everglades Construction Project.

Design: This feature includes construction of water control, management, and treatment facilities in the central, western, and eastern portion of the Big Cypress Reservation. The construction elements include conveyance systems, including major canal bypass structures, irrigation storage cells, and water resource areas. It is estimated that 3,800 acres will be required.

Location: The project is located on the Seminole Tribe Big Cypress Reservation in Hendry County, directly north of the Big Cypress Basin National Preserve and west of Water Conservation Area 3A (**Figures C-9, C-10, and C-11**)

County: Hendry

SYSTEMWIDE

60. Melaleuca Eradication Project and Other Exotic Plants

Restudy Component Letter: OPE

Geographic Region: Systemwide

Purpose: Increase the effectiveness of biological control technologies to manage melaleuca and other invasive exotic species

Operation: This feature includes 1) upgrading and retrofitting the current quarantine facility in Gainesville, and 2) large-scale rearing of approved biological control organisms for release at multiple sites within the South Florida ecosystem.

Location: South Florida

Counties: All counties

REFERENCES

USACE and SFWMD. 1999. *The Central and Southern Florida Flood Control Project Comprehensive Review Study Final Integrated Feasibility Report and Programmatic Environmental Impact Statement*. U.S. Army Corps of Engineers, Jacksonville District, Jacksonville, FL, and South Florida Water Management District, West Palm Beach, FL.

Appendix D
PERFORMANCE MEASURES USED IN THE
LOWER EAST COAST WATER SUPPLY PLANNING
PROCESS

OVERVIEW

Performance Measures

Performance measures quantify how well or how poorly an alternative meets a specific objective. Good performance measures have the following features:

- They are quantifiable.
- They have a specific target.
- They indicate when that target has been reached.
- They measure the degree of improvement toward the target when it has not been reached.

The performance measures used in the Lower East Coast (LEC) water supply planning process are hydrological performance measures that quantify changes in hydrological conditions relative to hydrologic targets. While achieving hydrologic targets does not necessarily guarantee ecological restoration, it is assumed that recapturing the hydrological characteristics of the natural or predrained system will provide maximum opportunity for recovery of the remaining Everglades landscape patterns and hence recovery of Everglades wildlife.

The LEC water supply planning process has developed two different types of performance measures: (1) a group of performance measures developed to assess LEC water supply issues and (2) a group of environmental performance measures designed to assess the performance of natural areas. In some cases, the type of measure is specific to a particular region, while in other cases, the performance measure is common to all the regions and is referred to as a regional performance measure.

The regional category was designed to permit evaluations that are regional in scale or cross the boundaries of one or more geographic subregions. Regional performance measures also permit comparison of particular performance measures between regions. Regional performance measures developed as part of the LEC water supply planning process include review of model performance by indicator regions, hydroperiod distributions, hydroperiod matches, surface water ponding matches, and overland flow direction and magnitude.

Performance Indicators

Performance indicators, in contrast to performance measures, do not have a specific target, but are used to provide an indication of the relative behavior of each water supply alternative. For example, a stage hydrograph without a specific stage target is considered a hydrologic performance indicator. Other examples of performance indicators include water budget tables, hydroperiod distribution histograms, hydroperiod matching maps, hydroperiod improvement maps, surface water ponding maps, ground water model animations, and regional water delivery graphics.

WATER SUPPLY PERFORMANCE MEASURES

Lake Okeechobee Service Area and Lower East Coast Service Areas

Meeting 1-in-10 Year Level-of-Certainty Water Supply for 31-Year Period of Record

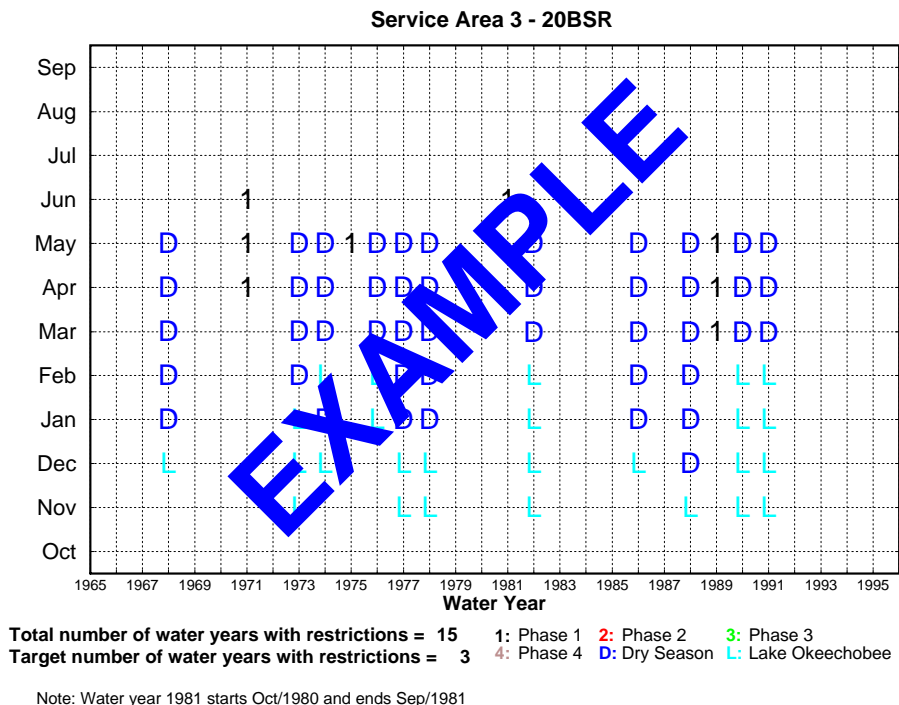
The 1997 water supply legislation requires the water management districts to provide, as part of the regional water supply plans, a water supply development component that includes a quantification of the water supply needs for all existing and reasonably projected future uses within the planning horizon. The level-of-certainty planning goal associated with identifying the water supply needs of the existing and future reasonable-beneficial uses shall be based upon meeting those needs for a 1-in-10 year drought event [373.0361(2)(a), F.S.]. The water management districts are charged with integrating this level-of-certainty concept into the regional water supply planning process.

One measure of whether water supply demands for the LEC Service Areas (LECSA-1, LECSA-2, and LECSA-3) can be met is if water supply restrictions can be avoided during a 31-year period of record, except during the most severe droughts. Current policy enables the South Florida Water Management District (District) to impose water restrictions during droughts to conserve water regional resources. The South Florida Water Management Model (SFWMM) mimics this policy by imposing restrictions on consumptive users when regional water supplies are diminished. Water demands are cut back due to low ground water stages in selected trigger cells (based on historical monitoring well locations) in the LEC Services Areas, low surface water stages in Lake Okeechobee, or continuation of the restriction in the dry season. The SFWMM restricts water supplies in each LEC Service Areas as needed. The Lake Okeechobee Service Area is placed on supply-side management when Lake Okeechobee levels are lower than the schedule.

Output. Results from the SFWMM are displayed as a graphic for the LEC and Lake Okeechobee service areas. The graphic displays the type of cutback (Lake Okeechobee levels, low ground water levels along the coast, or dry season criteria) and the severity and duration of cutbacks by water year (October - September). Water years are used, because counting water demand cutbacks by calendar year would double count events that extend through the dry season. An example of this output is provided in **Figure D-1**.

Target. The target is to meet a 1-in-10 year level of certainty for water supply as determined by counting the number of water years when there is a water supply cutback over the period of record. The maximum number of years with water supply cutbacks for each service area would be three years for the 31-year period of record with no events greater than seven months in duration for each service area.

Frequency of Water Restrictions for the 1965 - 1995 Simulation Period



Run date: 01/28/00 18:19:37
 For Planning Purposes Only
 SFWMM V3.7

Figure D-1. An Example of the Output for the **Meeting 1-in-10 Year Level of Certainty Water Supply for the 31-Year Period of Record** Performance Measure.

Lower East Coast Service Areas

Meeting 1-in-10 Year Level-of-Certainty Water Supply for Drought Conditions

The level of certainty concept was explicitly put into state law governing water supply planning in 1997. This required a water supply development component that includes 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 the existing and future reasonable-beneficial uses shall be based upon meeting those needs for a 1-in-10 year drought event (373.0361(2)(a), F.S.).

One measure of whether water supply demands for the LEC Service Areas can be met is if water supply restrictions can be avoided during a 1-in-10 year drought. Current District policy enables the District to impose water restrictions during droughts to conserve regional water resources. The ground water models mimic this policy by imposing restrictions on consumptive users when regional water supplies are diminished. Water supplies are cut back due to low ground water stages in selected trigger cells in the LEC Service Areas, low surface water stages in Lake Okeechobee, or continuation of the

restriction in the dry season. Ground water stage criteria varies by location of the trigger cells and is indicated on the daily stage hydrograph for the cell. The subregional ground water models divide the LEC Service Areas into Water Restriction Areas (WRAs) to more accurately reflect how the District's water shortage policy may be implemented.

Outputs. Results from the ground water models are displayed spatially for each service area (**Figure D-2**) and as a table showing the location of trigger cells and the severity and duration of cutbacks by cause (Lake Okeechobee levels, low ground water levels along the coast, or dry season criteria). Information on cutbacks due to Lake Okeechobee stages is imported from the SFWMM into the subregional ground water models.

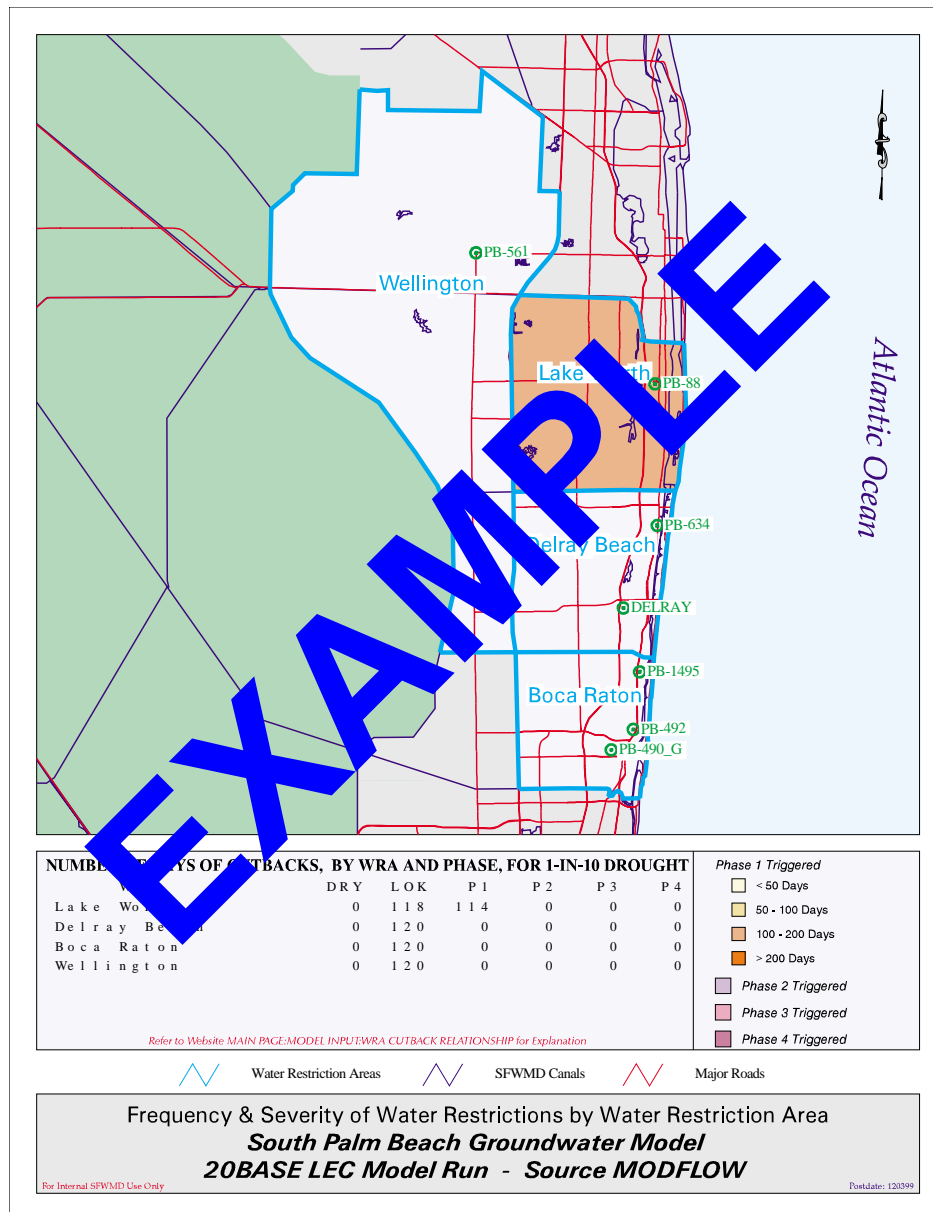


Figure D-2. An Example of the Output for the **Meeting 1-in-10 Year Level of Certainty Water Supply for Drought Conditions** Performance Measure.

Target. No water supply restrictions are incurred during a 1-in-10 year drought in the subregional ground water models due to Lake Okeechobee stages, ground water stages along the lower east coast, or due to dry season criteria.

Minimum Levels for the Biscayne Aquifer

The principal threat to maintaining the long-term functions of the Biscayne aquifer is saltwater intrusion. Saltwater intrusion is the contamination of the aquifer by salt water. The Biscayne aquifer is located along the eastern edge of Palm Beach County, underlies the majority of Broward County, and almost all of Miami-Dade County (**Figure D-3**). Along the aquifer's eastern edge, its fresh water is in contact with the salt water originating from the ocean. The constant westerly flow of fresh water from the Everglades helps to keep the salt water stationary. However, when ground water levels adjacent to the freshwater-saltwater interface are lowered, saltwater can potentially move inland replacing the fresh water (SFWMD, 1998). The higher density salt water tends to remain inland for long periods of time causing a permanent loss of that portion of the aquifer. Along the lower east coast, lowering of the ground water table due to overdrainage and increased wellfield withdrawals has allowed salt water to invade and contaminate the Biscayne aquifer during periods of drought (Parker et al., 1955). Saltwater intrusion of the Biscayne aquifer is considered one of the greatest threats to the long-term water supply of South Florida.

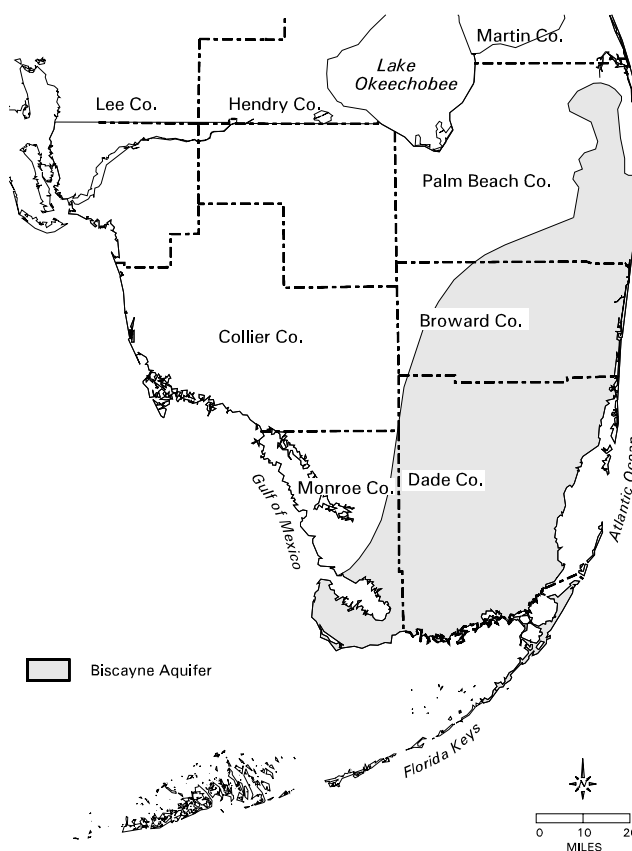


Figure D-3. Location of the Biscayne Aquifer within the LEC Water Supply Planning

Water levels in the coastal canals largely govern the expected inland migration of the saline interface. Review of water quality data from monitoring wells and modeling results show that on a regional scale, the position of the saltwater interface can be regulated by the management of water levels within the District's primary canal system. Based on this relationship, minimum water level criteria have been proposed for eleven of the District's primary canals as a means to protect a major portion of the Biscayne aquifer against saltwater intrusion (SFWMD, 1998).

Output. Model output is in the form of a table indicating the canal, water control structure, target water level, and the number of times the target was not met for 180 days in a 365-day period (**Figure D-4**).

Minimum Flow and Level Criteria for the Biscayne Aquifer

Failure to meet MFL stage criteria at control structures for 180 days or more

Canal/ Structure	MFL Stage (ft.)	Number of 95BSR	Times 20BSR	MFL Criteria 2020WR	Not Met LEC1	LEC1A
C-6@S-26	2.00	0	0	0	0	0
C-51@S-155	7.80	0	0	0	0	0
C-16@S-41	7.80	0	0	0	0	0
C-15@S-40	7.80	0	0	0	0	0
Hillsboro@G-56	6.75	0	0	0	0	0
C-13@S-36	4.00	0	0	0	0	0
C-14@S-37B	6.50	0	0	0	0	0
NNRiver@G-54	3.50	0	0	0	0	0
C-9@S-29	2.00	0	0	0	0	0
C-4@S-25B	2.20	0	0	0	0	0
C-2@S-22	2.20	0	0	0	0	0

Failure to meet MFL stage criteria at control structures for 90 days or more

Canal/ Structure	MFL Stage (ft.)	Number of 95BSR	Times 20BSR	MFL Criteria 2020WR	Not Met LEC1	LEC1A
C-6@S-26	2.00	0	0	0	0	0
C-51@S-155	7.80	0	0	0	0	0
C-16@S-41	7.80	0	0	0	0	0
C-15@S-40	7.80	0	0	0	0	0
Hillsboro@G-56	6.75	0	0	0	0	0
C-13@S-36	4.00	0	0	0	0	0
C-14@S-37B	6.50	0	0	0	0	0
NNRiver@G-54	3.50	0	0	0	0	0
C-9@S-29	2.00	4	4	0	0	0
C-4@S-25B	2.20	3	3	0	0	0
C-2@S-22	2.20	0	2	0	0	0

For Planning Purposes Only

Run date: 01/28/00 20:56:47

SFWMM V3.7

Script used: canal_mfl_lec.scr V1.2

canals_mfl_biscayne.report

Figure D-4. An Example of the Output for the **Minimum Levels for the Biscayne Aquifer Performance Measure**.

Targets. Water levels at the eleven specified water control structures (**Table D-1**) shall not fall below the proposed minimum level for more that 180 days in a 365-day period, excluding periods of flood releases. Minimum levels for the Biscayne aquifer in southeastern Miami-Dade County are not recommended at this time.

Table D-1. Recommended Minimum Canal Levels and Duration Criteria for the Biscayne Aquifer.^a

Canal and Control Structure	Canal Stage (NGVD)^b
C-51 Canal at S-156	7.80
C-16 Canal at S-41	7.80
C-15 Canal at S-40	7.80
Hillsboro Canal at G-56	6.75
C-14 Canal at S-37B	6.50
C-13 Canal at S-36	4.00
North New River Canal at G-54	3.50
C-9 Canal at S-29	2.00
C-6 Canal at S-26	2.00
C-4 Canal at S-25B	2.20
C-2 Canal at S-22	2.20

a. From SFWMD, 1998.

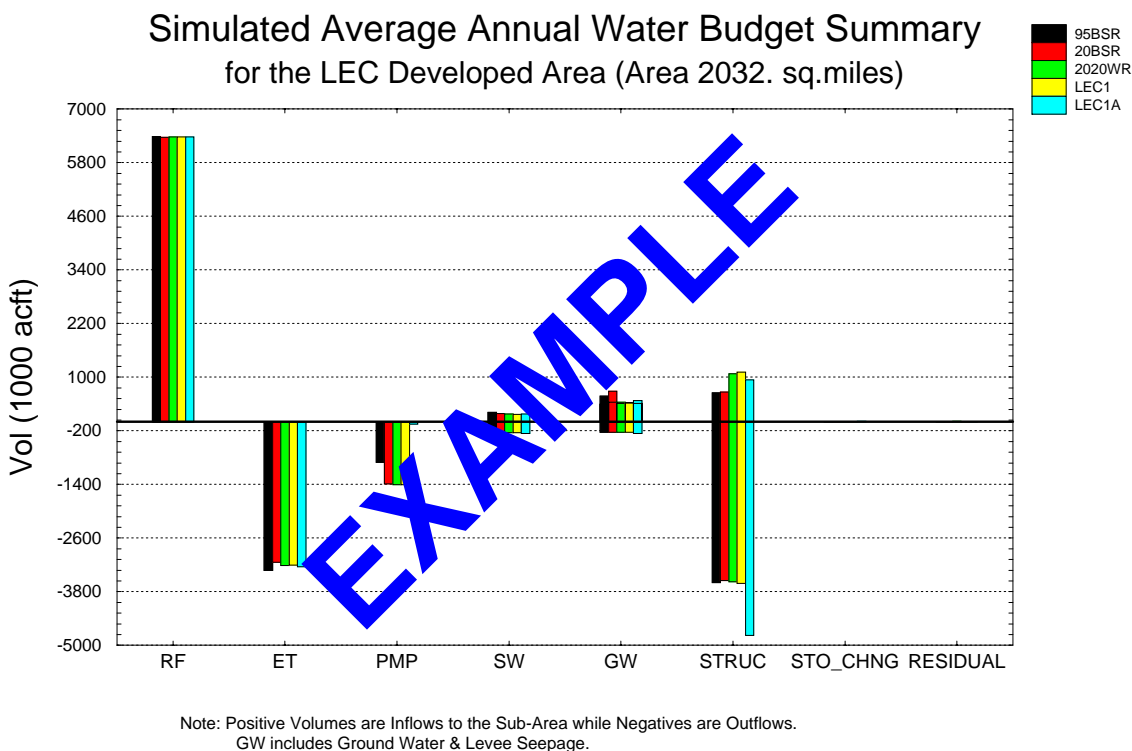
b. National Geodetic Vertical Datum; reference sea level from which elevations are measured.

WATER SUPPLY PERFORMANCE INDICATORS

Lower East Coast Service Areas

Annual Water Budget

This performance indicator graphic displays inflows and outflows for selected drainage basins in terms of average annual rainfall, evapotranspiration, ground water withdrawals, surface water flows, ground water flows, and changes in aquifer storage. Results are graphed in a bar chart for the 1-in-10 year drought period (**Figure D-5**).



Run date: 01/28/00 19:40:36
For Planning Purposes Only
SFWMM V3.7

Figure D-5. An Example of the Output for the Lower East Coast Service Area **Annual Water Budget** Performance Indicator.

Daily Stage Hydrograph for Each Trigger Cell in the Water Restriction Area

The daily stage hydrograph of each trigger cell, as well as the stage criteria that triggers cutbacks for each phase, is displayed for each WRA for the two-year period of record (**Figure D-6**). If low ground water levels have the potential to threaten protection of the Biscayne aquifer, withdrawals from the aquifer are restricted in the immediate vicinity. The severity of the restriction is commensurate with the potential threat to the resource.

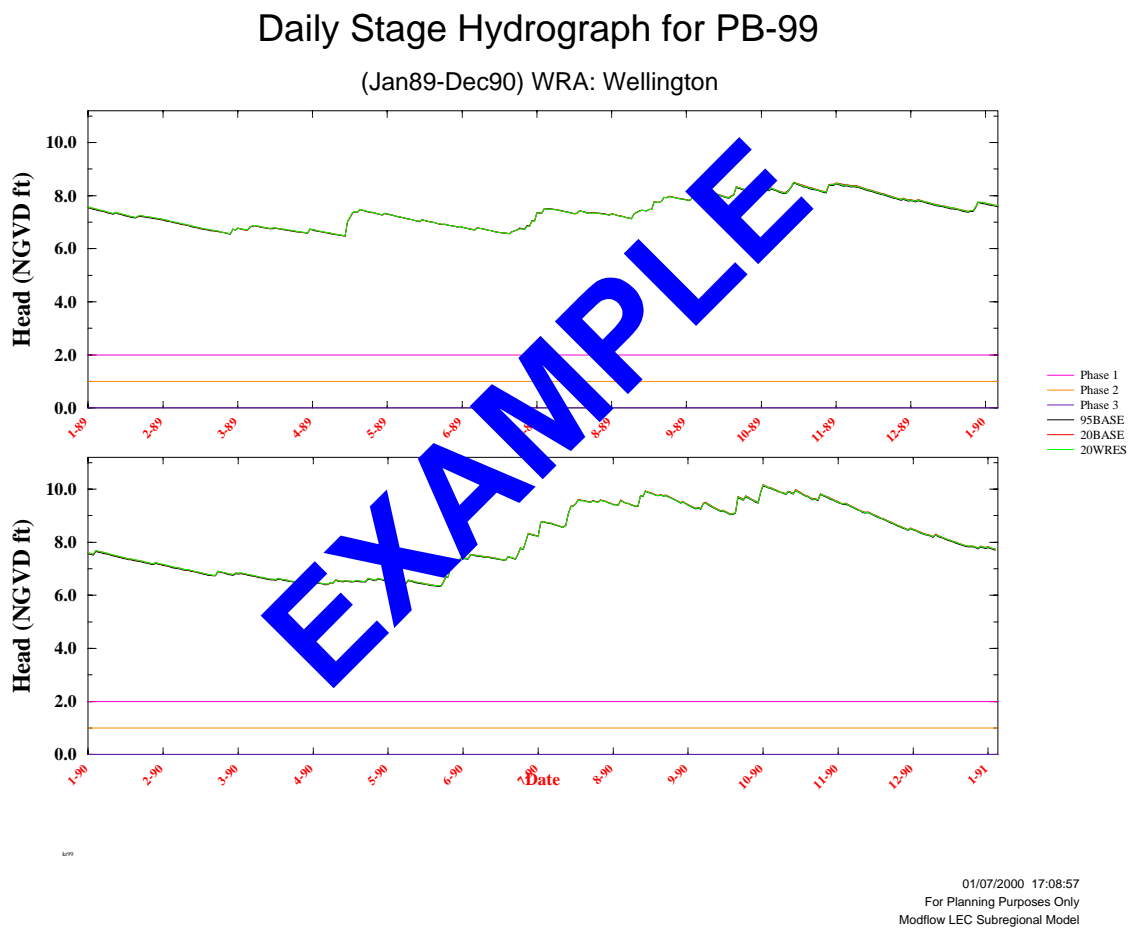


Figure D-6. An Example of the Output for the **Daily Stage Hydrograph for Each Trigger Cell in the Water Restriction Area** Performance Indicator.

Monthly Volume of Simulated Water Supply Cutbacks for Each Water Restriction Area

This performance indicator sums the monthly volume of demands not met due to water supply cutbacks as a time series for the two-year simulation period. Water supplies are cut back due to low stages in selected trigger cells in the LEC Service Areas, in Lake Okeechobee or a continuation of the restriction through the end of the dry season.

Percentage of Annual Demands and Demands Not Met, by Use Type, for Each Water Restriction Area

This performance indicator calculates the percentage of annual demands and demands not met due to water supply cutbacks by each water use type for the 1-in-10 year drought period. The percentage of annual demands met and demands not met are presented as a bar chart (**Figure D-7**). The annual volume of demands not met by water use types, including Aquifer Storage and Recovery (ASR), public water supply, agriculture overhead irrigation, agriculture flood irrigation, agriculture low volume irrigation, golf course irrigation, and nursery irrigation, are displayed in a table. Water supply cutbacks may be triggered by low stages in selected cells in the LEC Service Area or a continuation of the restriction through the end of the dry season.

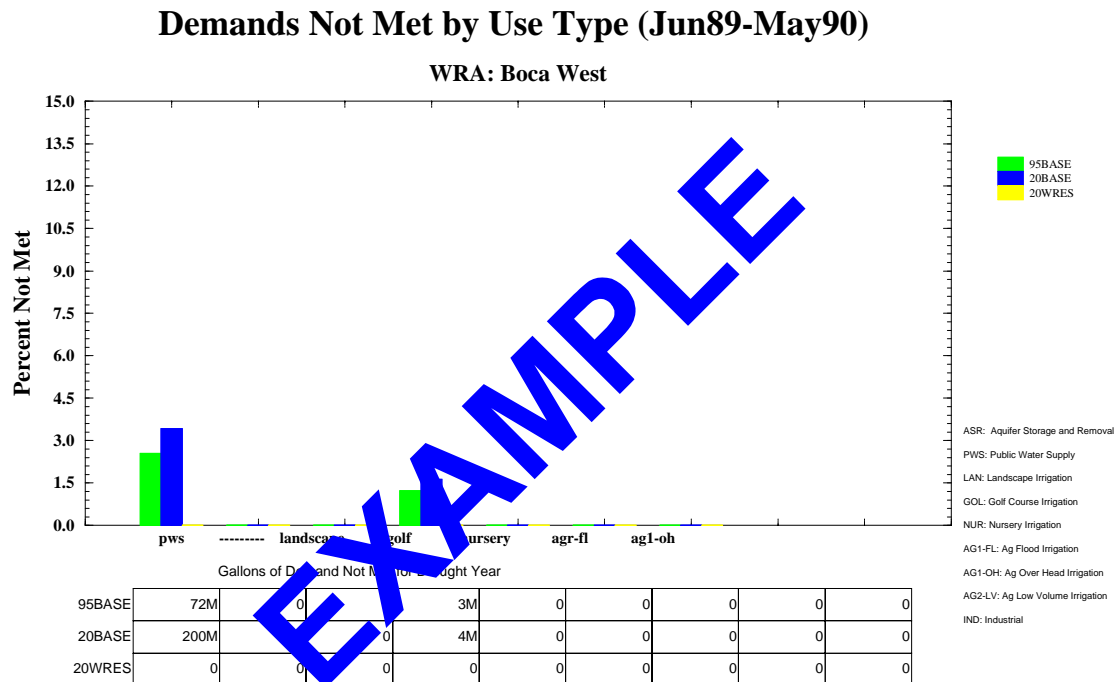


Figure D-7. An Example of the Output for the **Percentage of Annual Demands and Demands Not Met, by Use Type, for Each Water Restriction Area** Performance Indicator.

Frequency and Severity of Water Supply Restrictions

Frequency and severity of water supply restriction maps display the number of days and the severity (Phase 1, Phase 2, etc.) that water supplies are restricted due to low ground water stages near the coast, low stages in Lake Okeechobee, or dry season criteria. The location of the cells experiencing low stages and the WRA affected are color coded as to the severity of the cutbacks. Each WRA is listed on a table with the duration and severity of cutbacks experienced during the 1-in-10 year drought period (**Figure D-2**).

Average Monthly Ground Water Seepage

Monthly flows across a transect or seepage collection canal associated with a WPA component are averaged for the 1-in-10 year drought period and the results are displayed in a table similar to that in **Figure D-8**. The table displays the flows as follows:

- Intercepted by the seepage/borrow canal, if applicable
- Ground water flow underneath the seepage/borrow canal, if applicable
- The seepage rate of the ponded water (water above the ground)
- The vertical cross-section area of the water ponded and the average depth of the ponded water

The first two measurements, intercept and underflow, are most applicable to reservoirs and Water Conservation Areas (WCAs) that impound water, while the last three measurements, seepage rate, cross-section area and average depth are most applicable to aboveground reservoirs. The seepage rate is only useful if water is ponded, i.e., average depth is greater than zero.

		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
TOTAL	Intercept	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Underflow	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Seepage from the Acme STA(a)	Intercept	0.09	0.08	0.09	0.06	0.07	0.16	0.34	0.42	0.39	0.31	0.13	0.09	2.22
	Underflow	0.32	0.28	0.46	0.28	0.33	0.61	1.48	1.65	1.86	1.31	0.50	0.45	9.56
Seepage from the Acme STA(b)	Intercept	-0.11	-0.11	-0.11	-0.13	-0.13	-0.07	0.02	0.07	0.05	0.01	-0.09	-0.11	-0.72
	Underflow	-0.54	-0.54	-0.46	-0.58	-0.57	-0.39	0.07	0.19	0.28	-0.04	-0.45	-0.45	-3.49
Seepage from the Acme STA(c)	Intercept	0.03	0.01	0.02	0.00	0.00	0.02	0.07	0.10	0.11	0.10	0.05	0.04	0.55
	Underflow	0.12	0.05	0.08	0.02	0.03	0.08	0.31	0.39	0.49	0.41	0.22	0.16	2.35
TOTAL	Intercept	0.00	-0.02	0.00	0.00	0.00	0.06	0.11	0.44	0.59	0.55	0.41	0.09	2.05
	Underflow	-0.11	-0.21	0.09	0.28	-0.18	0.29	1.85	2.22	2.63	1.68	0.27	0.16	8.42
Seepage from the Acme Impoundment Area(a)	Intercept	0.10	0.00	0.00	0.11	0.12	0.12	0.18	0.21	0.22	0.22	0.20	0.17	1.79
	Underflow	0.35	0.26	0.37	0.51	0.58	0.51	0.73	0.87	0.94	0.96	0.85	0.72	7.60
Seepage from the Acme Impoundment Area(b)	Intercept	0.88	0.68	0.68	1.00	1.05	1.05	1.41	1.54	1.58	1.59	1.41	1.22	14.31
	Underflow	3.55	2.90	3.52	4.72	5.02	4.51	6.10	6.69	6.98	7.00	6.13	5.31	62.65
Seepage from the Acme Impoundment Area(c)	Intercept	1.32	0.90	0.26	1.40	1.49	1.49	1.94	2.12	2.21	2.25	2.04	1.78	20.30
	Underflow	4.06	4.00	1.52	6.55	7.19	6.45	8.44	9.23	9.75	9.96	8.92	7.80	89.16
Seepage from the Acme Impoundment Area(d)	Intercept	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Underflow	-0.00	-0.00	-0.01	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.10
TOTAL	Intercept	2.33	1.75	2.23	2.50	2.66	2.67	3.53	3.87	4.01	4.06	3.65	3.17	36.40
	Underflow	-0.26	6.91	9.79	11.77	12.79	11.47	15.27	16.78	17.66	17.90	15.89	13.82	159.31
Seepage from the PB Ag Reserve Reservoir(a)	Intercept	0.04	0.01	0.01	0.03	0.02	0.00	-0.06	-0.06	-0.05	-0.04	0.03	0.05	-0.03
	Underflow	0.25	0.11	0.06	0.12	0.11	0.01	-0.11	-0.20	-0.09	-0.03	0.08	0.12	0.42
Seepage from the PB Ag Reserve Reservoir(b)	Intercept	2.13	0.89	0.45	0.85	0.95	0.06	-1.72	-1.79	-1.08	-0.78	1.86	3.16	4.98
	Underflow	13.83	6.53	4.06	4.39	4.93	0.93	-1.88	-5.62	0.43	1.76	6.02	8.31	43.68
Seepage from the PB Ag Reserve Reservoir(c)	Intercept	0.05	0.02	0.00	-0.01	0.00	0.00	-0.01	-0.03	-0.02	0.00	0.05	0.07	0.12
	Underflow	0.37	0.15	0.09	0.00	0.01	0.00	0.07	-0.06	0.01	0.17	0.20	0.18	1.19
TOTAL	Intercept	2.22	0.92	0.45	0.87	0.97	0.05	-1.79	-1.88	-1.14	-0.81	1.94	3.28	5.08
	Underflow	14.45	6.79	4.20	4.50	5.05	0.95	-1.93	-5.88	0.36	1.90	6.29	8.61	45.29

Note: Average Monthly and Average Annual Groundwater Flow and Seepage (1000 acre-ft) for (1989-1990)

Negative values indicate flow in the reverse direction

Figure D-8. An Example of the Output for the Average Monthly Ground Water Seepage Performance Indicator.

Monthly Summary Report for Water Preserve Area Components

A table displays the average monthly budget for the two-year simulation of WPA components (**Figure D-9**). Budget information included for each component is as follows (some components will not include ASR facilities):

- Rainfall
- Evapotranspiration
- Seepage into the component from the bottom and sides
- Seepage out of the component through the bottom and sides
- Seepage recaptured and pumped back into the impoundment
- Seepage loss = seepage out - seepage recaptured
- ASR flows into the reservoir
- ASR flows out of the reservoir
- ASR net = ASR in - ASR out
- Reservoir outflows = evapotranspiration + surface water transferred in + seepage loss + ASR out
- Reservoir inflows = Rainfall + surface water transferred in + seepage in + ASR inflows + seepage recaptured
- Average volume = in 1,000 acre-feet/month
- Mean depth = Mean depth of the impoundment for the month
- Area = Area of the impoundment

Average Monthly LEC Component Budget: PB Ag Reserve Reservoir

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
YEAR 1989													
Rainfall	0.25	0.28	0.81	0.75	0.06	0.11	0.54	0.54	0.79	0.65	0.47	0.15	5.00
Evapotranspiration	0.43	0.79	0.88	0.72	0.71	0.96	0.98	0.98	0.84	0.75	0.61	0.33	7.45
Seepage Out	2.30	4.38	6.24	7.84	1.73	3.90	0.93	0.47	0.35	1.94	1.06	0.27	31.42
Seepage Recaptured	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Seepage Loss	2.30	4.38	6.24	7.84	1.73	3.90	0.93	0.47	0.35	1.94	1.06	0.27	31.42
ASR Into Reservoir	0.00	0.00	4.56	4.98	0.00	0.00	1.42	0.00	0.00	3.18	0.00	0.00	13.98
ASR Out of Reservoir	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ASR Net	0.00	0.00	4.56	4.98	0.00	0.00	1.42	0.00	0.00	3.18	0.00	0.00	13.98
Reservoir Outflows	2.73	5.17	6.93	8.56	3.98	3.90	1.44	1.13	1.19	2.68	2.01	0.60	39.96
Reservoir Inflows	4.94	6.78	5.38	6.38	0.22	0.13	1.95	0.79	3.74	0.47	0.15	0.15	40.07
YEAR 1990													
Rainfall	0.11	0.81	0.14	0.11	0.79	0.19	0.15	0.27	0.86	0.55	0.26	0.47	4.47
Evapotranspiration	0.58	0.66	0.73	0.66	0.62	0.64	0.71	0.33	0.66	0.74	0.58	0.44	7.32
Seepage Out	3.06	6.24	4.97	4.98	0.56	0.35	1.96	0.27	0.00	2.11	3.13	4.04	30.59
Seepage Recaptured	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Seepage Loss	3.06	6.24	4.97	4.98	0.56	0.35	1.96	0.27	0.00	2.11	3.13	4.04	30.59
ASR Into Reservoir	0.04	4.56	0.00	0.00	0.00	0.00	1.32	0.00	0.00	0.93	0.59	0.00	7.44
ASR Out of Reservoir	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ASR Net	0.04	4.56	0.00	0.00	0.00	0.00	1.32	0.00	0.00	0.93	0.59	0.00	7.44
Reservoir Outflows	3.64	6.90	10.68	4.98	1.18	1.19	2.67	0.60	0.67	2.85	3.88	4.48	49.11
Reservoir Inflows	5.96	5.38	3.34	2.98	0.22	0.79	3.22	0.15	0.42	1.61	6.52	34.14	

Notes: Average Monthly and Average Annual Water Budgets in 1000 acre-ft for 1989-1990

Figure D-9. An Example of the Output for the **Monthly Summary Report for Water Preserve Area Components** Performance Indicator.

Lower East Coast Wetland Drawdown Criteria

One of the concerns with withdrawals from the Biscayne aquifer and surface waters is the potential to impact wetlands. By comparing runs with and without public water supply, irrigation, and agricultural withdrawals, the effect of these consumptive uses can be evaluated. When the difference in heads within a wetland is one foot or greater for 30 days, it is tallied and displayed on a map of the model area (**Figure D-10**). This performance indicator is similar to the consumptive use criteria for permits. This performance indicator is only applied to the subregional ground water models in the LEC Service Areas.

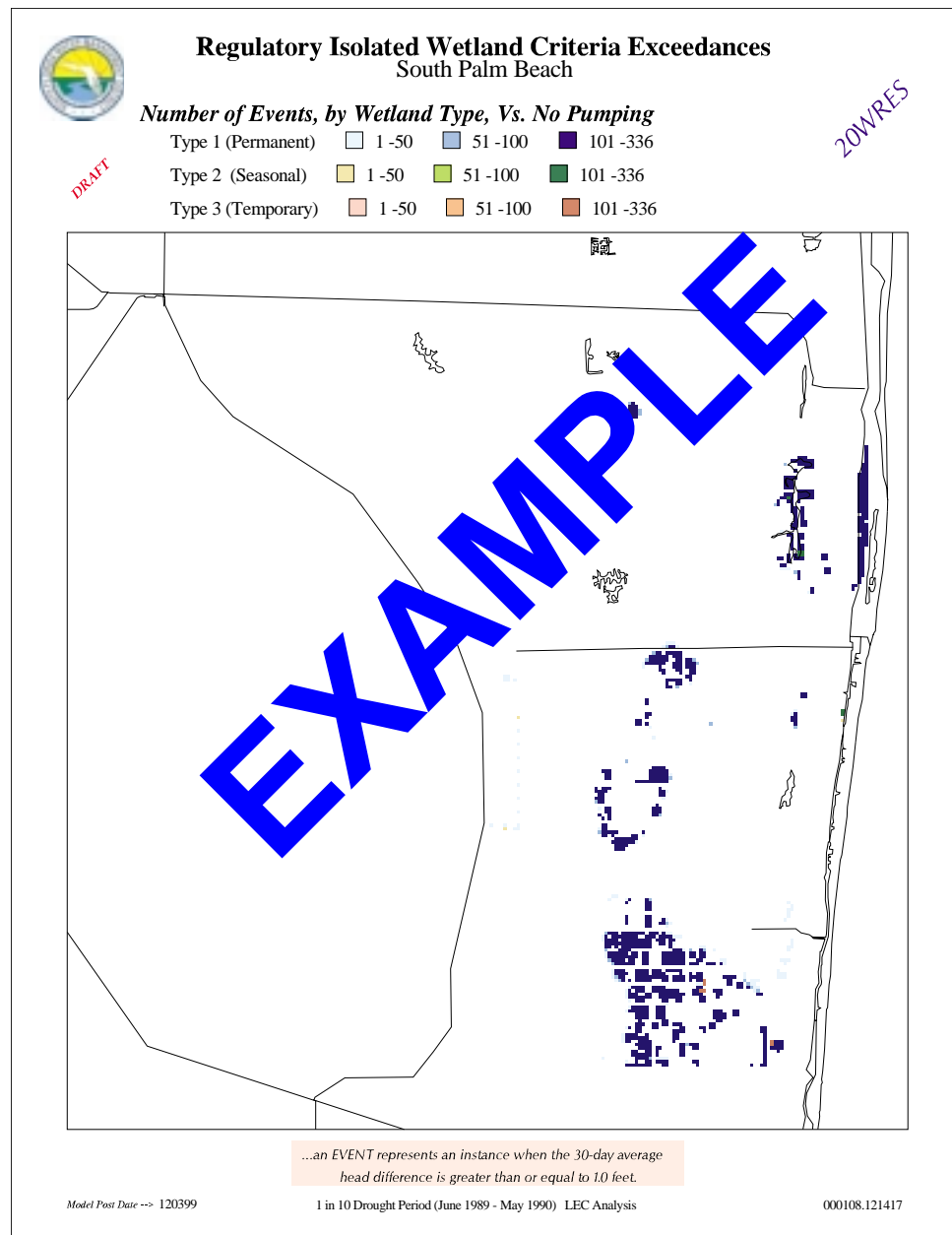


Figure D-10. An Example of the Output for the Lower East Coast Wetland Drawdown Criteria Performance Indicator.

Magnitude of Net Westward Flow Along the Coast

Another concern is whether withdrawals may affect the saltwater interface. If the ground water flow east towards the coast is less than the flow west towards a wellfield, the saline interface has the potential to move. By measuring ground water flows east and comparing them to westward flows, the net westward flow can be calculated and presented on a map (**Figure D-11**). Only when the net flow to the west is greater is the magnitude of the flow indicated. The net flow is calculated for both the water table, and the production zone. This performance indicator is only applied to the subregional ground water models in the LEC Service Areas.

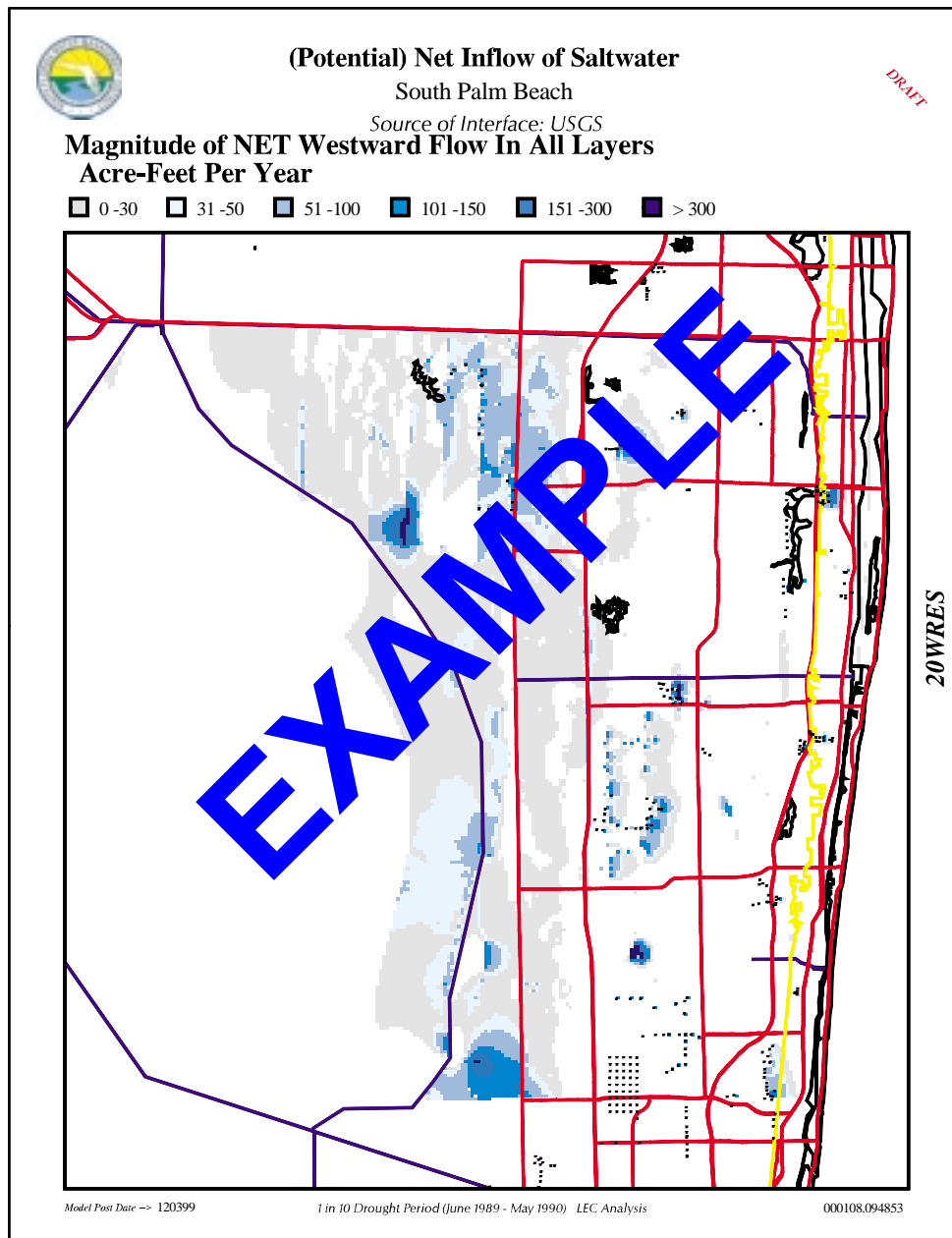


Figure D-11. An Example of the Output for the **Magnitude of Net Westward Flow Along the Coast** Performance Indicator.

ENVIRONMENTAL PERFORMANCE MEASURES FOR NATURAL AREAS

Lake Okeechobee

Minimum Water Level Criteria

A critical performance measure used to evaluate the various LEC water supply alternatives is the ability to meet Minimum Flows And Levels (MFL) criteria proposed for Lake Okeechobee (SFWMD, 1998). Minimum water level criteria for the lake consist of two components: 1) day-to-day operational MFL criteria used to identify when the MFL has been exceeded on a day-to-day basis and 2) longer-term water supply planning MFL criteria to determine how often, and for what duration, the MFL may be exceeded based on the expected frequency of natural drought conditions.

Target. In this evaluation we used the water supply planning MFL criteria to measure the performance of each water supply alternative. These criteria are defined as follows:

Water levels in the lake should not fall below 11 ft NGVD for more than 80 days duration, more often than once every six years on average.

Lake Okeechobee Priority Performance Measures

Five priority performance measures were developed for Lake Okeechobee as part of a draft conceptual model (Havens and Rosen, 1999). These five hydrologic variables are thought to play a major role in controlling ecosystem structure and function within the lake. The number of extreme high and extreme low water events (water level fluctuation) and timing of lake stages have a major effect on the distribution of native and exotic plant communities, and in turn impact habitat quality (vegetation cover, nesting sites, foraging habitat) available for fish, birds, and other aquatic dependent wildlife. Five performance measures were developed to evaluate the frequency, duration, and severity of extreme water events in Lake Okeechobee:

- Number of extreme high lake stage events (above 17 ft NGVD) which impact the ecosystem and increase the risk of flood control
- Number of prolonged, moderately high lake stages (above 15 ft NGVD for longer than 1 year)
- Number of prolonged, moderately low lake stages (below 12 ft NGVD for more than 1 year)
- Number of extreme low water events (below 11 ft NGVD) which completely dry out the littoral zone
- Number of spring water level recession events; the number of times water levels decline from near 15 ft to 12 ft NGVD during the months

of January through March, without a water level reversal greater than 0.5 feet, over the 31-year simulation period

Target. Water supply alternatives that best meet the five priority performance measures and MFL criteria listed above will be judged as best for protecting Lake Okeechobee.

Caloosahatchee Estuary

Performance Measures

The following performance measures and estuary protection targets were developed for the Caloosahatchee Estuary based on the work of Chamberlain and Doering (1997). These performance measures focus primarily on reducing the number of high discharge events that impact the estuary due to releases from Lake Okeechobee and local drainage basins. Low flow limits are also proposed. MFL criteria have not yet been developed for the Caloosahatchee Estuary. The performance measures are as follows:

- High Discharge Criteria - The number of times that mean monthly flows exceed 4,500 cubic feet per second (cfs). Mean monthly flows above 4,500 cfs results in freshwater conditions throughout the entire estuary.
- Estuary Protection Criteria - The number of times that mean monthly flows exceed 2,800 cfs. Mean monthly flows in excess of 2,800 cfs contribute to poor water quality conditions such as unfavorable salinity and increased turbidity and color which impact estuarine biota.
- Low Flow Criteria - The number of minimum flows of 300 cfs were not met within the estuary. Insufficient freshwater inflows cause hypersaline conditions, impacting estuarine seagrasses, fish and invertebrates, including critical indicator species (e.g. *Vallisneria*).

Targets. Based on a flow optimization study of the estuary (Chamberlain and Doering, 1997), the following flow targets have been established for the Caloosahatchee River Estuary (**Table D-2**):

- High Discharge Target - No more than six events with mean monthly flows exceeding 4,500 cfs
- Estuary Protection Target - No more than 22 events with mean monthly flows exceeding 2,800 cfs
- Low Flow Limit - No more than 60 months with mean monthly flows less than 300 cfs

Table D-2. Flow Targets for the Caloosahatchee Estuary.

Target	Mean Monthly Flow Range	Maximum Number of Events or Months Duration
High Discharge	> 4500 cfs	6 Events
Estuary Protection	> 2,800 cfs	22 Events
Low Flow	< 300 cfs	60 Months

St. Lucie Estuary

The following performance measures and estuary protection targets were developed for the St. Lucie Estuary as part of the Central and Southern Florida Project Comprehensive Review Study (Restudy) (USACE and SFWMD, 1999). As part of the LEC planning process, these targets and performance measures have been updated and modified based on the most recent information. The variables and performance measures have targets based on optimum flows and hydrologic conditions that would support habitat for fish, wildlife, and other aquatic resources. Again, these performance measures focus on reducing the number of high discharge events that impact the estuary due to releases from Lake Okeechobee and local drainage basins and meeting the proposed flow targets. Low flow limits are also proposed. MFL criteria have not yet been developed for the St. Lucie estuary. The performance measures are as follows:

- High Discharge Criteria - The number of times that mean monthly flows exceed 3,000 cfs. Mean monthly flows above 3,000 cfs result in freshwater conditions throughout the entire estuary.
- Estuary Protection Criteria - The number of times that mean monthly flows exceed 2,000 cfs. Mean monthly flows in excess of 2,000 cfs contribute to poor water quality conditions such as unfavorable salinity and increased turbidity and color which impact estuarine biota.
- Low Flow Criteria - The number of months minimum flows of 350 cfs were not met within the estuary. Insufficient freshwater inflows cause hypersaline conditions, impacting estuarine seagrasses, fish, and invertebrates.

Targets. Based on a flow optimization model of the estuary (Otero et al., 1995), the following flow targets have been established for the St. Lucie Estuary (**Table D-3**):

- High Discharge Target - No more than five events are allowed over the 31-year simulation period with mean monthly flows exceeding 3,000 cfs.
- Estuary Protection Target - No more than 23 events are allowed over the 31-year simulation period with mean monthly flows exceeding 2,000 cfs.

- Low Flow Limit - No more than 178 months with mean monthly flows less than 300 cfs are allowed over the 31-year simulation period.

Table D-3. Flow Targets for the St. Lucie Estuary.

Target	Mean Monthly Flow Range	Maximum Number of Events or Months Duration	Return Frequency not to be Exceeded
High Discharge	> 3000 cfs	5 Events	1-in-74
Estuary Protection	> 2000 cfs	23 Events	1-in-16
Low Flow	< 350 cfs	178 Months ^a	1-in-2

a. Over the 31-year simulation period.

Lake Worth Lagoon

The Lake Worth Lagoon currently experiences large volumes of poor quality water released to the estuary from the C-51 Canal. These releases cause large fluctuations in salinity, poor water quality, and increased sedimentation and turbidity near inflow structures (S-155, S-40, and S-141). Two performance measures for the Lake Worth Lagoon have been proposed:

- Number of times the 14-day moving average exceeds 500 cfs over the 31-year simulation period (modeling results have indicated that 500 cfs creates a steady state salinity of about 23 parts per thousand (ppt) within the lagoon).
- Mean wet and dry season flows delivered to Lake Worth via S-40, S-41, and S-155 for the 31-year simulation period

Target. Peer reviewed science-based hydrologic targets have not yet been determined for the Lake Worth Lagoon. The interim goal is to reduce, as much as possible, the number of high discharge events that impact the estuary. The maximum flow target is based on previous hydrodynamic modeling of the lagoon where 500 cfs produced a steady-state salinity of approximately 23 ppt. Until better information becomes available, this will be the interim high flow target for the lagoon. Model results are displayed in a bar graph format for the base cases and each proposed water supply alternative as shown in **Appendix H**.

Everglades

Performance measures for the Everglades were created with the intent of restoring the essential hydrologic features of the natural system that once existed prior to drainage and development of the region. The majority of performance measures developed for the Everglades were based on restoring the hydrologic patterns predicted by the Natural

System Model version 4.5F (NSM v4.5F). As part of the LEC water supply planning process the Scientific Working Group (1994) concluded that the NSM "...represents a reasonable estimate of hydrologic patterns as restoration targets for the Holey Land and Rotenberger Wildlife Management Areas (WMAs), Water Conservation Areas 1, 2, and 3, Everglades National Park, and the Big Cypress Preserve...." In addition, the NSM also appears consist with what is known or hypothesized about the optimum hydrologic patterns that will support the characteristic soils, plant and animal communities commonly associated with the Everglades Basin (Fennema et al., 1994). Performance measures utilized in this study were developed to evaluate each water supply plan's potential for the following:

- Protection and accretion of peat and marl soils as indicated by a low predicted occurrence of extreme low water events
- Protection of tree island communities as indicated by a low predicted frequency of extreme high water events
- Reestablishment of surface water inundation patterns that will maintain Everglades sawgrass or ridge and slough marsh communities as indicated by the number and duration of inundation events that closely match NSM-defined targets for a particular indicator region (see next section)

The LEC evaluation team also recognized that the NSM might not necessarily be the appropriate target for some areas of the Everglades. For example, the NSM is a relatively poor predictor of natural system conditions near model boundaries or where topographic features are not well known or represented in the model. In some areas, NSM predictions may conflict with what is currently known about the biology of a particular plant or animal community. In these instances the LEC Evaluation Team utilized the modified targets proposed in the Restudy for the following areas:

- The Arthur R. Marshall Loxahatchee National Wildlife Refuge (WCA-1) targets were the 1995 Base, in keeping with the current regulation schedule for the area.
- Indicator Region (IR) 17 (in south central WCA-3A) performance values were compared against the average NSM values for IR 14 and IR 18. This target value was selected because the NSM values for IR 17 were identified as being too low for this rather pristine area. For indicator regions in WCA-3B, not only NSM is considered, but also the number of high water events should be minimized.
- For high water extremes, the performance measure was that number and duration of events less than or equal to NSM.
- For low water extremes, the performance measure target was for frequencies and duration of events to be minimized.

Indicator Regions

Model results for each alternative were evaluated at the level of individual indicator regions. An indicator region is a grouping of model grid cells within the SFWMM that consists of similar vegetation cover and soil type. These larger groupings of cells were developed to reduce the uncertainty of evaluating results from a single two by two square mile grid cell that represents a single water management gauge or area. **Figure D-12** provides the location of each indicator region evaluated in this study. For

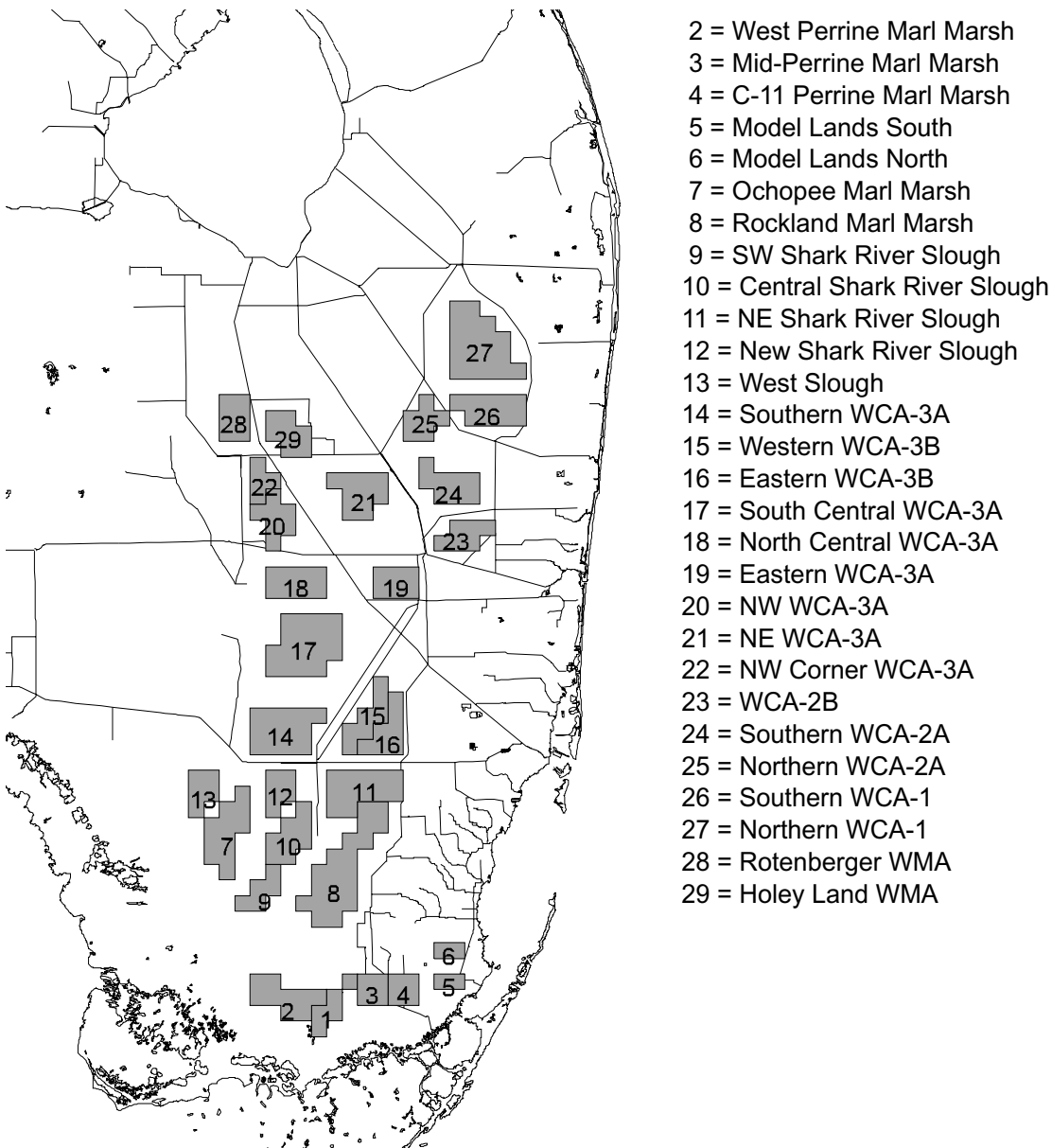


Figure D-12. Locations of Indicator Regions Within the Everglades Evaluated by the SFWMM for the Lower East Coast Regional Water Supply Plan.

final analysis, indicator regions that fell within areas of similar hydrological conditions or within the same impoundment system were grouped together. The final evaluation classified the indicator regions into 14 hydrological subregions of the Everglades:

- Arthur R. Marshall Loxahatchee National Wildlife Refuge (WCA-1): IR 26 and IR 27
- Holey Land and Rotenberger WMAs: IR 28 and IR 29
- WCA-2A: IR 25 and IR 24
- WCA-2B: IR 23
- Northeast WCA-3A: IR 21
- Northwest WCA-3A: IR 20 and IR 22
- East-Central WCA-3A: IR 19
- Central and Southern WCA-3A: IR 14, IR 17, and IR 18
- WCA-3B: IR 15 and IR 16
- Northeast Shark River Slough: IR 11
- Central Shark River Slough: IR 9 and IR 10
- Northwest Shark River Slough: IR 12
- Rockland marl marsh: IR 8
- Taylor Slough: IR 1

Each of the above indicator regions were evaluated using the following set of priority performance measures:

- The ability to meet Everglades MFL criteria (SFWMD, 1998)
- The ability to meet NSM-defined patterns of surface water flooding inundation/duration
- Number and duration of extreme high and low water events
- Interannual depth variation (average and standard deviation of water depths for the months of May and October for the 31-year simulation period)
- Temporal variation in mean weekly stage

Minimum Flows and Levels

Establishment of MFLs is a statutory requirement (Chapter 373.042(1), F.S.) that mandates all water management districts to establish MFLs for priority surface waters and aquifers within their jurisdiction. In July 1998, a draft technical document was developed identifying proposed minimum water level depths, duration, and frequencies of occurrence for Lake Okeechobee, the Everglades, and the Biscayne aquifer (SFWMD, 1998). The following minimum water level criteria were derived from this draft

document. Two criteria are proposed for wetlands overlying peat-forming and marl-forming soils.

Targets. Targets for the Everglades MFL performance measure are as follows:

- MFL criteria for peat-forming wetlands: Water levels within wetlands overlying organic peat-forming soils within the WCAs, the Rotenberger and Holey Land WMAs, and Shark River Slough should not fall 1.0 foot or more below ground level for more than a 30-day duration, at return frequencies that are not less than those shown in **Table D-4**.
- MFL criteria for marl-forming wetlands: Water levels within marl-forming wetlands that are located in the area east and west of Shark River Slough, the Rocky Glades, Taylor Slough, and the C-111 Basin should not fall below 1.5 feet below ground level for more than 90 days, at a return frequency of not more than once in five years (SFWMD, 1998) (**Table D-4**).

Table D-4. Minimum Water Levels, Duration, and Return Frequencies for Selected Key Water Management Gauges Located Within the Everglades.

Area	Key Gauge	IR	Soil Type	Minimum Depth (ft) and Duration (days)	Return Frequency (years) ^a
Loxahatchee National Wildlife Refuge (WCA-1)	1-7	27	Peat	-1.0 ft >30 days	1-in-4
WCA-2A	2A-17	24	Peat	-1.0 ft >30 days	1-in-4
WCA-2B	2B-21	23	Peat	-1.0 ft >30 days	1-in-6
Holey Land WMA	HoleyG	29	Peat	-1.0 ft >30 days	1-in-3
Rotenberger WMA	Rotts	28	Peat	-1.0 ft >30 days	1-in-2
Northwest corner of WCA-3A	3A-NW	22	Peat	-1.0 ft >30 days	1-in-4
Northwestern WCA-3A	3A-2	20	Peat	-1.0 ft >30 days	1-in-4
Northeastern corner of WCA-3A	3A-3	68	Peat	-1.0 ft >30 days	1-in-3
Northeastern WCA-3A	3A-NE	21	Peat	-1.0 ft >30 days	1-in-2
Central WCA-3A	3A-4	17	Peat	-1.0 ft >30 days	1-in-4
Southern WCA-3A	3A-28	14	Peat	-1.0 ft >30 days	1-in-4
WCA-3B	3B-SE	16	Peat	-1.0 ft >30 days	1-in-7
Northeastern Shark River Slough	NESRS-2	11	Peat	-1.0 ft >30 days	1-in-10
Central Shark River Slough	NP-33	10	Peat	-1.0 ft >30 days	1-in-10
Southwestern Shark River Slough	NP 36	9	Peat	-1.0 ft >30 days	1-in-7
Marl wetlands east of Shark River Slough	NP-38	70	Marl	-1.5 ft >90 days	1-in-5
Marl wetlands west of Shark River Slough	NP-201/G-620	12	Marl	-1.5 ft >90 days	1-in-5
Rockland Marl Marsh	G-1502	8	Marl	-1.5 ft >90 days	1-in-5
Taylor Slough	NP-67	1	Marl	-1.5 ft >90 days	1-in-5

a. Return frequencies for peat-forming wetlands were based largely on output of NSM v4.5, while those for marl-forming wetlands were based on recommendations by Everglades National Park scientists.

Inundation/Duration Patterns

Reestablishment of annual and interannual patterns of surface water inundation and drying is a key performance measure for restoration of the Everglades system. For each indicator region this performance measure calculates the number of continuous ponding events over the 31-year simulation period, the average duration of these ponding events in terms of week/event, and the average annual hydroperiod in terms of percent of time inundated over the 31-year simulation period. An example of this performance measure is shown in **Appendix H**.

Target. For most areas of the Everglades system the target is the inundation/duration patterns characterized by the NSM unless otherwise noted. These results are displayed for the NSM, base cases, and each proposed water supply alternative in the Inundation Duration Summary for indicator regions table in **Appendix H**.

Duration of Uninterrupted Surface Flooding

This performance measure was utilized primarily for evaluation of model output for Everglades National Park. Although similar to the inundation/duration performance measure, this performance measure compares patterns of uninterrupted surface water flooding at Everglades National Park indicator regions by calculating the number of times and duration an indicator region was continuously flooded 0.2 feet above ground level over the 31-year simulation period. Field observations indicate that when water depths drop to less than 0.2 feet during a flood event, aquatic fauna population densities decline, survivors retreat to refugia in solution or alligator holes, and population recovery is slowed (Loftus and Eklund, 1994; USACE and SFWMD, 1999)).

Target. Water supply alternatives, which best match NSM patterns of uninterrupted flooding, were judged as best for recovery of the ecosystem. These results are displayed for the NSM, base cases, and each proposed water supply alternative as shown in the Duration of Uninterrupted Flooding for indicator regions table in **Appendix H**.

Extreme High and Low Water Events

These two performance measures were developed to evaluate the performance of water supply plans for causing peat loss resulting from an increase in the frequency of extreme low water events and protection of tree island communities that may be impacted by extreme high water conditions. The extremely low water performance measure assesses the frequency and duration that water levels exceed values associated with damage to peat-forming regions of the Everglades. Damages include muck fires and microbial oxidation of peat (soil subsidence) caused by extreme low water events. In contrast, the high water performance measure calculates the number and duration of extreme high water events that potentially could impact tree island communities and Everglades wildlife. The number of times the high and low water criteria values are exceeded are obtained for each cell, and then averaged for all the cells within the indicator

region to obtain the number of extreme events and average duration for the 31-year simulation period.

Target. Water supply alternatives which best match NSM patterns of extreme high and low water were judged as best for recovery of the ecosystem. Model results are displayed for the NSM, base cases, and each proposed water supply alternative in the High Water Summary and Low Water Summary tables in **Appendix H**. These tables show the extreme high and low water depth criterion, the number of extreme events, their average duration (in weeks), and the average annual duration over the 31-year simulation period.

Interannual Depth Variation and Temporal Variation in Mean Weekly Stage

Water management has changed the temporal pattern of variation in water depth throughout the peat-forming and marl-forming soil landscapes of the Everglades. This includes changes in the timing of annual high and low water, the amplitude of depth variation, and the degree of year-to-year variation in water depth. Such alterations in the timing and delivery of water to the marsh are believed to cause significant effects on seasonally dependent events in the lives of Everglades organisms. The interannual depth variation and temporal variation in mean weekly stage performance measures were developed to provide for sustainable populations of native plants and animal species, restoration of more natural hydropatterns, and restored distribution of surface freshwater flows throughout the remaining Everglades, in response to rainfall and antecedent hydrological conditions. The interannual depth variation and temporal variation in mean weekly stage are two measures used to compare predicted hydropattern conditions with target values that support these objectives. The performance measures were applied to the northern and central Everglades, including the Arthur R. Marshall Loxahatchee National Wildlife Refuge (WCA-1), Holey Land and Rotenberger WMAs, WCA-2, and WCA-3.

Interannual depth variation is used to evaluate seasonal and annual variability of the marsh hydroperiod. Water depth for the months of May and October are averaged over the grid cells within a specific indicator region. The mean and standard deviation is calculated for the indicator region over the 31-year period used in the SFWMM model simulation. These values are presented in a tabular format for each alternative and indicator region.

Temporal variation in mean weekly stage is a calculation of the average water depths for a given week over the 31-year simulation period. The mean depths for each week were averaged over the grid cells within a specific indicator region. The between-year standard deviation in weekly mean depth was also calculated and these values are displayed in a graphical format.

Targets. Water supply alternatives which best reflect NSM-defined targets for these two performance measures will be judged as better for improving temporal patterns of variation in water depth throughout the peat-forming and marl-forming soil landscapes.

Biscayne Bay

Since the early 1900's, the hydrology of Biscayne Bay has been extensively modified due to coastal construction and the development of the extensive water management system now in place (Wanless et al., 1984). Freshwater flows to the bay have been highly modified from predevelopment patterns, limiting surface and ground water flows to the bay. Currently the main sources of flow to the bay are local rainfall and canal discharges. During the wet season, large volumes of fresh water are discharged to the bay via the flood control structures causing wide variations in salinity near canal inflow points and reduced salinity on the western fringe of the bay (Wang et al., 1978). Increased surface water runoff during the rainy season has also impacted inflow water quality by increased nutrient loading, sedimentation, and turbidity (Alleman et al., 1995).

Performance Measures

Performance measures are based on the mean annual wet and dry season flows discharged into five regions of the bay through the following water management structures:

- Snake Creek (S-29)
- North Bay (G-58, S-28, S-27)
- Miami River (S-25, S-25B, S-26)
- Central Bay (G-97, S-22, S-123)
- South Bay (S-21, S-21A, S-20F, and S-206).

These performance measures were developed as part of the Restudy (USACE and SFWMD, 1999) and are intended to provide a surface water inflow regime that will support salinity conditions that will not cause further damage to the ecosystem.

Target. The target applied to these regions is the current mean annual flow discharged to Biscayne Bay under the 1995 Base Case, with a 30 percent increase in flow applied to dry season discharges for the central and south bays. For Snake Creek (S-29), a separate target was developed based on canal discharge that maintains salinity ranges suitable for oyster survival. These results are displayed in a bar graph format base cases and each proposed water supply alternative as shown in **Appendix H**.

REGIONAL PERFORMANCE INDICATORS

As discussed previously, performance indicators do not have specific targets, but are used to provide an indication of the relative behavior of each water supply alternative. The following performance indicators were used in the evaluation of each proposed water supply alternative reviewed in this plan.

Weekly Stage Hydrographs

Stage hydrographs represent the time series of a water stage at a particular location. The location is typically the value of a grid cell, either 500 feet by 500 feet or two miles by two miles, depending on the model. Stage hydrographs can be used to compare hydrograph characteristics with those of different alternatives at the specific location, providing information on how well each alternative performs with regard to the duration and severity of seasonal water level fluctuations, minimum and maximum levels, the occurrence and frequency of dry out, or the duration and severity of water restrictions. Hydrographs are located throughout the model area in wetlands, near Water Preserve Areas (WPA) components, wellfields, and along the coast.

Stage Duration Curves

Stage duration curves provide an indication of the cumulative probability that a particular stage is exceeded or not exceeded. Stage duration curves are produced at the same locations as the stage hydrographs. From the duration curve the probability of exceeding a given stage is easily quantified for each alternative. It is useful to understand how the area performs during the high and low water extremes.

Normalized Stage Hydrographs and Duration Curves

Normalized stage hydrographs and normalized stage duration curves are used to reference stages with respect to land elevation rather than NGVD to facilitate comparison of ponding depths. When applying the SFWMM, this is important in comparing stages from different alternatives with the NSM values where land subsidence has occurred. For the subregional ground water models, normalization facilitates understanding the ponding frequency and duration of wetland systems, while comparing ground water heads measured relative to NGVD is useful for understanding water levels near the saltwater interface or wellfields.

Hydroperiod Distributions and Hydroperiod Matches

Hydroperiod distribution maps of the model area and histograms indicate the total area inundated for 30-day inundation period classes for each of the alternatives compared. For the subregional models, a hydroperiod distribution map for each model displays the spatial distribution of the average hydroperiod. In addition, a histogram is generated for each natural area of interest summing the acreage in each hydroperiod class. Both the map and the histogram are divided into 30-day inundation period classes.

For the SFWMM, cell-by-cell maps and histograms of the hydroperiod distribution were developed to determine how well predrainage spatial inundation patterns are reproduced by each alternative. Cell-by-cell comparisons determine how alternatives compare to, or match, the predrainage system as simulated with NSM at each modeled grid cell and indicate where changes have taken place. Hydroperiod histograms measure conditions over an area or for a particular landscape.

Histograms quantify the area that matches the inundation pattern simulated by the NSM for each alternative and provide a quick overview of the regional performance. Inundation patterns within plus or minus 30 days of those of the target are considered to match NSM. Histogram classes quantify the areas that have either longer or shorter inundation periods than NSM. This is applied only to those areas where NSM is the target.

Ground Water Flows, Heads, and Overland Flows

The subregional ground water models segregate the surficial aquifer system into multiple layers. The top layer simulates wetlands and soil transmissivity. Simulations of the top layer (Layer 1) enable the reviewer to understand how wetlands and other natural features perform. The production zone (Layer 2 or 3, depending on the model) generally simulates the most productive area of the aquifer. Review of the ground water heads in this layer provides insights of the effects of ground water withdrawals.

To understand how water flows across large spatial areas, animations of the direction and the magnitude of volume of water flows are displayed. For each model area, the change in the direction and volume of ground water flows over time can be viewed. These changes provide a general understanding or an overview of how flows are affected. For the subregional models, ground water flows are simulated for the water table (generally Layer 1), while the SFWMM generates overland flow maps.

Ground water heads, or the elevation of the water table, as simulated by the subregional models can be displayed for large areas as well. Ground water heads are generated for each cell in the model area, then grouped together to display ground water gradients. Changes in the gradients over time is animated for the period of record for the water table and production zone where public water supplies are withdrawn.

To compare changes in ground water heads between runs, ground water head differences are generated. A cell's ground water head at a specific date in the period of record in a run is compared to the ground water head for the same location and date in another run. The ground water head differences for the cells in a model's area are animated for the water table (Layer 1) and the production zone (Layer 3 or 4, depending on the model).

REFERENCES

- Alleman, R.W., D. Black, S.E. Formati, L.K. Gulick, and J.A. Vanarman. 1995. *Surface Water Improvement and Management Plan for Biscayne Bay*. Planning Department, South Florida Water Management District, West Palm Beach, FL.
- Chamberlain, R.H. and P.H. Doering. 1997. Freshwater inflow to the Caloosahatchee Estuary and the resource-based method for evaluation. Okeechobee Systems Research Division, Ecosystem Restoration Department, South Florida Water Management District. West Palm Beach, FL. Draft manuscript.
- Fennema, R.J., C.L. Neidrauer, R.A. Johnson, T.K. MacVicar, and W.A. Perkins. 1994. A computer model to simulate natural Everglades hydrology. *In*: Ogden, J.C., S.M. Davis, and W.A. Park (eds.), *Everglades: The Ecosystem and its Restoration*. St. Lucie Press, Delray Beach, FL.
- Havens, K.E. and B.H. Rosen. 1999. Draft Lake Okeechobee conceptual model. *In*: *Central and Southern Florida Project Comprehensive Review Study, Final Integrated Feasibility Report and Programmatic Environmental Impact Statement*. U.S. Army Corps of Engineers, Jacksonville District, Jacksonville, FL. and the South Florida Water Management District, West Palm Beach, FL.
- Loftus, W.F. and A.M. Eklund. 1994. Long-term dynamics of an Everglades small-fish assemblage, *In*: Ogden, J.C., S.M. Davis, and W.A. Park (ed.), *Everglades: The Ecosystem and its Restoration*. St. Lucie Press, Delray Beach, FL.
- Otero, J.M., J.W. Labadie, D.E. Haunert, and M.S. Daron. 1995. Optimization of managed runoff to the St. Lucie Estuary. *In*: W.H. Esprey, Jr. and P.G. Cobbs (eds.), *Water Resources Engineering, Volume 2*, Proceedings of First International Conference of Water Resources Engineering and American Society of Civil Engineers, pp. 1506-1510.
- Parker, G.G., G.E. Ferguson, and S.K. Love. 1955. *Water Resources of Southeastern Florida with Special Reference to the Geology and Groundwater of the Miami Area*. Water Supply Paper 1255, U.S. Geological Survey, U.S. Government Printing Office, Washington, D.C., 965 pp.
- Scientific Working Group. 1994. Record of the proceedings of the Scientific Working Group meetings of August 29-31, 1994, conducted at the Palm Beach Hilton Hotel, West Palm Beach, FL., in support of the Lower East Coast Regional Water Supply Plan, South Florida Water Management District, West Palm Beach, FL.
- SFWMD. 1998. *Proposed Minimum Water Level Criteria for Lake Okeechobee, the Everglades, and the Biscayne Aquifer within the South Florida Water Management District*, Planning Department, South Florida Water Management District, West Palm Beach, FL.
- USACE and SFWMD. 1999. *Central and Southern Florida Project Comprehensive Review Study Final Integrated Feasibility Report and Programmatic Environmental Impact Statement*. U.S. Army Corps of Engineers, Jacksonville District, Jacksonville, FL. and the South Florida Water Management District, West Palm Beach, FL.
- Walker, W.W., Jr. 1995. *Design Basis for Everglades Stormwater Treatment Areas*. Water Resources Bulletin 31: 671-685.

- Wanless, H.R., D. Cottrell, R. Parkinson, and E. Burton. 1984. *Sources and Circulation of Turbidity, Biscayne Bay, Florida*. Final Report to Dade County and Florida Sea Grant, Miami, FL.
- Wang, J.D., E. Daddio, and M.D. Horwitz. 1978. *Canal Discharges into South Biscayne Bay*. Report to the Department of Environmental Resources Management, Metro-Dade County, FL., University of Miami, RSMAS. 75 p.

Appendix E
REGIONAL MODELING FOR THE LOWER EAST
COAST REGIONAL WATER SUPPLY PLAN

GENERAL DESCRIPTION

Model Used (SFWMM v3.7)

The complex water management system in South Florida is influenced by a unique hydrology, an intricate water control infrastructure and a comprehensive set of operational policies. South Florida is unique due to its flat topography, high water table, sandy soils, and highly transmissive surficial aquifer. There are over 1,400 miles of levees and canals, 18 major pump stations, and more than 180 control structures in South Florida. The South Florida Water Management District (District, SFWMD), in collaboration with several federal, state, and local agencies, is assigned the task of evaluating several environmental and water resource development projects within the next two decades that will enable the present and future urban, agriculture, and natural system water needs to be met within the Lower East Coast (LEC) Planning Area.

A critical component of the LEC planning effort is computer modeling. It provides a feasible means of assessing systemwide impacts of the various proposed modifications to the water resources system in South Florida without the time delay and capital expense of field testing individual projects. The South Florida Water Management Model (SFWMM v3.7) is the model used by the SFWMD to simulate alternatives for the LEC water supply planning process.

The SFWMM is an integrated surface water-ground water model that simulates the hydrology and associated water management schemes in the majority of South Florida using climatic data from January 1, 1965, through December 31, 1995. The model simulates the major components of the hydrologic cycle that includes rainfall, evapotranspiration (ET), infiltration, overland and ground water flow, canal flow, and levee seepage. The model also simulates current and numerous proposed water management control structures and associated operating rules. A key management feature of the model is its ability to simulate different water shortage policies, current and proposed, for the different subregions in the system (e.g., LEC water shortage and Lake Okeechobee Service Area supply-side management plans). The gridded portion of the model domain employs a distributed modeling approach. Lake Okeechobee is simulated as a lumped hydrologic system. The amount, timing, and distribution of structure flows in and out of the lake are dictated by management rules related to flood control, water supply, and environmental restoration. Also, the model simulates inflows from Kissimmee Basin, and runoff and managed discharges within the St. Lucie and Caloosahatchee Basins.

Documentation

The most recent published documentation of the model is *A Primer to the South Florida Water Management Model (Version 3.5)* (SFWMD, 1999). This publication was completed in partial support of the computer modeling efforts for the Central and Southern Florida Project Comprehensive Review Study (Restudy) which was completed in

(USACE and SFWMD, 1999). The documentation is available on-line at <http://www.sfwmd.gov/org/pld/hsm/models/sfwmm>.

Temporal and Spatial Scale

A fixed time step of one day is used in the model. The selection of this time step is consistent with the minimum time increment for which hydrologic data such as rainfall, evaporation, and structure discharge are generally available. Rainfall and potential evaporation (PET) are the primary driving processes. Therefore, the longest total simulation time for the model is a function of the available historical (or an estimate of historical) rainfall and PET data. The model (version 3.2 and later) can be run for as short as one month and for as long as 31 years from January 1, 1965, through December 31, 1995. The hydrologic processes are generally modeled sequentially within one time step. A continuous unconfined ground water system is assumed to underlie the gridded portion of the model domain. To simplify programming and reduce computational time, no iteration is performed between surface and ground water routines within a time step. Within a time step, calculations for more transient phenomena, such as channel flow routing, are performed before less transient phenomena, such as ground water flow. The bulk of the computer code is comprised of the operational rules that drive the human management of the entire system.

The gridded portion of the model domain describes the extent of the finite difference solution to the governing overland and ground water flow equations and is defined just south of Lake Okeechobee (**Figure E-1**). The network is comprised of two-mile square grid cells that cover the large coastal urban areas of Palm Beach, Broward, and Miami-Dade counties, the Everglades Agricultural Area (EAA); the Water Conservation Areas (WCAs), and Everglades National Park. The model has 1,746 computational grid cells. The SFWMM assumes homogeneity in physical, as well as hydrologic characteristics within each grid cell. In addition to water levels at grid cells, and surface and ground water flow between cells, the model also calculates discharges for the major hydraulic structures within the model domain.

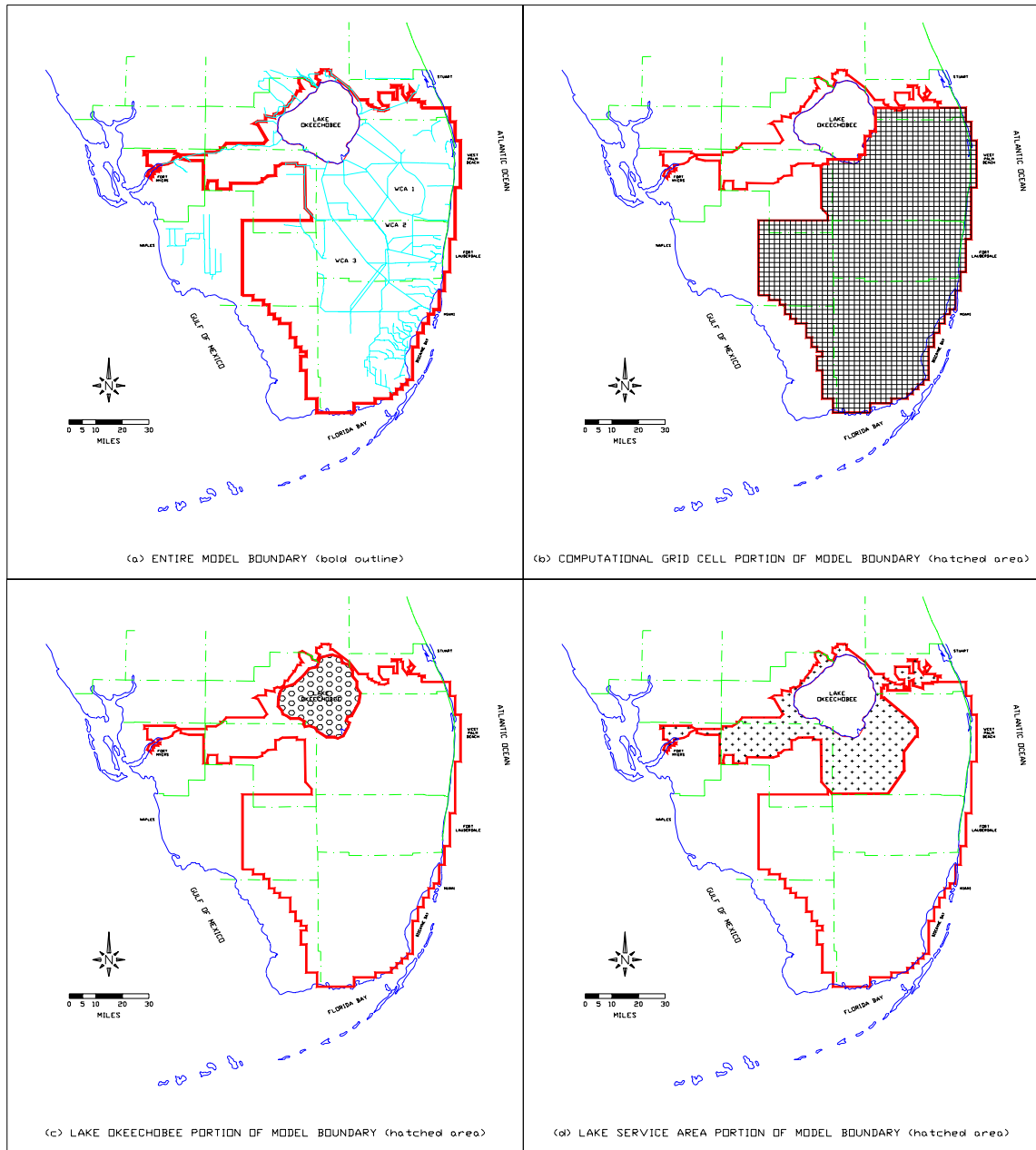


Figure E-1. South Florida Water Management Model Boundaries.

Rainfall and Evapotranspiration

Rainfall is the main climatic data that the SFWMM uses to simulate daily hydrology from Lake Okeechobee to the southern tip of the Florida peninsula. The model uses a spatial database, based on almost 700 rainfall stations, to assign a rainfall value for each model grid cell on a daily basis. A nearest station approach was used in the model in lieu of a more rigorous method. While this approach may not yield the best estimate of rainfall, it affords several advantages over different interpolation/estimation methods:

- With a fairly large set of raw data, as in the case of the SFWMM, no estimation of missing rainfall data is required. Although rainfall is a continuous variable, a value of zero is not uncommon.
- Most interpolation methods tend to assign nonzero values for days when no recording is made. The method employed in both models uses the next best estimate of the rainfall by using the closest available rainfall station.
- The current estimation method is flexible enough to accept updated information and additional rainfall stations as they become available.

The calculation of ET in the SFWMM is based on reference crop ET which is adjusted according to crop type, available soil moisture content, and location of the water table. Algorithms used to calculate actual ET vary geographically because of different data availability, calibration approaches, and varying physical and operational characteristics of different areas within the model domain. For Lake Okeechobee, the pan evaporation method is used to calculate open water and marsh zone ET. In the EAA, total ET is the sum of its components from the saturated, unsaturated, and open water zones. In nonirrigated areas, such as the Everglades, the unsaturated zone does not exist and total ET is calculated as the sum of open water evaporation and saturated zone (water table) ET. Finally, in irrigated areas within the LEC Planning Area, a simple accounting procedure is used to calculate unsaturated zone ET while saturated and open water ET are calculated based on the Penman-Monteith (P-M) reference crop ET.

In all cases, the generalized form of the ET function in the model is **Equation E-1**. A reference crop ET is computed for each of the ten data collection sites using meteorological data such as rainfall, temperature, sky cover, and wind speed.

$$ET = K \times E_0 \quad E-1$$

where:

K = an adjustment factor that takes into account vegetation/crop type and location of the water table relative to land surface

E₀ = the Penman-Monteith reference crop (turf grass) ET

The actual reference ET assigned to each grid cell is obtained from a linear interpolation scheme based on the grid cell's inverse distance from all ten stations. The P-M equation (Monteith, 1965), in its original form, is given by **Equation E-2**.

$$\lambda ET_0 = \frac{\Delta(R_n - G) + \rho C_p (e_a - e_d) \frac{1}{r_a}}{\Delta + \gamma \left(1 + \frac{r_c}{r_a}\right)} \quad E-2$$

where:

- λET_0 = latent heat flux of evaporation ($\text{KJ m}^{-2} \text{s}^{-1}$)
- ET_0 = mass flux of ET ($\text{kg m}^{-2} \text{s}^{-1}$)
- λ = latent heat of vaporization (KJ kg^{-1})
- Δ = slope of vapor pressure curve ($\text{kPa } ^\circ\text{C}^{-1}$)
- R_n = net radiation flux at surface ($\text{KJ m}^{-2} \text{s}^{-1}$)
- G = soil heat flux ($\text{KJ m}^{-2} \text{s}^{-1}$)
- ρ = atmospheric density (kg m^{-3})
- C_p = specific heat of moist air ($\text{KJ kg}^{-1} ^\circ\text{C}^{-1}$)
- e_a = saturation vapor pressure at surface temperature (kPa)
- e_d = actual ambient vapor pressure at dew point (kPa)
- $(e_a - e_d)$ = vapor pressure deficit (kPa)
- γ = psychrometric constant ($\text{kPa } ^\circ\text{C}^{-1}$)
- r_c = crop canopy resistance (s m^{-1})
- r_a = aerodynamic resistance (s m^{-1})

Overland Flow

The diffusion flow model (Akan and Yeh, 1981) is used to simulate overland flow in the SFWMM. The primary driving force for diffusion flow is the slope of the water surface. A diffusion wave model accounts for backwater effects but prohibits water from traveling opposite head gradients. Essentially the continuity and momentum equations are solved. The two-dimensional continuity equation for shallow water flow is **Equation E-3**.

$$\frac{\partial h}{\partial t} + \frac{\partial(hu)}{\partial x} + \frac{\partial(hv)}{\partial y} - q = 0 \quad E-3$$

where:

h = water depth (ft)

u, v = velocity in the x- and y- directions (ft/day)

q = vertical influx which consists of the net effect of rainfall, infiltration, and ET (ft/day)

t = time (day)

x and y = Cartesian coordinates aligned along the major axes of hydraulic conductivity or transmissivity

Expressing depth of flow as water level above a datum, the momentum equation in the x-direction can be expressed as **Equation E-4**, while the momentum equation in the y-direction is **Equation E-5**.

$$\frac{\partial H}{\partial x} + \frac{\tau_{bx}}{\rho gh} = 0 \quad E-4$$

$$\frac{\partial H}{\partial y} + \frac{\tau_{by}}{\rho gh} = 0 \quad E-5$$

where:

H = $h + z$

$h + z$ = water level above a given datum (ft NGVD); the SFWMM uses the National Geodetic Vertical Datum (NGVD) of 1929

h = depth of flow (ft); the hydraulic radius is essentially the depth of flow for wide channels

z = channel bottom elevation above the datum (ft NGVD)

τ_{bx}, τ_{by} = bed (bottom and sides) shear stress in the x- and y- directions (lb/ft²)

ρ = density of water (slugs/ft³)

g = acceleration due to gravity (ft/sec²)

After some mathematical manipulations, the solution to the governing equations yields an expression for the cell-to-cell flow velocities in the x- and y- directions (SFWMD, 1999). These are given as **E-6** and **E-7**. Using a finite difference representation

of these equations, an alternating direction explicit (ADE) scheme is used to solve the governing equations within the model.

$$u = 1.49 \frac{h^{\frac{2}{3}}}{n \sqrt{S_n}} \frac{\partial H}{\partial x} \quad E-6$$

$$v = 1.49 \frac{h^{\frac{2}{3}}}{n \sqrt{S_n}} \frac{\partial H}{\partial y} \quad E-7$$

where:

n = the overland flow roughness coefficient which varies as a function of depth of flow

S_n = the maximum energy slope

Ground Water Flow

Ground water flow in the SFWMM involves the solution to the Partial Differential Equation (PDE) describing transient flow in a two-dimensional, anisotropic, heterogeneous, unconfined aquifer. The PDE is of the form of **Equation E-8**:

$$\frac{\partial}{\partial x} \left(T_{xx} \frac{\partial h}{\partial x} \right) + \frac{\partial}{\partial y} \left(T_{yy} \frac{\partial h}{\partial y} \right) = S \frac{\partial h}{\partial t} - R \quad E-8$$

where:

T_{xx} and T_{yy} = transmissivity tensors of the aquifer (ft²/day)

h = the unknown hydraulic or potentiometric head (ft)

S = unconfined aquifer storage coefficient or specific yield of the porous media; vertically-averaged specific storage; volume of water released or taken into storage per unit cross-sectional area per unit change in hydraulic head in the aquifer (dimensionless)

R = recharge; volumetric flux per unit surface area (ft/day)

A finite difference scheme using a modified Saul'yev (1964) method is used to solve the above equation. This procedure is unconditionally stable and explicit. The scheme uses a finite difference formulation that varies in four different directions that is solved in four successive time steps.

Infiltration and Percolation

Infiltration is the process by which water on the soil surface enters the soil column. Water may come from rainfall and/or irrigation and increases moisture in the unsaturated zone or directly goes to the saturated zone via percolation. Percolation is the recharge to the saturated zone or the amount of water crossing the water table. In South Florida, where unconfined aquifer conditions exist, the location of the water table determines the upper limit of the saturated zone. Ponding exists when the water table elevation exceeds the land surface elevation and the unsaturated zone no longer exists. Infiltration and percolation are assumed to be strictly vertical processes. The volume of infiltration is taken as the minimum of the following three quantities:

- Available water (above land surface) to infiltrate
- Infiltration rate multiplied by grid cell area and time step
- Available void space between the water table and land surface

Infiltration rates vary from grid cell to grid cell and were determined from the soil classification scheme used for the entire model domain. Percolation is the amount of water that enters the saturated zone when field capacity is exceeded. Field capacity is the maximum moisture content that can be stored in the unsaturated zone.

Levee Seepage

To facilitate urban development in the LEC Planning Area, drainage canals were constructed to lower the water table and drain surface water from the eastern portion of the Everglades to the Atlantic Ocean. To protect the developing urban sprawl from the Everglades flood waters, an extensive east coast protective levee system was built in the 1950s and early 1960s as part of the federally funded Central and South Florida Project for Flood Control and Other Purposes (C&SF Project). Hydrologically, these levees resulted in highly concentrated easterly ground water flows, most of which are diverted south via a system of borrow canals just east of the levees. Unfortunately, levee seepage cannot be adequately simulated by a coarse model such as the SFWMM. Therefore, a set of regression equations were derived to empirically represent levee seepage within the SFWMM. These equations were based on an independent set of computer simulation runs using SEEPN. SEEPN is a two-dimensional (vertical plane) finite element model developed at the U.S. Army Corps of Engineers Waterways Experiment Station (USGS-WES). This latter model simulates steady state subsurface flow through a multilayered aquifer system by solving the Laplace equation using Darcy's Law (Tracy, 1983).

In the SFWMM, the total subsurface flow beneath a levee is the sum of the regional ground water flow (underseepage) and levee seepage (**Figure E-2**).

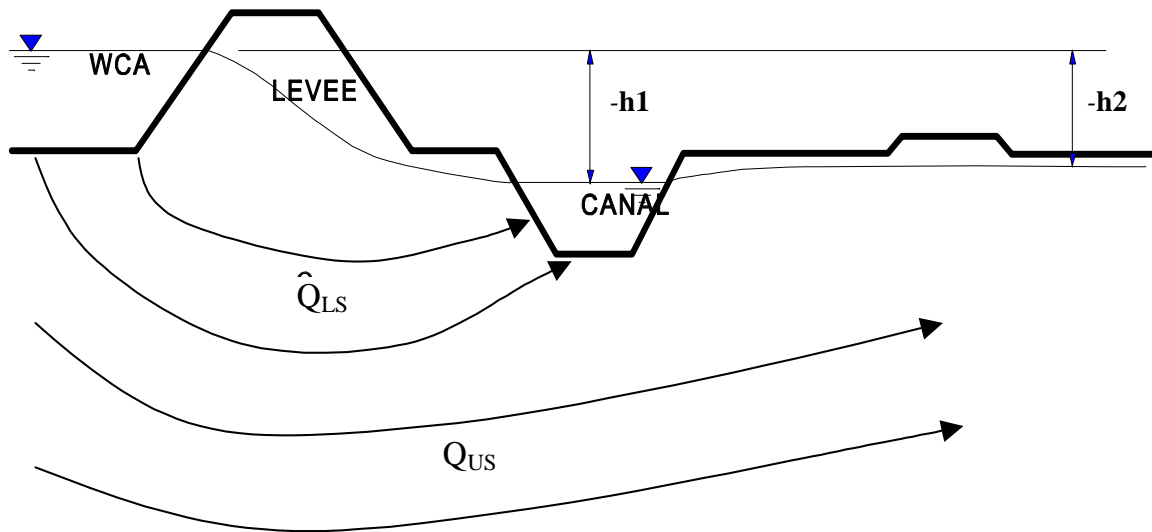


Figure E-2. Canal-Levee configuration depicting levee seepage (Q_{LS}) and underseepage (Q_{US}) as simulated in the South Florida Water Management Model.

The regression equation is of the form of **Equation E-9**:

$$Q_{seep} = \beta_0 + \beta_1 \Delta h_1 + \beta_2 \Delta h_2 \quad E-9$$

where:

Q_{Seep} = the levee seepage in cubic feet per second/mile

$\beta_0, \beta_1, \beta_2$ = levee seepage coefficients

Δh_1 = the head gradient across a levee representing the difference in the water levels inside a WCA and a levee borrow canal (local head gradient)

Δh_2 = the head gradient across a levee representing the difference in the water levels on opposite sides of a levee borrow canal (regional head gradient)

Canal and Structures Flow

Canal or channel flow routing in the SFWMM uses a mass balance approach to account for any changes in storage within a canal reach given beginning-of-day canal stage, canal and structure properties, and calculated or specified inflows and outflows. The mass balance is performed every time step for each canal reach and involves grid cells

where each canal reach passes through. The SFWMM assumes that the width of a canal is constant along its entire length. The model also assumes a wedge-shaped longitudinal water level profile such that a seasonal offset or head drop occurs along the length of each canal reach. This offset can be considered as a predefined slope in the hydraulic grade line that represents the average or long-term difference between the stage in the canal at its upstream end and at its downstream end. It is assumed to vary seasonally and is independent of the discharge in the channel. This simplification is used to trace flow and stages within the canal as a function of space and time, unlike traditional distributed flow routing procedures, i.e., solution of the kinematic, diffusion, or dynamic wave equations. The components of the canal water budget are rainfall, ET, overland flow, canal seepage, and structure inflows and outflows. Because some of these components are functions of canal stage, an iterative procedure is used to calculate the end-of-day canal stage.

A complex set of inflow and outflow rules is used in the model by all structures (weirs, spillways, pumps, and culverts) along the length of each canal. Several other structure operating rules are coded in the model that govern flow in and out of storage areas (e.g. lakes, reservoirs, Stormwater Treatment Areas [STAs], and WCAs) (SFWMD, 1999).

In the LEC service areas (LECSAs), reservoirs are generally proposed as part of the Water Preserve Areas whose functions are 1) to store excess water from a drainage basin which may result in increased flood control in the basin and reduced seepage volumes from the WCAs and 2) to release the stored water for water supply purposes and/or environmental enhancement to decrease the dependence of the LECSAs on the regional system. Aquifer Storage and Recovery (ASR) wells are proposed in conjunction with reservoirs to enhance the system's ability to store water and to effectively use excess water during times of need.

Surface-Subsurface Interaction

One of the strengths of the SFWMM is its ability to simultaneously describe the state of the surface water and ground water systems within the model domain. This state is defined in terms of ponding depths, unsaturated zone water content, and ground water levels. Recharge, levee seepage, and the procedures briefly outlined in the preceding discussions comprise the vertical coupling of ground water and surface water in the model. Recharge is the combined effect of percolation, ET, canal-ground water seepage, and aquifer withdrawal for domestic, industrial, and irrigation purposes.

Figure E-3 shows a block diagram of the physical processes simulated in the model for surface and subsurface systems. Rainfall is a process that moves water from the atmosphere into surface storage. ET is the movement of water from both surface and subsurface systems into the atmosphere. A canal, which is essentially a special form of surface storage, exchanges water with ponding and the saturated zone storage through runoff/overbank flow and canal-ground water seepage, respectively. Lastly, levee seepage is a localized flow phenomenon that describes the movement of water from the aquifer across a major levee and into a borrow canal.

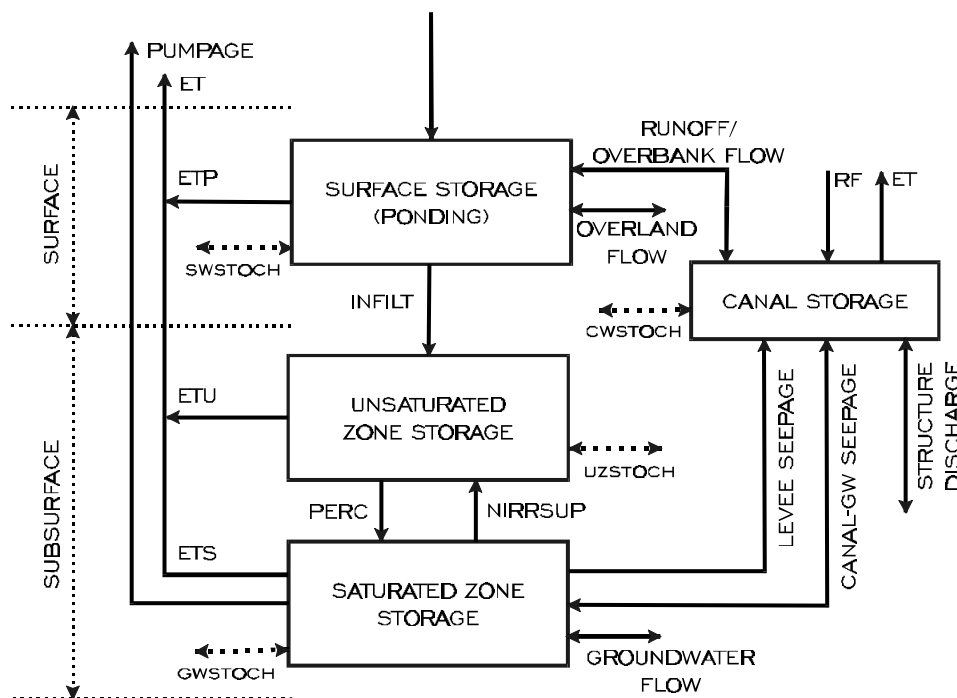


Figure E-3. Generalized Block Diagram of Surface-Subsurface Interaction in the South Florida Water Management Model.

Accuracy

In order to demonstrate model accuracy, water budget postprocessing tools are available to summarize water budget components on a monthly, seasonal, and annual basis for individual or group of grid cells. Also, calibration exercises are routinely performed on the model to demonstrate history-matching capabilities of the model (SFWMD, 1999).

Several publications and presentations have been made in the past to address model accuracy and model applicability (e.g., Lal, 1998; Bales et al., 1997; Loucks et al., 1998).

Previous Applications of SFWMM

The SFWMM has been the primary modeling tool for evaluating regional-scale effects of major water management projects associated with the Lake Okeechobee-Everglades system. The model has been used for the following projects:

- Development of the *Draft Lower East Coast Regional Water Supply Plan* (SFWMD, 1993)
- *Central and Southern Florida Flood Control Project Comprehensive Review Study Final Integrated Feasibility Report and Programmatic*

Environmental Impact Statement (Restudy) (USACE and SFWMD, 1999)

- *Development of Regulation Schedules for Lake Okeechobee (SFWMD and USACE, 1999)*
- Several studies related to the hydrologic restoration of the Everglades

The SFWMM is an appropriate tool for evaluating large-scale, long-term hydrologic effects from structural and operational modifications. Since the model has a coarse (two mile-by-two mile square grid cells) and a daily time step, it cannot adequately evaluate local-scale or highly transient events (e.g. flooding in individual farms and local developments). However, the model's utility can be extended beyond these limitations. Model output is being used as boundary conditions for the more detailed countywide ground water models (<http://www.sfwmd.gov/org/pld/proj/lec/aboutmod.html>). Likewise, since the SFWMM is essentially a water transport model, its output has been used as input to water quality models (<http://www2.shore.net/~wwwalker/restudy>) and some ecological models (<http://www.sfwmd.gov/org/pld/restudy/hpm>)

SPECIFIC ASSUMPTIONS AND ROUTINES DEVELOPED FOR SOUTH FLORIDA WATER MANAGEMENT MODEL VERSION 3.7

LEC alternatives were designed to address local needs and formulated to be more responsive to local and state mandates, based on knowledge gained from the SFWMM simulations for the Restudy, the Modified Water Delivery Project, and the Everglades Construction Project. Thus, a few modifications in the modeling assumptions and enhancements were incorporated into the model. Although most of these changes focus on areas outside the LECSAs, they may impact or enhance the effectiveness of the components of the proposed alternatives specific to the LEC Planning Area. Specifics on these changes and their impact on the different base run scenarios can be found in Santee (1999).

Water Supply and Environmental Schedule for Lake Okeechobee

Water levels in Lake Okeechobee are currently managed through regulatory (flood control) and nonregulatory releases. Regulatory releases are made according to a regulation schedule, established by the USACE in conjunction with the District and other public entities, to ensure that the integrity of the peripheral levee is not compromised due to high water levels. The regulatory level for Lake Okeechobee ranges from 15.65 ft NGVD in late May to 16.75 ft NGVD on October 1. The summary of the regulatory rules, the Run 25 Schedule, as set forth by the USACE is given in **Figure E-4**.

Nonregulatory releases are made to meet (1) water supply requirements of the LECSAs, (2) agricultural/irrigation demands in the Lake Okeechobee Service Area (LOSA), and (3) environmental needs of the St. Lucie and Caloosahatchee estuaries, the

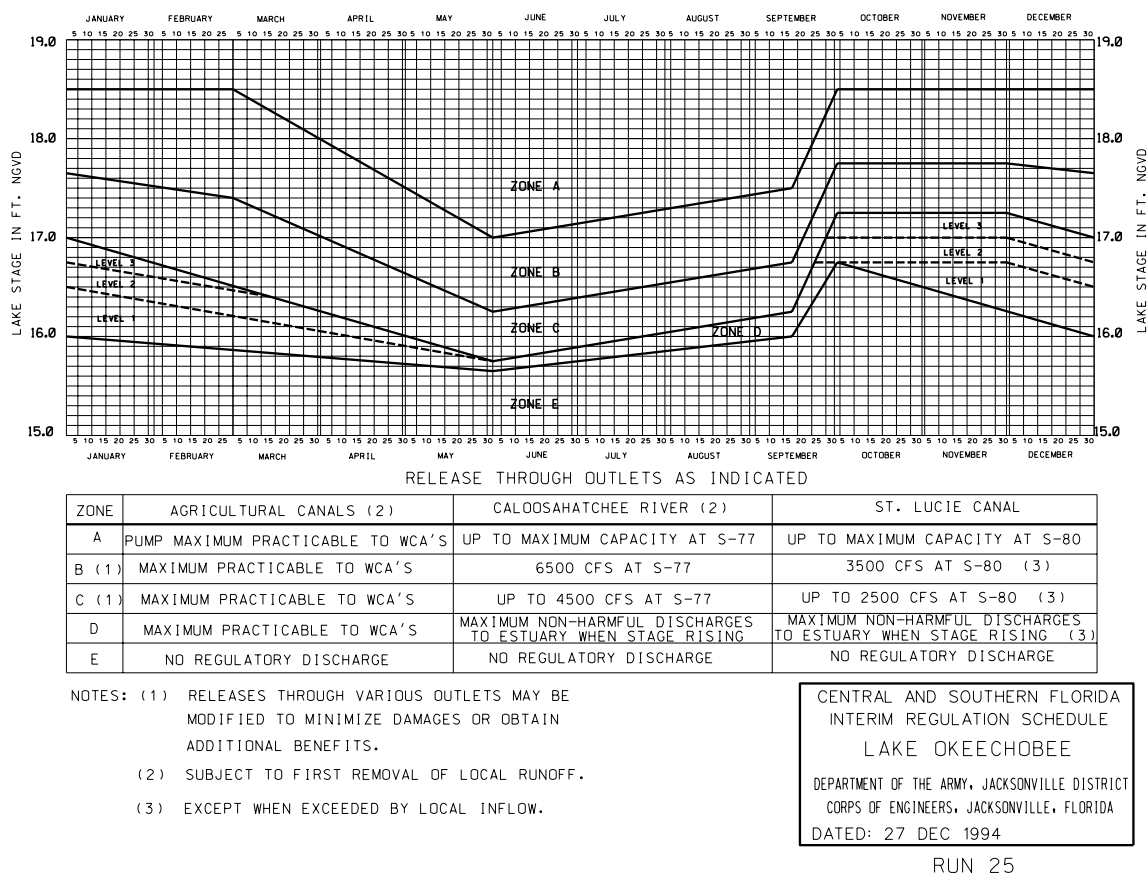


Figure E-4. The Run 25 Schedule for Lake Okeechobee.

WCAs, and Everglades National Park. These releases are sent to areas in the system that may need water for irrigation (e.g., EAA), saltwater intrusion control (e.g., canals), domestic use (e.g., some lakeside communities), backup water supply (e.g., LECSAs), and environmental enhancement (e.g., estuaries and WCAs). Currently, no detailed and comprehensive policy governs lake environmental release. The model, however, has the capability to make this type of lake releases based on meeting stage and flow targets (minimum flows and levels), and in conjunction with other proposed infrastructures in the system such as STAs, ASR technology, and impoundments like reservoirs or buffer (marsh) areas.

The regional simulation models used in the LEC water supply planning process included an operational assumption of supplying sufficient water to the STAs to avoid dry-out, a condition that would compromise the performance of phosphorus removal. In accordance with a prioritization scheme in the simulations, water is delivered from Lake Okeechobee to maintain a minimum level of six inches in the STAs. Prioritization of Lake Okeechobee water is first to the LOSA and then to the STAs to meet the six-inch minimum maintenance level. Thereafter, water is supplied to meet LEC Planning Area water supply demands or to meet environmental demands in the WCAs through the STAs.

When Lake Okeechobee goes into Supply-Side Management cutbacks, water is still supplied to the STAs for their six-inch minimum level requirement. When the lake drops into Zone B of the Supply-Side Management schedule, flow from the lake to the STAs to maintain the six-inch minimum is cut off completely, even though there may still be some reduced flows to LOSA to meet demands there.

Full implementation of the proposed Water Supply and Environmental (WSE) Operational Schedule (**Figure E-5**) is now part of the most recent version of SFWMM. Emphasis was placed on water supply and environmental objectives (within the lake and affected areas) in the development of the WSE schedule with some increase in the lake's flood protection capability. A highly desirable approach in overall Lake Okeechobee management is to consider the entire spectrum of hydrologic, meteorologic, and climatic data and forecasts when implementing the WSE schedule. In order to achieve operational proficiency, the schedule incorporates tributary hydrologic conditions and climate forecasts.

Figure E-6 shows a detailed operational decision tree that will enable the successful implementation of the WSE schedule. Due to the approximate nature of extended climate forecasts, the extent of their application is proposed to be constrained by hydrologic conditions existing within the vast tributary basins (SFWMD and USACE, 1999).

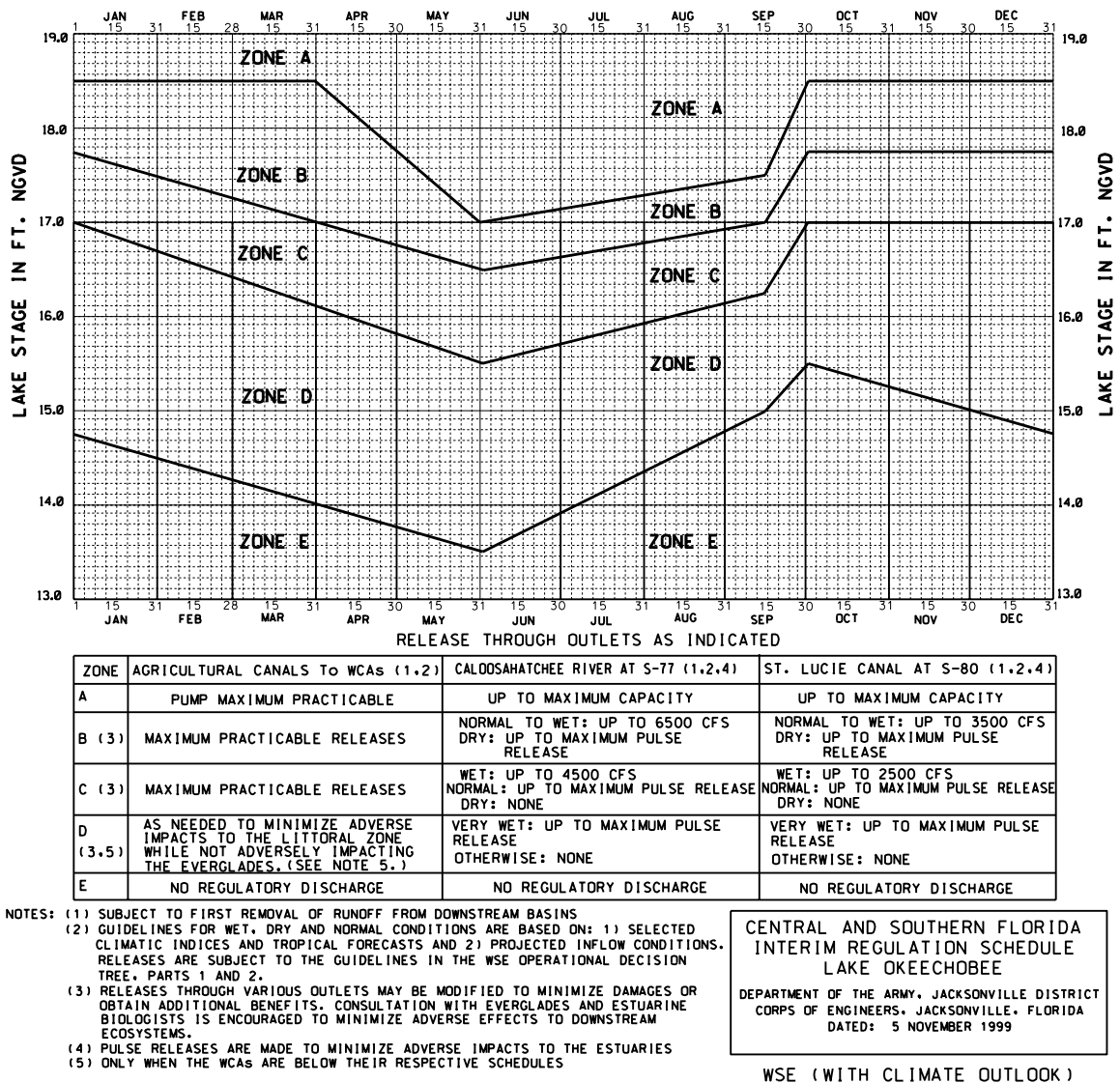


Figure E-5. The WSE Schedule for Lake Okeechobee.

E-18

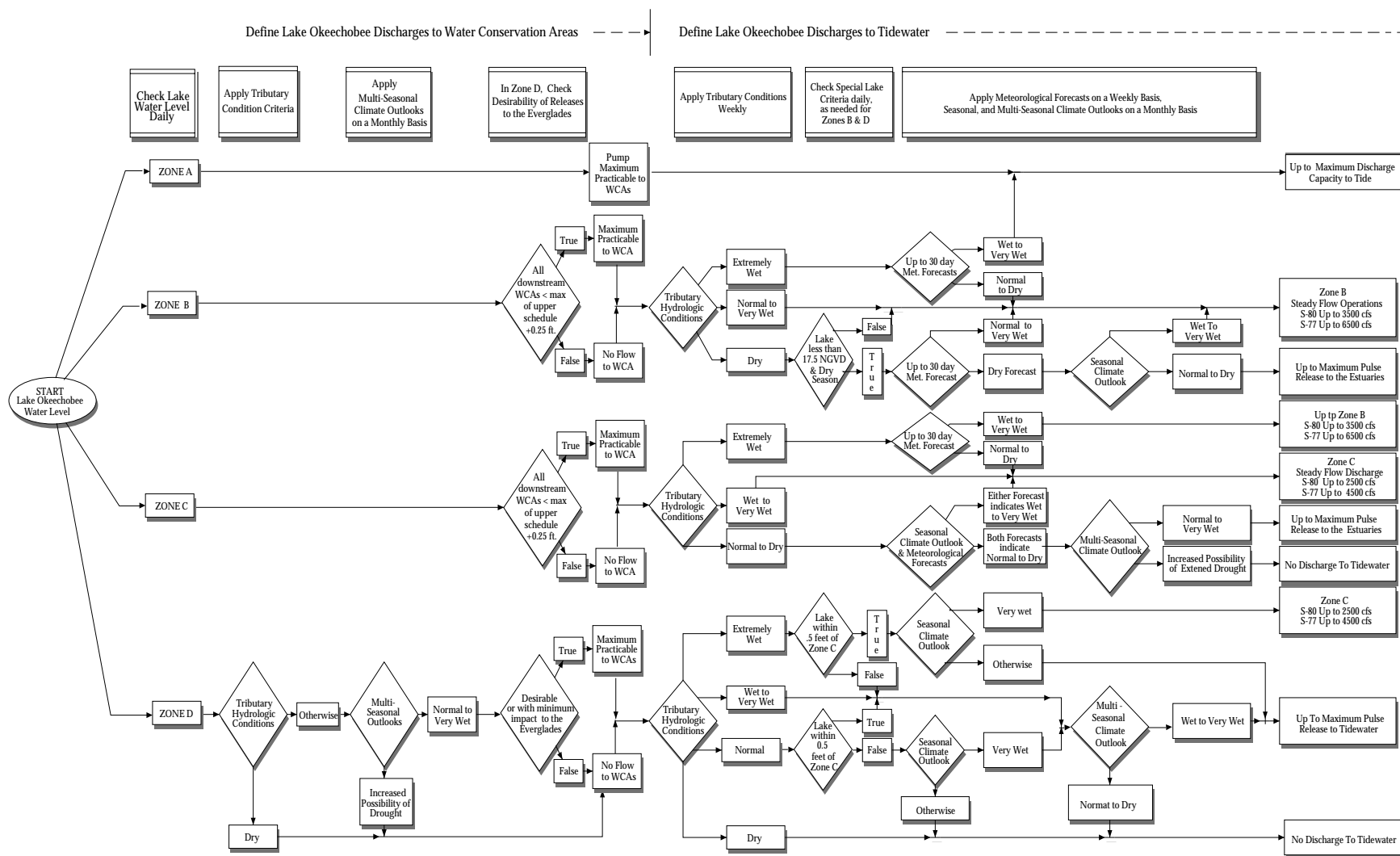


Figure E-6. WSE Operational Decision Tree.

Optimized Aquifer Storage and Recovery Operations

ASR is a water management technology in which water is stored under ground in a suitable aquifer through a well during times when the water is available and recovered from the same well when needed (Pyne et al., 1996). The SFWMM simulates ASRs by performing a simple water budget on the mound of injected water below the surficial aquifer, taking into consideration inefficiencies in injection and withdrawal phases of the operation. ASRs do not lose water via ET which is significant in aboveground reservoirs.

Proposed ASRs in previous modeling showed an accumulation of storage at the end of the simulation period. This untapped source of water was exploited by diverting ASR water in more remote areas. For example, the operation of ASRs in LECSA 1 was modified so that it is now possible to divert this water back into the WCAs in times of excess, making it available to other users of the regional water.

REFERENCES

- Akan, A.O. and B.C. Yen. 1981. Diffusion-Wave Flood Routing in Channel Networks. *Journal of the Hydraulics Division*, American Society of Civil Engineers, Vol. 107, No. HY6, Proc. Paper 16299, June 1981, pp. 719-732.
- Bales, J.D., J.M. Fulford, and E. Swain. 1997. *Review of Selected Features of the Natural System Model, and Suggestions for Applications in South Florida*. U.S. Geological Survey Water-Resources Investigations Report 97-4039, U.S. Geological Survey, Raleigh, NC, 42p.
- Lal, A.M.W. 1998. Performance Comparison of Overland Flow Algorithms. *Journal of Hydraulics Division*, American Society of Civil Engineers, p124(4).
- Loucks, D.P., W.D. Graham, C.D. Heatwole, J.W. Labadie, and R.C. Peralta. 1998. *A review of the Documentation for the South Florida Water Management Model*. Submitted to the Hydrologic Systems Modeling Division, Planning Department, SFWMD, West Palm Beach, FL.
- Monteith, J. L. 1965. Evaporation and Environment. In: *Nineteenth Symposia of the Society of Experimental Biology*. University Press, Cambridge, Volume 19, pp. 205-234.
- Pyne, R.D.G., P.C. Singer, and C.T. Miller. 1996. Aquifer Storage Recovery of Treated Drinking Water. AWWA Research Foundation and American Water Works Association. Denver, CO.
- Santee, E.R. 1999. *Changes in Assumptions SFWMMv3.5 to SFWMM v3.7*. Internal Memorandum submitted to C. Neidrauer and K. Tarboton, Hydrologic Systems Modeling Division, Planning Department, SFWMD, West Palm Beach, FL.
- Saul'yev, V.K. 1964. *Integration of Equations of Parabolic Type by the Methods of Nets*. Pergamon Press, New York, NY.

- SFWMD. 1993. *Draft Working Document Lower East Coast Regional Water Supply Plan*. Planning Department, South Florida Water Management District, West Palm Beach, FL.
- SFWMD. 1999. *A Primer to the South Florida Water Management Model (version 3.5)*. Hydrologic Systems Modeling Division, Planning Department, South Florida Water Management District, West Palm Beach, Florida. [<http://www.sfwmd.gov/org/pld/hsm/models/sfwmm/v3.5/wmmpdf.htm>]
- SFWMD and USACE. 1999. *Final Report: Implementation Strategies Toward the Most Efficient Water Management: The Lake Okeechobee WSE Operational Guidelines*. South Florida Water Management District, West Palm Beach, FL.
- Tracy, F.T. 1983. *Users Guide for a Plane and Axisymmetric Finite Element Program for a Steady-State Seepage Problem*. U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, Mississippi.
- USACE and SFWMD. 1999. *Hydrology and Hydraulics Modeling – Appendix B*. Central and Southern Florida Project Comprehensive Review Study. U.S. Army Corps of Engineers, Jacksonville District, FL, and South Florida Water Management District, West Palm Beach, FL.

Appendix F
SUBREGIONAL GROUND WATER MODELS FOR
THE LOWER EAST COAST REGIONAL WATER
SUPPLY PLAN

OVERVIEW OF SUBREGIONAL MODELING

Introduction and Purpose

The primary goals and objectives of the *Lower East Coast Regional Water Supply Plan* (LEC Plan) include the conceptual design and evaluation of numerous structural improvements to the regional water management system within the Lower East Coast Service Areas (LECSAs), as discussed in **Appendix C**. In support of this objective, five high resolution ground water flow models were developed to allow the various proposed structural improvement plans to be evaluated and compared at the desired level of detail. The boundaries of these models are depicted in **Figure F-1**.

An evaluation of water supply improvements based on hydrologic models is necessarily made relative to both current and future base conditions (i.e., as is with no improvements). Additionally, the ability of hydrologic models to assess the benefits and impacts of the proposed improvements is usually realized through the systematic use of preselected performance measures. Examples of such performance measures would include, but not be limited to, stage duration curves for wetlands and reservoirs, ground water level hydrographs, and ground water flow across selected boundaries. In the evaluation of structural water supply alternatives for the LEC Plan, assessments of the benefits and impacts of proposed improvements were carried out by first constructing performance measure based graphics from the model output of each type of scenario simulation and then comparing the graphics across the simulations.

Each of the subregional models developed in support of the LEC Plan was used to perform this type of comparative analysis of the alternatives that were proposed within the respective model domains. To aid in developing an understanding of the common model features that are required to accomplish this objective, general discussions of typical features that are common to all of the subregional models are provided below. Specific details regarding the development and unique features of each model are provided later within this appendix.

General Features of MODFLOW

Once modeling objectives have been established and a preliminary understanding of the predominant hydrologic processes within each area of interest has been attained, a model code that can meet the model development and application objectives is selected. MODFLOW, a code created by the U.S. Geological Survey (USGS), was selected for this purpose for the following primary reasons:

- It has been widely accepted in the ground water modeling profession for over ten years.
- The code is well documented and within the public domain.
- The code is readily adaptable to a variety of ground water flow systems.

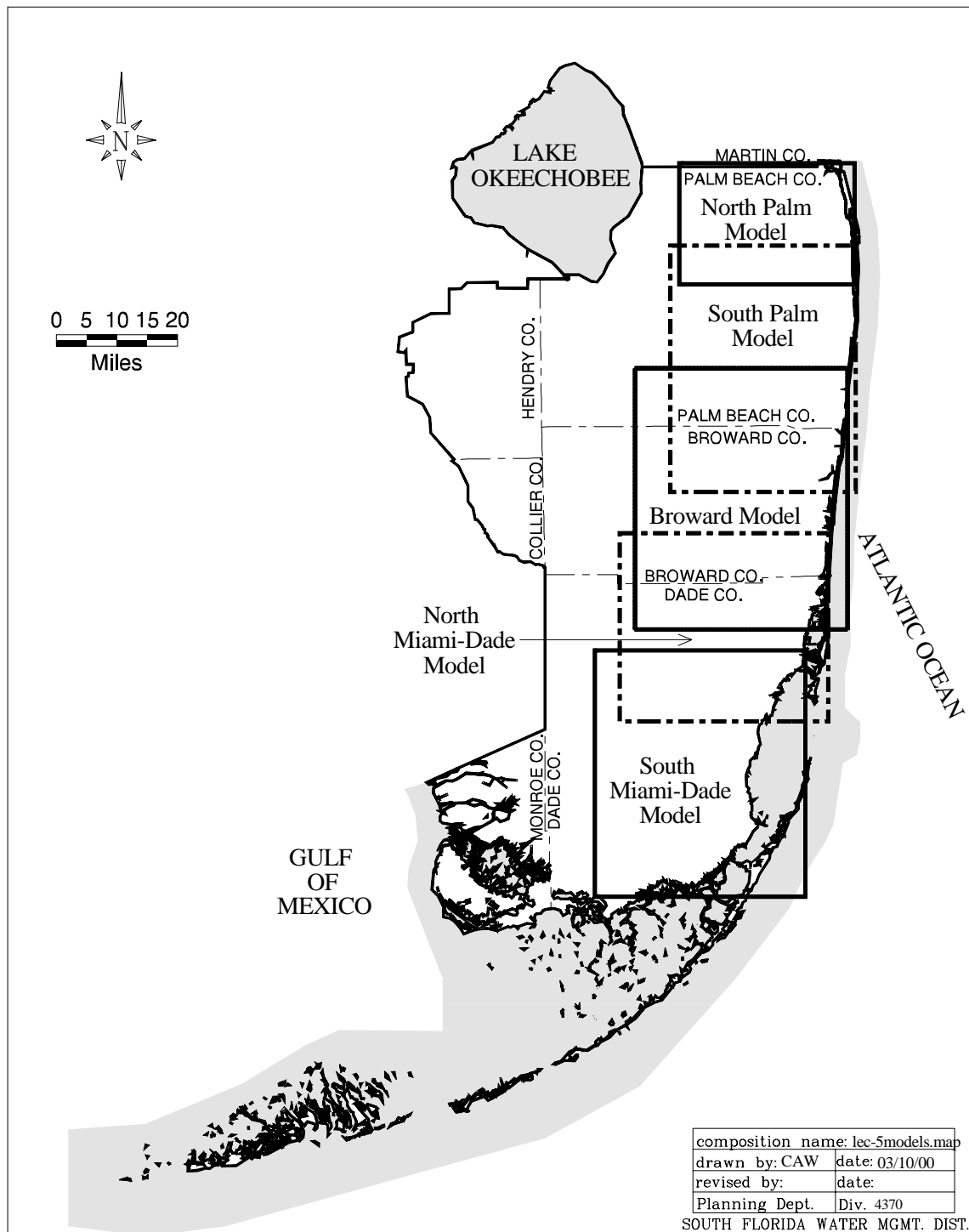


Figure F-1. Boundaries for the Lower East Coast Subregional Ground Water Models.

- The modular structure of the code facilitates any modifications required to enable its application to the types of unique ground water flow problems encountered in South Florida.
- MODFLOW was used to develop existing ground water flow models located within the LECSAs that could be upgraded to meet the current objectives.

MODFLOW simulates ground water flow in aquifer systems using the finite-difference method. The aquifer system is divided into rectangular or quasi-rectangular blocks by a grid (Figure F-2). The grid of blocks is organized by rows, columns, and layers, and each block is commonly called a cell.

For each cell within the aquifer system, the user must specify aquifer properties. Also, the user specifies information relating to wells, canals, and other hydrologic features for the cells corresponding to the locations of the features. For example, if the interaction between a canal and an aquifer system is simulated, then for each cell traversed by the canal, the required input information includes layer, row, and column indices; canal stage; and hydraulic properties of the channel bed. Also, MODFLOW allows the user to specify which cells within the grid of blocks are part of the ground water flow system and which are inactive (i.e., outside of the ground water flow system).

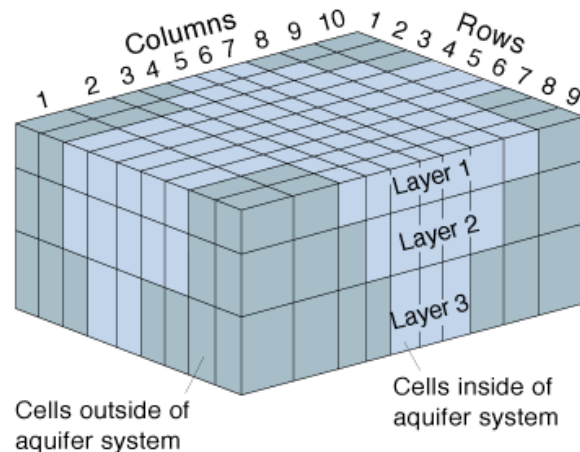


Figure F-2. Example of a Model Grid for Simulating Three-Dimensional Ground Water Flow.

The MODFLOW model code consists of a main program and a series of independent subroutines called modules. The modules, in turn, have been grouped into packages which deal with a particular hydrologic process or solution algorithm. The packages used for LEC simulations, including those developed or enhanced by South Florida Water Management District (District, SFWMD) staff, are shown in **Table F-1**.

General Subregional Model Features

In addition to the application of the MODFLOW code, there are various other features that are common to each of the subregional models. Brief discussions of these features are provided below. In particular, it should be emphasized that certain types of input to these subregional models depend on the characteristics of regional water management systems and therefore need to be derived from the results of the regional model simulations (**Table F-1**). Consequently, a brief description of the relationship between the subregional models and the regional model, the South Florida Water Management Model (SFWMM), is also provided.

Table F-1. MODFLOW Packages Used in the LEC Subregional Models.

Package	Description	Notes
Core		
Basic and Output Control	Defines stress periods, time steps, starting heads, grid specifications, units, and output specifications	Handles the primary administrative tasks associated with a simulation
Block-Centered Flow	Specifies steady state vs. transient flag, cell sizes, anisotropy, layer types, and hydrogeologic data for each layer	Derived primarily from geologic data used to construct the model
Surface Water Stresses and Processes		
Recharge	Simulates aerially distributed recharge to a water table during each stress period	Preprocessed using an Agricultural Field-Scale Irrigation Requirements Simulation (AFSIRS) based ET-Recharge model
Evapotranspiration (ET)	Simulates removal of water from the water table via transpiration and direct evaporation	Preprocessed using an AFSIRS based ET-Recharge model; ET rate diminishes with increasing water table depth
River	Simulates ground water interchanges with canals that can either recharge or drain the aquifer	Canal stages are usually based on measured stages, control elevations, or stages extracted from South Florida Water Management Model (SFWMM) output
Drain	Essentially the same as the River package except that canals can only drain the aquifer and water removed by the drains is removed permanently from the model	Canal stages are usually based on measured stages, control elevations, or stages extracted from SFWMM output
Canal	Essentially the same as the River package except it adds the capabilities to limit the drainage rate to a specific rate and the recharge rates to a different rate, as well as allowing separate control levels for recharge and drainage	When applied in combination with the wetlands package the controlled discharge is the combined total of surface water runoff and ground water seepage. When applied without the Wetlands package, the controlled discharge is the solely ground water seepage.
Redirected Flow	Essentially the same as the Drain package except that it allows water to be redirected to another location in the model instead of being permanently removed from the model.	
Lake	Simulates interaction between mining lakes (quarries) or reservoirs and the ground water system	Computes lake stages and performs an accounting of inflows/outflows; module was enhanced by District staff
Operations	Simulates the surface water transfer of water based on the availability of water	
Wetland	Simulates the overland flow in wetlands using the uppermost model layer	Enhanced to also simulate either specified or system dependant water diversions within wetlands
General Head Boundary	Simulates ground water exchange between selected cells and a specified boundary as a function of water level difference	Boundary stages are usually based on measured stages or stages computed by the SFWMM

Table F-1. MODFLOW Packages Used in the LEC Subregional Models. (Continued)

Water Supply and Management		
Well	Simulates withdrawals from wells	Includes Public Water Supply (PWS), irrigation, and Aquifer Storage and Recovery (ASR) wells; enhanced by the District to read multiple input files
Pumpage Reduction	Simulates wellfield withdrawal cutbacks as a function of water level in trigger wells and in Lake Okeechobee; simulates LEC water shortage policy associated with saltwater intrusion	Cutback zones are based on SFWMM, refined to include more details; SFWMM simulates the timing of Lake Okeechobee cutbacks
Reinjection Drainflow	Simulates the backpumping of seepage into impoundments by returning seepage collected in perimeter canals back to the impoundments	At the present, this module cannot be applied to impoundments that are relatively small or narrow
Solution Algorithms		
Strongly Implicit Procedure (SIP)	A mathematical solution algorithm internal to the model	Usually used
Preconditioned Conjugate Gradient (PCG)	A mathematical solution algorithm internal to the model; more computationally rigorous than SIP	Used only occasionally when model experiences convergence problems

Relationship to the SFWMM

The regional model covers the entire LEC Planning Area with two mile by two mile grids (square mesh) and simulates the systemwide hydrologic implications of a selected alternative. The SFWMM simulates the ground water system within its boundary using a vertically aggregated, single layer to mimic the composite effects of the nonhomogeneous surficial aquifer. Conversely, the subregional models typically use a stratigraphic, three-dimensional approach in which stratification within the surficial aquifer is simulated using multiple layers with intervening, semiconfining units that can transfer water from one layer to another. Furthermore, the ground water models typically consist of 500 feet by 500 feet spatial cells and up to seven layers. Both the regional model and the subregional models, however, have a stress period (i.e., a time increment for hydrologic stresses) and a time step (i.e., a time increment for numerical computation) equal to one day.

As with any hydrologic model, the use of these high resolution ground water models for a particular scenario requires both spatial and temporal information at their boundaries (i.e., at external boundaries and internal boundaries such as canals) along with information at locations of imposed hydrologic stresses (e.g., a pumping well or a structure discharging into a wetland). This information can include, but is not limited to, water levels, discharges at structures, recharge, potential evapotranspiration (ET), and withdrawals from Public Water Supply (PWS) wells. The nature of such information along with its derivation from the results of SFWMM simulations (where applicable) are discussed below.

Outer Boundary Conditions

The General Head Boundary package (**Table F-1**) is applied at all of the cells located along the ground water model boundaries. Water levels are therefore needed to simulate fluxes during all stress periods into and out of the model domain across the northern, eastern, southern, and western faces of boundary cells in all layers. Generally, the eastern face (**Figure F-1**) includes all of the coastal boundary cells and the water levels along this boundary are computed from the nearest tidal station with measured data. A correction is made to the computed head to account for the density difference between the salt water and fresh water. In addition, conductance associated with the general head boundary implementation is progressively reduced with depth (using a quadratic formula) to indirectly force the movement of fresh water towards the upper layers at the freshwater-saltwater interface. This is an approximation for the complex three-dimensional nature of flow dynamics that typically occur near the interface.

The water levels from the remaining faces of the model boundary (northern, western, and southern) are estimated from the SFWMM for all stress periods. For example, the water levels in the ground water model boundary cells located in the Water Conservation Areas (WCAs) are estimated from the corresponding water levels computed in the SFWMM simulation. Again, the same water level is assumed for boundary cells in all vertical layers. In some cases, a primary canal simulated by the SFWMM corresponds to the ground water model boundary. Where this occurs, the canal water levels resulting from the SFWMM run are used to define the heads at this boundary.

Initial Conditions

Similar to the concept of defining heads at a spatial boundary over time is the notion of defining heads at a temporal boundary over space. More specifically, water levels must be specified at each model cell at the beginning of a simulation (i.e., the temporal boundary). Water levels at the beginning of a simulation are derived from the output of the corresponding SFWMM simulation for the initial date (January 1, 1988). The first step in this process involves the use of Geographic Information System (GIS) based techniques to assign water levels corresponding to the SFWMM cells to each of ground water model cells in the respective two mile by two mile cells. Next, the resulting high resolution, initial water level surface is smoothed using the FOCALMEAN function of ARC/INFO. Finally, these initial head values are applied to cells in all layers.

Recharge and Evapotranspiration

For planning based applications of the high resolution ground water models, recharge and ET time series are computed using an ET-recharge model (Restrepo and Giddings, 1994). This is an extension of the Agricultural Field-Scale Irrigation Requirements Simulation (AFSIRS) Program (Smajstrla, 1990). The input rainfall for the AFSIRS model corresponds to the rainfall time series input for each of the SFWMM cells. Moreover, the potential ET rates required by this application are computed using the Penman-Monteith formula for a reference crop of dense grass cover 12 inches in height.

Unlike the rainfall data, the meteorological data necessary for this approach are obtained from selected stations in South Florida.

Canals

Since the River, Drain, and, in certain cases, the ReInjection Drainflow packages are used to represent the canals within a given subregional model domain, canals have been classified (somewhat subjectively) as either rivers or drains, depending on their characteristics. Regardless of the canal classification, however, canal stage time series are required for all canal reaches that are to be included in the model. Because the subregional model simulation periods are a subset of the simulation periods for the SFWMM, it is possible to extract canal stages computed by the SFWMM for a particular scenario for subsequent input to a subregional model. In particular, the canal stages were usually derived from SFWMM simulation results by using hydraulic grade line elevations and slopes computed by the SFWMM at specified locations to estimate hydraulic grade line elevations at all canal reaches included in subregional model simulations. Certain canal reaches, however, were either assigned fixed control elevations or stages that reflect other operational protocol not simulated by the SFWMM (e.g., various canals within Lake Worth Drainage District).

Wetlands

The Wetlands package (Restrepo et al., 1998) was used to simulate overland flow in extensive wetland systems located within the model boundaries. This package enables the user to define a wetland layer as the top layer of the model grid while enabling the MODFLOW code to apply the physical laws of overland flow within this layer. Interactions between the wetland layer and the uppermost aquifer layer can also be accounted for.

In certain cases (such as in the South Palm Beach ground water flow model), there are interior structures (e.g., S-10s) which divert water from one wetland system to another (e.g., from WCA-1 to WCA-2A). In such instances, a diversion option in the wetland module is used to take water out from a group of cells in one area (say WCA-1) and spread it over the receiving wetland (say WCA-2A). Water can also be diverted into the model domain from external sources. For example, discharges into the model domain across water control structures at the model boundary need to be simulated using this type of diversion option.

Quarries

At certain locations within the LECSAs, the presence of large mining quarries can impact ground water flow. To account for this, interactions between quarries and the ground water flow system are simulated using the Lake package (Nair and Wilsnack, 1998). This package is essentially the same as a previous version of the Lake package (Counsel, 1998) but modified by District staff in order to better account for the high degree of interaction that usually exists between ground water and quarries located in the LECSAs. The Lake package conceptualizes lakes or quarries as sources or sinks with

respect to ground water flow and allows stages within them to fluctuate with time. This can enable a MODFLOW model to simulate quarry stages in addition to ground water levels.

Pumpage

The types of ground water withdrawals accounted for in the subregional model simulations include PWS, irrigation, Aquifer Storage and Recovery (ASR), and seepage return. Withdrawals from PWS and irrigation wells in the subregional model simulations were based on current or future permitted allocations. ASR withdrawals and injections were based on local trigger water levels, as well as a daily accounting of available water determined by the SFWMM simulation of the given scenario. Pumpage from seepage return wells was based solely on the design flow rates for the wells and the pumpage was usually returned to the wetland layer at a designated location.

Interactions with GIS

The preceding discussions reveal that in order to apply the MODFLOW code to a specific ground water flow system, the engineer or hydrogeologist is faced with the voluminous task of defining or quantifying all of the required parameters for each active model cell. Such an endeavor requires a systematic and efficient means of managing large amounts of spatial data. In the case of the LEC subregional models, this would naturally suggest that a spatial database containing parameter based thematic maps or coverages is needed for each subregional area of interest. The most suitable means for constructing such a database is GIS.

The GIS software ARC/INFO was used to construct a separate GIS database for each of the subregional model domains. Each database contains numerous thematic coverages that span, at a minimum, the active model domain and contain the data required to construct model input data sets. Examples of such thematic coverages include land use, canals, hydraulic aquifer properties, wellfields, quarries, etc. Conversely, GIS databases were also set up to enable the conversion of certain model output (e.g., ground water levels) to thematic coverages. This greatly facilitated the visualization and review of simulation results.

Period of Record for Subregional Model Simulations

The period of record selected for the required water supply management scenarios was 1987 to 1990. Most of the entire LEC Planning Area experienced drought conditions that were close to 1-in-10 year drought conditions, enabling the scenario simulations to address issues related to a 1-in-10 year drought (required by HB 715). Also, since the drought conditions historically diminished over 1990, the use of the 1988-1990 period of record allowed for an assessment of postdrought recovery.

In addition to a three-year duration, the subregional model simulations were temporally discretized using constant stress period and time step lengths of one day. This relatively short time step interval was used to minimize the types of errors that can result

from using too large of a time step (Lal, in press). Also, performance measures related to wetland hydroperiods or reservoir water levels can be assessed more accurately when daily stress periods and time steps are used.

Model Output

Table F-2 summarizes the different types of output that normally result from a subregional model simulation. It should be noted here that although flow based parameters were computed on a daily basis, most of them were summed over each month before they were written out by the model. This was done primarily to speed up model execution while also conserving disk space.

Table F-2. Various Types of Output Resulting from a Subregional Model Simulation.

Output Parameter	Output Time Increment
Wetland water levels	Daily
Specified wetland diversions	Monthly
System-dependant wetland diversions	Daily
Ground water levels	Daily
Ground water flows	Monthly
Quarry stages	Daily
Seepage return flows	Monthly

SUBREGIONAL MODELS

The LEC regional water supply planning effort used five subregional ground water models. Each model covers a different geographic area within the planning area and is named for the area: North Palm Beach, South Palm Beach, Broward, North Miami-Dade, and South Miami-Dade.

North Palm Beach County Ground Water Flow Model

Introduction

The North Palm Beach County Ground Water Flow Model, is a modified version of the Half Mile Ground Water Flow Model completed in December of 1989 (Shine et al., 1989). The boundary and hydrostratigraphy (transmissivities, permeabilities, and vertical conductance) of the original Half Mile Ground Water Flow Model were not modified significantly. The Half Mile model used six layers. A seventh layer was added in the North Palm Beach County Ground Water Flow Model to facilitate the use of the Wetlands package (Restrepo et al., 1998). The Drain, Evapotranspiration, General Head Boundary,

Recharge, River, and Well input files were updated and the Canal, Lake, Operations, Redirected Flow, and Wetland input files were added. These changes are discussed in more detail below in the Physical Features section.

Figure F-3 depicts the active model domain in relation to the predominant features of this area. A. The model domain currently uses a square quarter-mile grid resulting in 116 columns and 80 rows.

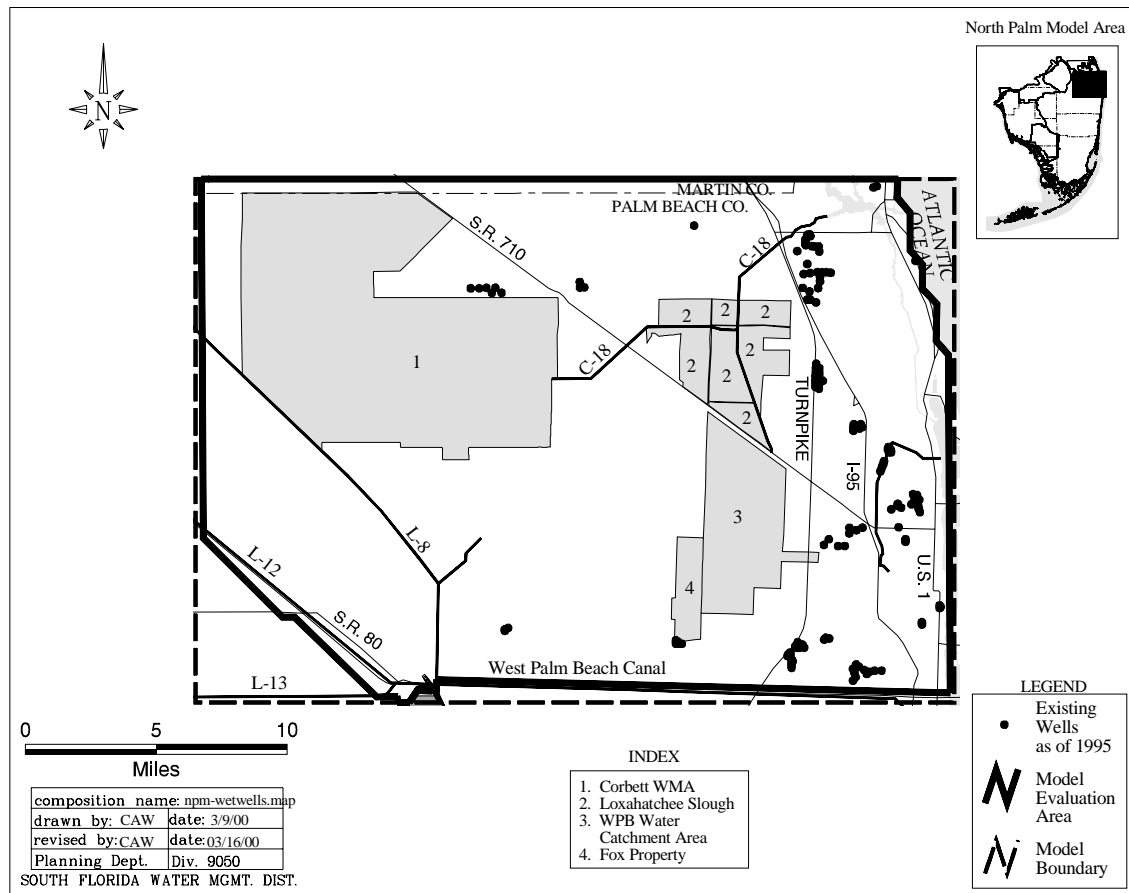


Figure F-3. Model Boundaries and Major Features of the North Palm Beach County Ground Water Flow Model.

Physical Features

Hydrogeology and Model Layers

The North Palm Beach County Ground Water Flow Model was developed to model flow in the Surficial Aquifer System (SAS). As described in Ground Water Resource Assessment of Eastern Palm Beach County, Florida (Shine et al., 1989), the SAS within the model boundary is comprised primarily of saturated rock and sediment from the water table down to the relatively impermeable silts and clays of the underlying Intermediate Confining Unit and the upper portion of the Hawthorn Group. The thickness

of the SAS varies greatly across the modeling area and ranges from a minimum of approximately 100 feet to over 400 feet. The transmissivity of the SAS also varies greatly spatially, ranging from approximately 10,000 square feet per day in the southwest to over 150,000 square feet per day. Transmissivity within the central portion of the model typically ranges from 20,000 to 60,000 square feet per day with localized maximums on the order of 150,000 square feet per day. This area of higher transmissivity is thought to be an extension of the Biscayne aquifer. This area of higher transmissivity extends from State Road 441 in the west to State Road 809 in the east up to the west leg of the C-18 North Canal. Transmissivity in the remaining portion of the model generally ranges from 10,000 to 20,000 square feet per day.

The model was divided into seven layers of variable thickness. The tops and bottoms of the model layers do not correspond directly to particular aquifer zones within the SAS. In general, the SAS was composed of the following zones based on transmissivity. Layers 1 and 2 are composed of an upper layer of unconsolidated sediments (predominately a fine trace to slightly silty sand) ranging in horizontal permeability from 10 to 100 feet per day and thickness from 20 to 80 feet below sea level (from -20 to -50 ft NGVD). In the Half Mile Ground Water Flow Model (Shine et al., 1989), this upper layer of sand was incorporated as a single layer. To facilitate the use of the Wetlands package in this modeling effort, this layer was divided into two layers. Layers 3 and 4 are zones of higher permeability with yield sufficient to support significant withdrawals. The top of this layer (Layer 3) coincides with the bottom of the unconsolidated sediments. The bottom of this production zone (Layer 4) ranges in depth from 100 to 150 feet below sea level (from -90 to -140 ft NGVD). The Biscayne aquifer, if it is present, typically extends from a depth of 50 to 80 feet below sea level (-30 to -60 ft NGVD). Layers 5 through 7 are zones of moderate permeability underlying the production zone ranging in thickness from 20 to 60 feet. The horizontal permeability of this zone typically ranges from 50 to 200 feet per day.

Recharge and Evapotranspiration

The models used to simulate recharge and evapotranspiration are discussed in the General Subregional Model Features section earlier in this appendix. The stations used for the North Palm Beach County Ground Water Flow Model are presented in **Figure F-4**.

Surface Water Management System – Canals and Lakes

Surface water systems interactions with the SAS are included in the model through use of the Drain, Lake, River or Wetland packages. The criteria for selecting the appropriate package to model surface water management systems (e.g., canals, lakes, and reservoirs) are discussed below.

Surface water bodies that solely drain the SAS were assigned to the Drains package. These drains were identified and located using quarter-mile grid. The hydraulic conductivity and thickness of the sediment associated with these drains was adjusted during calibration. In some cases the drain conductance approached the hydraulic

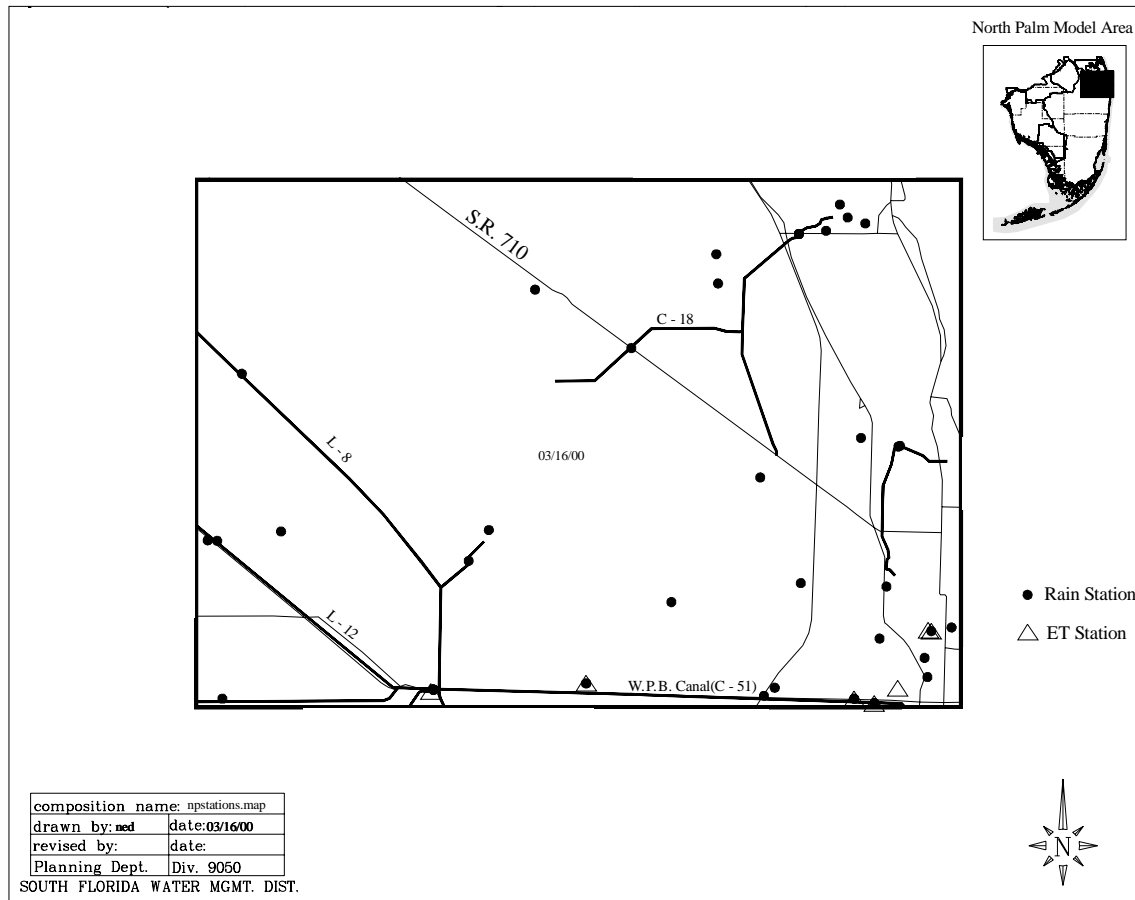


Figure F-4. Rainfall and Evapotranspiration Station Locations used in the North Palm Beach County Ground Water Flow Model.

discharge capacity of the surface water management system indicating that these areas ground water levels were predominately controlled by the discharge capacity of the surface water systems.

The Canal package is currently applied to areas with complex operational rules or discharge limitation. For example, the canal package is used to limit the discharge rate from the developments. Included within the model are all or portions of the following District canals: C-17, C-18, C-18 West, and the West Palm Beach Canal (C-51) (**Figure F-6**). In addition, numerous secondary canals affect ground water levels within the modeling area.

The Lake package was added to facilitate the modeling of a proposed reservoir located approximately one mile north of the C-51 Canal and less than a 0.25 miles west of the L-8 Canal. The proposed reservoir currently covers approximately two square miles and provides 48,000 acre-feet of storage volume. The Lake package was added to improve the models numerical stability and better simulate features of the proposed reservoir (e.g., slurry wall, flat surface water, and the potential to compartmentalize the reservoir and operate these compartments at different levels). The proposed storage range of 30 feet

(from a maximum control level of 24 ft NGVD to a minimum control level of -14 ft NGVD) is substantial and warrants the use of this package.

Surface water bodies which can both drain and provide recharge to the SAS were assigned to the River package. The hydraulic conductivity and thickness of the sediment associated with these drains was adjusted during calibration. Surface water bodies with complex operations were handled by separate or combined application of the Wetland, Canal, and Operations packages. The stages estimated by the SFWMM were used to specify the control levels for the C-18, C-18 West, C-17, and C-51 canals.

The recently developed Operations package was implemented to simulate the surface water transfer of water within the North Palm Beach County Ground Water Flow Model. For example, the Operations package allows the user to set criteria that transfers water from the proposed L-8 Basin Reservoir to the West Palm Beach Water Catchment Area and subsequently to the Loxahatchee River based on the availability of water in the L-8 Reservoir (stage) and the need in the West Palm Beach Water Catchment Area (stage) or discharge to the Northwest Fork of the Loxahatchee River.

Wetlands

The major wetland systems within the active model area are the J.W. Corbett Wildlife Management Area, the Dupuis Reserve, Loxahatchee Slough, the West Palm Beach Water Catchment Area, and the Fox Property. Surface water elevations within these wetlands are influenced by ground water levels, inflows, outflows, rainfall, ET, and topography.

The Wetlands package (Restrepo et al., 1998) was used to simulate overland flow along with interactions between the surface water and ground water within areas where either overland flow, surface storage, or both are important. For example, the overland flow is very important in the J. W. Corbett Wildlife Management Area, because wet season rainfall typically exceed the ground water drainage rates resulting in surface water accumulation and runoff. The direction and rate of the overland flow resulting from this runoff is determined by the Wetland package based on the topography, surface water elevation, and Kadlec equation for wetland flow. Both ponded surface water and shallow geology within the wetland layer (Restrepo and Montoya, 1997) was used to minimize the number of model layers, and to avoid the periodic drying of cells.

The Redirected Flow package is used to remove water from the J. W. Corbett Wildlife Management Area. This package is almost identical to the Drains package except that it allows water to be redirected to another location in the model instead of being permanently removed from the model.

Water Use

Most of the ground water withdrawals in northern Palm Beach County are for PWS purposes and occur at the wellfield locations shown in **Figure F-4**. Pumpage for golf course irrigation and local domestic supplies also occurs at various locations. During the

calibration period and the 1995 Base Case, approximately 14.2 million gallons per day (mgd) of irrigation demands were supplied from the SAS. Due to land use changes and the availability of reuse water, this daily demand was reduced to 9.0 mgd for 2020 demands. The primary source of PWS in this region is the SAS however, the Village of Jupiter does obtain a significant portion of its PWS from reverse osmosis of Floridan aquifer water. **Table F-3** provide a list of the yearly withdrawals from the SAS during the calibration period. These values were estimated from monthly raw water demand figures recorded in the SFWMD regulatory database. **Table F-4** lists SAS withdrawals for the 1995 and 2020.

Table F-3. North Palm Beach County Public Water Supply Withdrawals for the Calibration Period

Utility	Permit Number	Withdrawals (MGD)								
		1987	1988	1989	1990	1991	1992	1993	1994	1995
Town of Jupiter	50-00010-W	8.0	8.7	9.4	9.4	8.7	8.6	9.2	9.4	9.5
Mangonia Park	50-00030-W	0.6	0.6	0.6	0.6	0.5	0.4	0.4	0.4	0.3
Tequesta	50-00046-W	1.3	1.6	1.6	1.0	1.1	1.5	1.2	1.4	1.4
PBC 1W	50-00135-W	0.2	0.3	0.5	0.5	0.7	0.2	0.1	0.1	0.1
PBC 2W	50-00135-W	3.7	4.9	5.0	5.1	4.5	5.6	6.8	6.7	7.4
PBC 8W	50-00135-W	6.6	6.4	8.4	8.5	10.1	9.9	10.6	11.1	11.2
PBC/Century Utility	50-00178-W	0.9	0.9	0.9	0.8	0.8	1.2	0.6	0.4	0.4
Seacoast	50-00365-W	12.6	12.0	15.6	14.3	13.8	13.6	14.8	14.1	14.5
Royal Palm Beach	50-00444-W	1.8	1.8	2.0	1.8	1.8	1.6	1.9	2.0	2.2
Riviera Beach	50-00460-W	8.2	8.3	8.1	7.5	8.4	9.0	9.0	9.0	9.0
United Technologies	50-00501-W	1.0	1.0	1.0	0.7	0.7	0.6	0.6	0.6	0.6
Lion Country	50-00605-W	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1
City of West Palm Beach	50-00615-W	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Good Samaritan Hospital	50-00653-W	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3
		45.1	46.9	53.4	50.5	51.4	52.6	55.5	55.4	56.9

Features of the Outer Boundary

As shown in **Figures F-1** and **F-3**, the outer model boundary consists of the following:

- The Atlantic Ocean and Lake Worth Lagoon (east)
- The C-51 Canal (south)
- The L-10 and L-12 Canals (southwest)
- The Dupuis Area (west)
- The Palm Beach County line (north)

Table F-4. North Palm Beach County Public Water Supply Withdrawals.

Utility	Permit Number	Withdrawals (MGD)	
		1995	2020
Town of Jupiter	50-00010-W	9.5	13.2
Mangonia Park	50-00030-W	0.3	0.3
Tequesta	50-00046-W	1.4	1.8
PBC 2W	50-00135-W	6.5	10.0
PBC 8W	50-00135-W	12.1	18.6
PBC 2W & 8W	50-00135-W	18.7	28.6
Seacoast	50-00365-W	14.5	28.4
Royal Palm Beach	50-00444-W	2.2	0.0
Riviera Beach	50-00460-W	9.0	11.7
United Technologies	50-00501-W	0.6	1.1
Lion Country	50-00605-W	0.1	0.1
City of West Palm Beach	50-00615-W	25.2	42.0
Good Samaritan Hospital	50-00653-W	0.4	0.4
		100.4	156.2

Each of these boundaries was incorporated into the model using the General Head Boundary package. Equivalent freshwater heads were used along the coastal/Lake Worth Lagoon boundary. Along the northern and western boundaries, stages were based on water levels estimated by the SFWMM. The eastern boundary data sets were modified to use tidal data from the tailwater readings of the S-155 Structure with adjustment to correct for the affect of discharges from the S-155 Structure. In addition, equivalent freshwater heads were developed and applied for the eastern boundary. No general head boundary cells were used along the southern boundary because the C-51 Canal stages control the ground water levels in this area and because the use of general head boundary cells could introduce an artificial source of water during the alternative analysis.

Model Calibration

The periods of record selected for history matching was 1987-1995, which includes both a relatively dry hydrologic period (1989-1990) and a relatively wet hydrologic period (1993-1995). The model was calibrated under transient conditions. For this calibration period, the objectives was to adjust the input factors within reasonable ranges to achieve agreement with the observed data 90 percent of the time. Of the 19 calibration sites, 16 met the criteria of being within one foot of the observed value for more than 75 percent of the time. While this agreement between the observed data and input factors is only 84 percent, no well is below the observed value more than 50 percent of the time. The three wells that did not achieve the desired level of agreement are as follows:

- **SM-009 Donald Ross Road and I-95.** The water levels in this area are greatly influence by the undocumented withdrawal rates of Mecca Farms during the calibration period. Sensitivity analysis indicated that variations in the pumping rate could, by itself, explain the discrepancy in water levels.
- **PB-0685 - C-51 West.** The lack of calibration is thought to be a result of a combination of needing to modify (reduce) the transmissivity in this area combined with the complexity of the Fox Trail Drainage System.
- **PB-0561 - Royal Palm.** In general, this well has good calibration, however its score of 70 percent is below the target value of 75 percent.

It is important to note that the statistics for each gage are based on the measured water level data available at that site within the calibration period of record. At some gages, data only exist over a fraction of the total period of record and result in statistics that may not be indicative of model accuracy over the entire period of record. Furthermore, the measured ground water levels are the daily maximum values (the only ground water levels published by the USGS) at each site and may not always be close to observed end-of-day ground water levels. In contrast, the model computes water levels at the end of each daily time step.

Recommendations and Conclusions

Model Capabilities and Limitations for Applications

The preceding discussions suggest that the model, in its current state, is adequate for comparative type analyses where water level based performance measures for various water supply alternatives are compared in order to select the most appropriate alternative(s). The locations of such performance measures should be within the evaluation area discussed previously. Furthermore, it is suggested that only water levels be used to formulate performance measures since all of the history matching work completed so far has been limited to water levels. Ground water flows and canal base flows computed by the model should be used with caution. In either case, it is recommended that the effect of uncertainties in model input on model based alternative comparisons be assessed prior to making any final decisions regarding alternative selections.

Future Improvements

Certain improvements to the model are recommended in order to enhance the model's ability to support future applications. Such enhancements should include, but not necessarily be limited to, the following:

- Additional runs should be performed to improve the calibration of the southwestern portion of the model (PB-0685). These additional runs should include exploring how calibration is affected by reducing the transmissivity in the southwestern portion of the model. Specifically,

evaluation of the dewatering rates at the Palm Beach Aggregate Quarry (located immediately west of the L-8 Canal and approximately one mile north of the C-51 Canal) indicate a SAS transmissivity on the order of 2,000 square feet per day. The model currently has a transmissivity of approximately 10,000 square feet per day in this area. A cursory site visit to identify key features of the Fox Trail Drainage System is also recommend.

- Additional runs should be performed to improve the model's performance as follows: 1) the water levels in the West Palm Beach Water Catchment Area are too high during wet periods and the operational rules need to be modified to lower these levels, 2) the location and operational rules for ASR associated with the West Palm Beach Water Catchment Area should be optimized, 3) the operational rules for the ASR associated with the C-51 Canal need to be changed substantially as they continue to pump during dry period, 4) optimize the criteria and distribution of recharge water for the Village of Jupiter, and 5) optimize the criteria and distribution of recharge water for Seacoast Utilities to protect the wetland preserve in the proposed Golf Digest Project.
- Minor modifications should be made to existing postprocessing programs to facility the rapid review of performance measures and facilitate a more direct comparison of water budgets with the SFWMM results. These changes would facilitate the review of identified performance measures without extensive postprocessing for Internet posting. These modification would include developing process to allow the comparison of canal base flow and water budgets.

South Palm Beach County Ground Water Flow Model

Introduction

The South Palm Beach County ground water flow model is the third in a series of models developed for the SAS within Palm Beach County. The first models were developed by Shine, et. al. (1989) and used to assess the ground water resources of eastern Palm Beach County. In particular, this effort involved the development and application of two models: one for the northern portion of the county (north of the C-51 Canal) and the other for the southern portion (south of the C-51 Canal). A second version of the model was developed by Yan, et al. (1993) in which the two models for the northern and southern portions of the county were combined into one model. The current version of the model includes significant refinements in both spatial and temporal resolution while incorporating major wetland systems (e.g., WCA-1 and WCA-2A) along with a detailed representation of the Lake Worth Drainage District canal system. The model has been developed specifically to support the Central and Southern Florida Flood Control Project Comprehensive Review Study (Restudy), the subsequent Comprehensive Everglades Restoration Plan (CERP), and the LEC regional water supply planning process.

Model Domain

The model encompasses the portions of Palm Beach County and northern Broward County shown in **Figure F-5**. The northern boundary of the model is located along the M Canal, Clear Lake, and Lake Mangonia. The western boundaries of the active model area include the L-8 Canal, the L-7 Levee and Borrow Canal (WCA-1), the L-6 Levee and Borrow Canal (WCA-2A) and the L-38E Levee and Borrow Canal (WCA-2A). The southern boundary of the model traverses the L-35B Levee and Borrow Canal along with the C-14 Canal in Broward County. The eastern boundary of the model is located along the intercoastal waterway. A subset of the active model domain was defined where the model results of planning based applications could be used for decisionmaking purposes. This evaluation area of the model is shown in **Figure F-5**.

Horizontal and Vertical Discretization

The South Palm Beach model domain was discretized spatially into 430 rows and 324 columns using 500-foot square cells. The model is discretized vertically into five layers of varying thickness, with the wetland layer as the uppermost layer and the bottommost layer terminating at an elevation of –300 ft NGVD.

Physical Features

Hydrogeology

The SAS is an unconfined aquifer system recharged by rain, and by leakage from canals and other surface water bodies. Data from existing well logs were used to determine the aquifer extent and construct a conceptual hydrostratigraphic model. The top wetland layer is restricted to the extensive wetland systems within the model domain and includes WCA-1, WCA-2A, the Strazzulla Tract, and the Loxahatchee Mitigation Bank areas. It consists of ponded surface water, as well as the peat, sand, and caprock layers underlying the wetlands. The bottom elevation of the wetland layer varies from –10 to 5 ft NGVD. Layer two represents the sand and shell layers overlying the Biscayne aquifer, where the bottom elevation varies from –25 to –100 ft NGVD. Layers three and four represent the Biscayne aquifer, the most productive interval within the SAS. The Biscayne aquifer in southern Palm Beach County is also referred as the Zone of Secondary Porosity (Swayze and Miller, 1984) and is characterized by highly solutioned limestones with large hydraulic conductivities. The bottom elevation of the Biscayne aquifer within the model domain varies from –90 to –210 ft NGVD. The relatively large thickness of the Biscayne aquifer and the fact that most of the production wells are present in this zone made it desirable to subdivide this zone into two layers. The model layer below the Biscayne aquifer is comprised of the relatively less permeable sequences of clays, silts, and limestones of the Hawthorn group. It is also considered to be within the intermediate confining unit that lies between the SAS and the Floridan aquifer. The bottom of this layer was set at a constant elevation of –300 ft NGVD since there were not enough data to clearly demarcate the transition from the SAS to the intermediate confining unit.

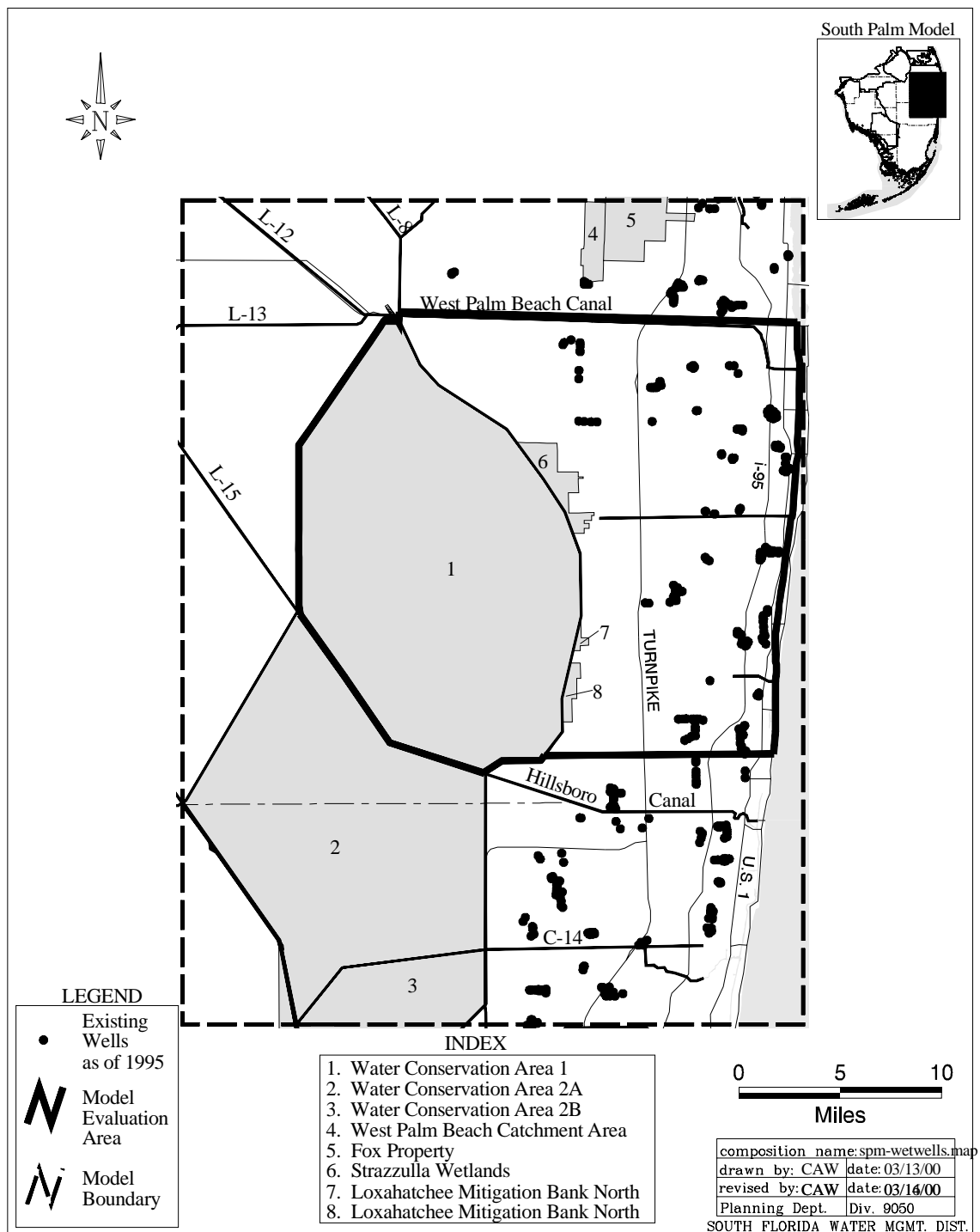


Figure F-5. Model Boundaries and Major Features of the South Palm Beach County Ground Water Flow Model.

The hydraulic properties of the SAS were estimated in part through Aquifer Performance Tests (APTs) performed by the USGS, SFWMD, U.S. Army Corps of Engineers (USACE), and independent consultants. In addition, specific capacity tests, lithologic correlations and geophysical logs were used, where applicable, to estimate the hydraulic properties.

Recharge and Evapotranspiration

The models used to simulate recharge and evapotranspiration are discussed in the General Subregional Model Features section earlier in this appendix. The stations used for the South Palm Beach County Ground Water Flow Model are presented in **Figure F-6**.

Surface Water Management

Within the model domain is an extensive network of surface water management systems that have a significant effect on the ground water (**Figure F-5**). The District canals incorporated into the model include the C-51, C-15, C-16, Hillsboro, and the C-14. In addition, the model incorporates the numerous surface water management systems operated by independent drainage and water control districts. These include the Lake Worth Drainage District, the Acme Improvement District, the Loxahatchee Groves Water Control District, the Indian Trail Improvement District, and the West Palm Beach Water Catchment Area south of the M Canal in Palm Beach County. The water control districts within Broward County include the North Springs Improvement District, the Pine Tree Water Control District, the Cocomar Water Control District, Water Control District 2, Sunshine Drainage District, Coral Springs Improvement District, Turtle Run Drainage and Improvement District, Coral Bay Control and Drainage District, and Water Control District 3. Data regarding the operations of the independent drainage districts were compiled from a variety of sources including the system operators, SFWMD permit files, aerial photographs, field inspections, and real estate (REDI) maps.

The interaction of the canal network with the aquifer was modeled using the River and Drain packages. The canals were classified as rivers or drains depending on whether they were maintained or only used to drain the aquifer. For both cases, model input included canal stages and values for a conductance term defining the degree of interaction between the canal and the aquifer. Measured water levels at stage monitoring stations were used to define the hydraulic grade line elevations.

Wetlands

The largest wetlands in the model domain are WCA-1 and WCA-2A. Also included in the model as wetlands are the Strazzulla Tract and the Loxahatchee Mitigation Bank areas that form a buffer between WCA-1 (Loxahatchee National Wildlife Refuge) and the developed areas to the east. WCA-1 has an area of 227 square miles. The vegetation in WCA-1 consists predominantly of wet prairies, sawgrass prairies, and aquatic slough communities along with tree islands which are interspersed throughout the area. WCA-2A has an area of 173 square miles with vegetation cover types consisting of open water sloughs, large expanses of sawgrass intermixed with cattail, and drowned tree

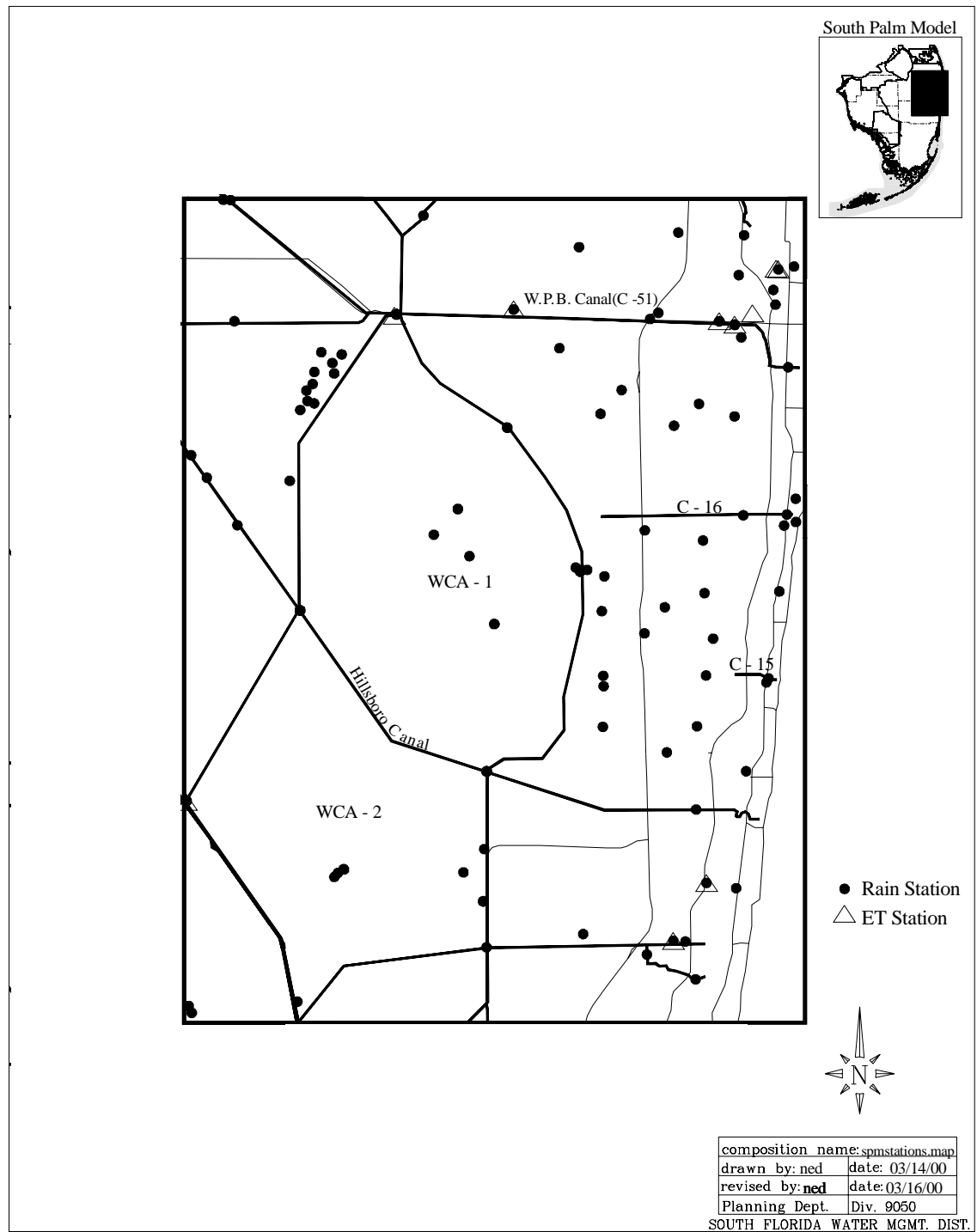


Figure F-6. Rainfall and Evapotranspiration Station Locations used in the South Palm Beach County Ground Water Flow Model.

islands dominated by willow. The Strazzulla Tract contain the only remaining cypress habitat in the eastern Everglades and one of the few remaining sawgrass marshes adjacent to the coastal ridge. The Loxahatchee Mitigation Bank wetlands are located south of the Strazzulla Tract. The spatially varying vegetative cover was accounted for in the Wetland package by the use of vegetative resistance coefficients.

The Wetland package (Restrepo et al., 1998) was the customized MODFLOW package used to simulate overland flow within the wetland areas of the model. The wetland model conceptualizes these areas as isolated wetlands with user specified inflows or outflows. The West Palm Beach Water Catchment Area located south of the M Canal was not modeled as a wetland since it is not only located outside the evaluation area for this model, but it is also adjacent to the model boundary.

Both WCA-1 and WCA-2A were modeled using the diversion option of the Wetland package. For purposes of computational stability the net inflow (difference between the inflows and outflows through the structures of each WCA) was applied uniformly over all the cells of each WCA for each time step. The Strazzulla Tract and Loxahatchee Mitigation Bank areas were modeled as wetlands having no structural inflows or outflows.

Water Use

The locations and attributes of PWS wells were obtained from the District's Water Use and Permits Division and modified to reflect current information. Monthly public water use was extracted from utility reports submitted to the District as a part of the permit limiting conditions. Also included in the reports were the well depths and the casing intervals. Based on this information, along with the percentage allocation among the different wells within each permit, average daily pumpages were assigned to each well in the model data sets. The pumpage was distributed between the model layers based on the layer transmissivities as outlined by McDonald and Harbaugh (1988).

Model Calibration

History matching was performed for two periods of record: a relatively dry period from June 1, 1988, through June 30, 1989, and a relatively wet period from June 1, 1994, through June 30, 1995. Both the history matching periods were preceded by a two-month warm up period in order to help minimize the effects of initial conditions on computed water levels.

The South Palm Beach Ground Water Model was calibrated under both steady state and transient conditions. The transient calibrations completed so far were restricted to history matching of heads and the model was considered to be calibrated at a given well location if the absolute value of the difference between the observed and the computed water levels was less than 1.0 feet for at least 75 percent of that portion of the calibration period of record where data was available. Since most applications of the model involved transient runs, the transient calibration results are reported here.

A total of 37 USGS and SFWMD water level gages were used in the wet calibration period while a total of 24 gages were available for the dry calibration period. The wet period has more observation wells available since some of the District gages in WCA-2 became operational only in late 1994. The locations of all wells and staff gages used for the calibration of the model are given in **Figure F-5**. Although the USGS observation wells have recorders that record the hourly water levels for each day, only the daily maximums are processed and stored in the USGS Automated Data Processing Systems (ADAPS) database. Hence, these ground water levels (as opposed to end-of-day water levels) were the only ground water level data available for history matching.

The transient calibration results are shown in **Table F-5** for the wet period of record and in **Table F-6** for the dry period of record. The tables show the percentage of time that the calibration criterion cited above was met. Also shown in the table are the mean error, or bias, and the standard deviation of the residuals.

A comparison of the two calibration periods of record show that, in general, the model performs better during the wet season than in the dry season. This is especially true in the wetland areas. The results also show that while all of the gages in the WCAs met the calibration criteria for the wet period of record, only two of the five gages met the criterion during the dry period of record when the water levels were below open land surface. Apparently, simulations of wetland stages are fairly accurate when the water levels are above land surface and there is overland flow. It is possible that when no overland flow exists the uncertainties inherent to characterization of the shallow wetland geology result in an under prediction of heads in the wetland layer.

Shortcomings in both the model itself and the water level data prevented calibration targets from being met within certain areas. For example, in the urban areas, it is apparent that the model does not meet the calibration criteria in southeastern Broward County. This is at least partially due to the fact that the operational criteria of the secondary canals within this area cannot be adequately represented by the River and Drain packages. Also, the proximity of observation wells to local stresses sometimes precludes the use of their data for history matching with a finite-difference model. For example, the model was consistently overpredicting water levels at the well PB-1491, which is within the city of Boca Raton's wellfield. In addition, several of the observation wells had suspected errors in their measuring point elevations. Some of these were corrected or verified while others could not be addressed since the observational wells are no longer in service. Also, limitations in boundary conditions can affect model results at sites located near the boundaries.

Perhaps one of the most significant obstacles to achieving calibration goals was posed by the somewhat inappropriate nature of much of the available water level data. As mentioned earlier, the historical ground water levels currently available from the USGS database are daily maximum values. In contrast, the model computes the heads for the end of each day. Significant differences can exist between daily maximum and end-of-day ground water levels. Also, most of the canal stage data available for the Lake Worth Drainage District, a large portion of the model domain, are only spot measurements and not the mean daily stages that should be used for model input.

Table F-5. South Palm Beach County Calibration Statistics for the Wet Period (June 1, 1994, through June 30, 1995).

Gage Name	Percent Within One Foot	Mean Error (feet)	Standard Deviation Error (feet)	Within Evaluation Area	Comments
PB-809	92.9	-0.329	0.462	N	
PB-99	99.7	-0.085	0.508	N	
PB-1639	53.7	-1.181	0.819	Y	
PB-1491	2.8	2.918	1.009	Y	Boca Raton Wellfield
PB-732	96.5	-0.425	0.324	Y	
PB-1684	94.7	-0.338	0.269	Y	
PB-1661	92.2	-0.343	0.420	Y	
PB-900	79.6	0.571	0.542	Y	
PB-561	73.8	-0.796	0.642	N	
PB-683	79.8	-0.595	0.490	Y	
PB-1680	89.2	0.551	0.365	Y	
PB-685	83.8	-0.034	0.690	N	
PB-445	97.0	-0.148	0.506	Y	
G-1260	43.0	-0.965	1.209	N	Southeast Broward County
G-2739	85.8	0.457	0.567	N	
G-1213	85.9	-0.302	0.783	N	
G-1315	61.5	-0.318	1.049	N	Southeast Broward County
G-1215	27.3	-1.197	2.100	N	Southeast Broward County
G-2031	98.1	-0.092	0.314	N	
G-2147	25.7	-1.717	1.106	N	Southeast Broward County
G-1316	98.9	0.306	0.357	N	
G-853	55.0	-0.756	1.330	N	Southeast Broward County
G-616	94.1	0.019	0.623	N	
1-9 ^a	100.0	0.083	0.301	N	
1-8T ^a	100.0	0.098	0.314	N	
1-7 ^a	100.0	0.199	0.238	N	
2-17 ^a	100.0	0.072	0.189	N	
2-19 ^a	76.6	-0.723	0.848	N	Southeast boundary of WCA-2
2A-300_B ^a	100.0	-0.234	0.227	N	
2A-17_B ^a	100.0	0.065	0.194	N	
2-15 ^a	100.0	0.118	0.334	N	
WCA2RT ^a	100.0	-0.105	0.169	N	
WCA2F4 ^a	100.0	0.064	0.197	N	
WCA2E4 ^a	100.0	-0.066	0.219	N	
WCA2E1 ^a	95.6	-0.123	0.408	N	
WCA2F1 ^a	95.6	-0.206	0.385	N	
WCA2U1 ^a	100.0	0.120	0.195	N	

a. USGS and SFWMD Gages in the WCAs

Table F-6. South Palm Beach County Calibration Statistics for the Dry Period (June 1, 1988, through June 30, 1989).

Gage Name	Percent Within One Foot	Mean Error (feet)	Standard Deviation Error (feet)	Within Evaluation Area	Comments
PB-561	69.4	0.062	1.051	N	
PB-809	93.4	-0.453	0.366	N	
PB-99	92.9	-0.620	0.296	N	
PB-683	82.3	-0.500	0.591	Y	
PB-445	97.5	-0.403	0.332	Y	
PB-900	72.7	0.794	0.767	Y	
PB-1491	0.0	7.348	1.502	Y	Boca Raton Wellfield
PB-732	98.0	-0.044	0.433	Y	
PB-88	89.4	0.149	0.675	Y	
PB-1495	15.7	1.322	0.351	Y	May have survey problems
G-1260	76.2	0.374	0.700	N	
G-1213	50.9	0.405	1.061	N	Southeast Broward County
G-1315	46.3	-0.906	1.029	N	Southeast Broward County
G-1215	51.4	0.425	1.126	N	Southeast Broward County
G-2031	95.7	0.444	0.482	N	
G-2147	74.7	-0.508	0.675	N	
G-1316	98.0	-0.362	0.299	N	
G-853	19.8	1.942	0.950	N	Southeast Broward County
G-616	46.0	-1.512	1.061	N	Southeast Broward County
1-9 ^a	95.7	-0.616	0.298	N	
1-8C ^a	71.1	0.574	1.035	N	
1-7 ^a	65.3	0.364	0.849	N	
2A-300_B ^a	6.1	-1.885	0.462	N	South boundary of WCA-2
2A-17_B ^a	87.1	-0.047	0.698	N	

a. Gage is in the WCAs where water levels were below land surface part of the time.

Conclusions and Recommendations

Model Capabilities and Limitations

The ground water model developed simulates the hydrogeology of the SAS within southern Palm Beach County, as well as the overland flow in the wetland systems. However, the current version of the model has been calibrated only with respect to water levels. The model has not been calibrated for base flows due to resource limitations. This limitation of the model should be kept in mind while evaluating canal base flow or ground water flow across selected boundaries. Consequently, stage duration curves for wetlands

and water level hydrographs used for comparative type analysis are the primary type of hydrologic performance measures that the model is capable of supporting.

In addition to the caveats mentioned above, it should be emphasized that the eastern boundary of the model is based on a simplistic representation of the saltwater-freshwater interface within the SAS. The characteristics, position, and movement of this interface are all based on complex factors and principles (e.g., density-driven flow) that cannot be readily incorporated into a ground water flow model that only accounts for freshwater flow. Consequently, the model cannot directly support any performance measures that relate to, or are contingent upon, the shape, position, or movement of the saltwater wedge that, in reality, constitutes the eastern boundary of the ground water flow system.

Future Improvements

The model shall be improved in the future to address the following:

- Sensitivity and uncertainty analysis of all model parameters to improve the overall model calibration
- Acquire the necessary data and resources to calibrate the model for base flows
- Sensitivity analysis of the wetland model parameters to understand the dynamics of the wetland aquifer interactions when the water level goes below the land surface
- Addition of new packages which will incorporate the recharge/ET computations into the simulation model and avoid the use of preprocessed values
- Resolve the discrepancies with the USGS associated with monitored daily maximum values and the model computed end-of-day values
- Formulate cooperative agreements with the secondary water control districts to improve the data collection efforts for stage monitoring
- An improved representation of the saltwater-freshwater interface located along the coastal boundary

Broward County Ground Water Flow Model

Introduction

The District, in cooperation with the Hydrological Modeling Center at Florida Atlantic University, developed a ground water flow model of the SAS to simulate ground water conditions in central and eastern Broward County, as well as portions of northeastern Miami-Dade County and southeastern Palm Beach County. The model was completed in November, 1999. The new model was constructed and based, in part, on the initial Broward County Ground Water Flow Model developed by Restrepo et al. (1992).

Figure F-7 depicts the active model domain in relation to the predominant features of this area. The model domain was discretized horizontally using a finite-difference grid consisting of 456 rows, 371 columns, and 500-foot square cells. It was calibrated to observed water levels from the period from January 1988 to December 1995.

Physical Features

Hydrogeology and Model Layers

Only the SAS was included in the Broward County Ground Water Flow Model. The SAS within Broward County essentially consists of (in order of increasing depth) Holocene and recent sediments/soils; the Miami Limestone (formerly referred to as the Miami Oolite); the Fort Thompson formation and/or the Anastasia Formation; the upper unit of the Tamiami formation; the Gray Limestone aquifer; and the lower clastic sediments of the Tamiami formation. Deviations from this general sequence of units, however, can occur in the extreme eastern and western portions of the model domain. For further details, see Perkins (1977), Fish and Stewart (1991) and Causarus (1985).

The vertical discretization of the Broward model corresponds to the hydrostratigraphy described above. The model has five model layers. The top layer, corresponding to the youngest Pleistocene marine unit deposited in the region (referred to as Q5), generally extends from land surface to an elevation of -5 to -20 ft NGVD. Layer two consists of the next two marine Pleistocene deposits (referred to as Q4 and Q3) (Perkins, 1977). Layer three encompass the main production zone of the Biscayne aquifer, and correspond to the middle and late Pleistocene deposits of the Fort Thompson and Anastasia formations. Layer four encompasses the upper unit of the Tamiami formation. Layer five encompasses the Gray Limestone aquifer in the west, and the coastal equivalent of the lower Tamiami aquifer.

Recharge and Evapotranspiration

The models used to simulate recharge and evapotranspiration are discussed in the General Subregional Model Features section earlier in this appendix. The stations used for the Broward County Ground Water Flow Model are presented in **Figure F-8**.

Canals

The predominant canal network within the Broward County model domain is shown in **Figure F-7**. In addition to all major District canals, it includes numerous lakes and secondary canals in the region. Water levels in all of these canals are controlled and maintained by a network of District and local structures.

Canal-aquifer interactions are included in the model through use of the River and Drain packages. The canals in the region were classified as both rivers and drains depending upon their connections to the regional system. In either case, the required input data included canal stages along with conductance terms depicting the degree of hydraulic interaction between the canals and the aquifer. Canal stages were assigned to the various

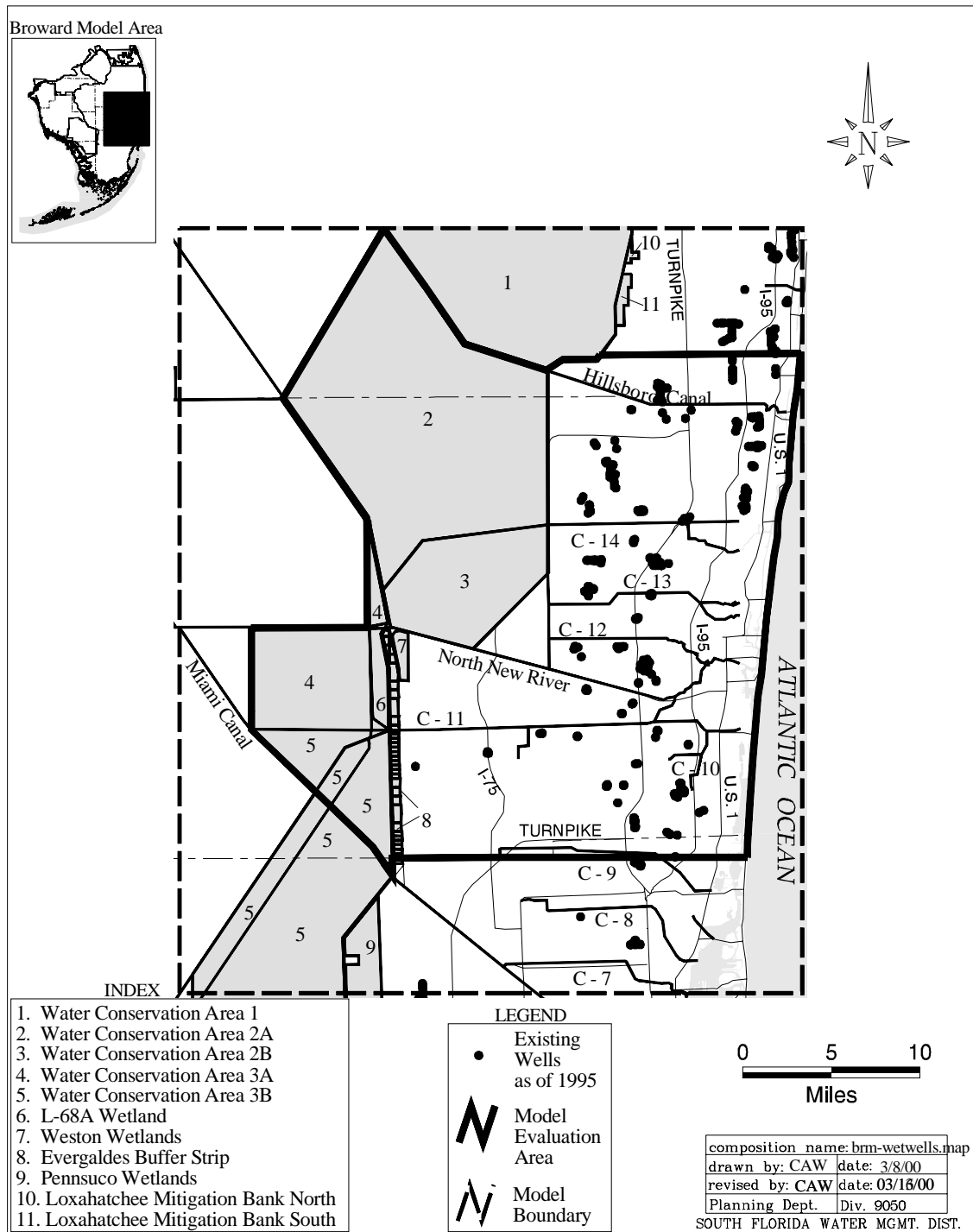


Figure F-7. Model Boundaries and Major Features of the Broward County Ground Water Flow Model.

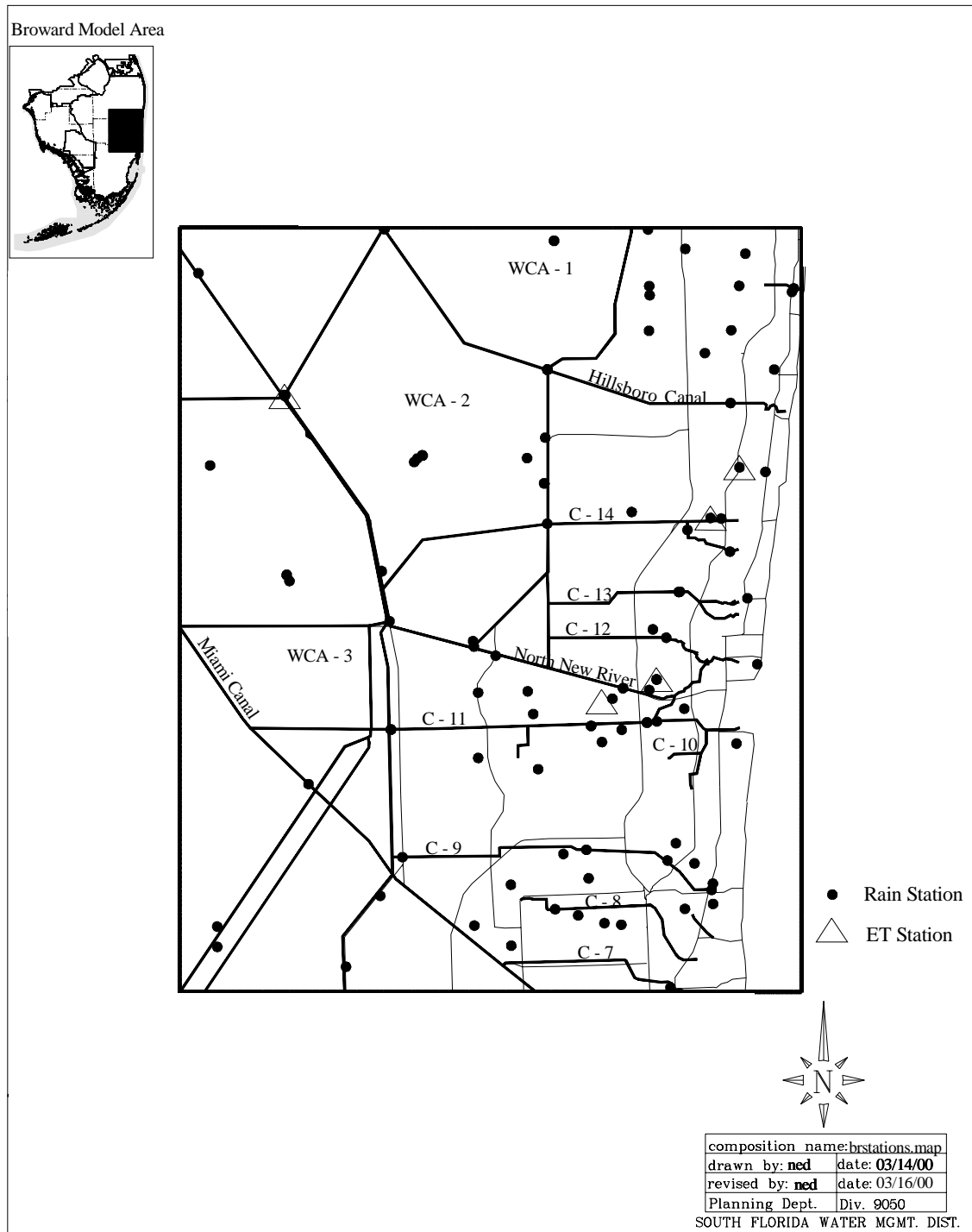


Figure F-8. Rainfall and Evapotranspiration Station Locations used in the Broward County Ground Water Flow Model.

canal reaches by using observed or simulated water levels from the SFWMM, depending upon the scenario at stage monitoring stations to estimate hydraulic grade line elevations within each reach. A third package utilized in the model was the seepage collection system around the proposed reservoirs. This option simulates the removal of water from a canal and subsequent discharge back into the reservoir systems.

Wetlands

The major wetland systems within the active model area include all or portions of WCA-1, WCA-2A, WCA-2B, WCA-3A, WCA-3B, the Everglades Buffer Strip and a number small wetland systems located east of the East Coast Protective Levee. Ground water levels, structure discharges, rainfall, ET, and topography influence surface water elevations within these wetlands.

The Wetlands package (Restrepo et al., 1998) was used to simulate overland flow within the wetland systems along with interactions between the surface water and ground water. Topographic features influencing the rate of movement through the wetlands (i.e., levees, sloughs, and air boat trails) are explicitly represented in the wetlands package.

Water Use

Ground water withdrawals in Broward County are primarily concentrated in Public Water Supply (PWS), and golf course, landscape, and agricultural irrigation. All permitted withdrawals are explicitly represented in the modeling through the wells package.

Demands for irrigation users were based on the permitted average annual demand. For PWS users, information contained in monthly water use reports submitted to the District was used to assign monthly pumpage rates to each utility. Monthly distributions were based upon the historical record. Actual annual demands were based upon the historical record or projected demand as shown in **Table F-7**, depending upon the simulation. The resulting mean daily pumpage for each utility was then divided among its wells according to a specified percentage for each well.

Features of the Outer Boundary

As shown in **Figure F-1**, the portion of the outer model boundary located east of the levees consists of the following:

- A coastal boundary
- A northern boundary located along the C-15 Canal and southern boundary along the C-6/C-7 canals
- A western boundary within the Everglades

Along the coastal boundary, the required stages and conductance values were determined in the manner explained in the **General Subregional Model Features** section

Table F-7. Public Water Supply Demands on the Surficial Aquifer System by Utility.

Utility	Permit #	Average Annual Demands (MGY)		Average Daily Demands (MGD)	
		1995 Base	2020 Base	1995 Base	2020 Base
North Palm Beach (NPB)					
Town of Jupiter	50-00010-W	3,463.85	4,818.00	9.49	13.20
Mangonia Park	50-00030-W	122.90	122.90	0.34	0.34
Tequesta	50-00046-W	512.97	638.75	1.41	1.75
Seacoast	50-00365-W	5,276.22	10,369.65	14.45	28.41
Riviera Beach	50-00460-W	3,270.72	4,275.00	8.96	11.71
Good Samaritan Hospital	50-00653-W	127.75	135.05	0.35	0.37
PB Park Commerce	50-01528-W	3.65	357.00	0.01	0.98
Total for NPB Service Area		12,778.06	20,716.35	35.01	56.76
LEC Service Area 1 (LECSA1)					
Deerfield Beach	06-00082-W	4,000.42	4,069.00	10.96	11.15
Parkland	06-00242-W	74.48	112.00	0.20	0.31
North Springs	06-00274-W	515.62	1,715.50	1.41	4.70
Palm Springs	50-00036-W	1,465.87	2,292.20	4.02	6.28
Atlantis	50-00083-W	17.68	0.00	0.05	0.00
PBC (Palm Bch Co) (2W,8W)	50-00135-W	6,821.62	10,442.65	18.69	28.61
Tropical MHP	50-00137-W	33.29	0.00	0.09	0.00
Delray Beach	50-00177-W	4,441.69	5,810.80	12.17	15.92
Century Utilities/PBC	50-00178-W	152.42	0.00	0.42	0.00
Jamaica Bay	50-00179-W	0.00	0.00	0.00	0.00
Lake Worth	50-00234-W	2,611.92	3,556.50	7.16	9.74
Highland Beach	50-00346-W	411.27	508.00	1.13	1.39
Boca Raton	50-00367-W	13,106.54	17,136.75	35.91	46.95
PBC System (3W, 9W)	50-00401-W	5,719.56	16,516.25	15.67	45.25
Royal Palm Beach	50-00444-W	803.70	0.00	2.20	0.00
ACME (Wellington)	50-00464-W	1,475.09	3,504.00	4.04	9.60
Boynton Beach	50-00499-W	3,226.66	6,278.00	8.84	17.20
Manalapan	50-00506-W	365.86	474.50	1.00	1.30
Nat'l MHP (Worth Village)	50-00572-W	70.24	97.00	0.19	0.27
Lantana	50-00575-W	752.29	890.60	2.06	2.44
Lion Country Safari	50-00605-W	18.49	42.00	0.05	0.12
Village of Golf	50-00612-W	152.66	196.00	0.42	0.54
City of West Palm Beach ^a	50-00615-W	9,206.80	15,330.00	25.22	42.00
AG Holley (St of FL)	50-01092-W	24.70	85.00	0.07	0.23
Arrowhead	50-01283-W	0.00	0.00	0.00	0.00
United Technologies	50-00501-W (old) 50-01663-W	212.57	408.80	0.58	1.12
Total for LEC Service Area 1		55,681.44	89,465.55	152.55	245.11
LEC Service Area 2 (LECSA2)					
Seminole Tribe	06-00001-W	126.70	321.15	0.35	0.88
Royal Utility Company	06-00003-W	133.05	149.00	0.37	0.41
North Lauderdale	06-00004-W	1,107.97	2,299.50	3.04	6.30
Hollywood	06-00038-W	7,048.74	8,030.00	19.31	22.00
Miramar	06-00054-W	1,529.04	4,504.10	4.19	12.34
Pompano	06-00070-W	5,929.80	7,300.00	16.25	20.00
Tamarac	06-00071-W	2,044.49	3,650.00	5.60	10.00
Coral Springs I/D	06-00100-W	1,488.85	1,752.00	4.08	4.80

Table F-7. Public Water Supply Demands on the Surficial Aquifer System by Utility. (Continued)

Utility	Permit #	Average Annual Demands (MGY)		Average Daily Demands (MGD)	
		1995 Base	2020 Base	1995 Base	2020 Base
Hillsboro Beach	06-00101-W	313.85	360.00	0.86	0.99
Coral Springs City	06-00102-W	2,642.64	3,525.90	7.24	9.66
Plantation	06-00103-W	5,082.17	6,293.00	13.92	17.24
Sunrise	06-00120-W	6,612.50	11,351.50	18.12	31.10
Margate	06-00121-W	3,045.09	4,124.50	8.34	11.30
Ft. Lauderdale	06-00123-W	17,791.10	21,900.00	48.74	60.00
Lauderhill	06-00129-W	2,712.21	2,887.10	7.43	7.91
Davie	06-00134-W	1,112.42	1,929.00	3.05	5.29
Pembroke Pines	06-00135-W	3,405.35	7,300.00	9.33	20.00
Hallandale	06-00138-W	1,261.06	1,277.50	3.45	3.50
Broward 2A (east)	06-00142-W	5,305.05	4,015.00	14.53	11.00
Broward 3A/3C (Picolo)	06-00145-W (old) 06-01474-W	964.80	5,657.50	2.64	15.50
Broward 1A,1B	06-00146-W	3,406.95	4,380.00	9.33	12.00
Broward 3B	06-00147-W (old) 06-01474-W	793.50	0.00	2.17	0.00
Ferncrest	06-00170-W	285.35	401.00	0.78	1.10
Dania Beach	06-00187-W	898.93	730.00	1.85	2.00
Cooper City	06-00365-W	1,278.26	2,226.00	3.50	6.10
South Broward	06-00435-W	241.89	0.00	0.66	0.00
Broward North Regional	06-01634-W	0.00	1,825.00	0.00	5.00
Total for LEC Service Area 2		76,561.76	108,188.75	209.13	296.41
LEC Service Area 3 (LECSA3)					
FKAAb	13-00005-W	5,136.91	6,935.00	14.07	19.00
Alexander Orr (WASD)	13-00017-W	61,375.50	103,065.05	168.15	282.37
Florida City	13-00029-W	837.97	1,025.65	2.30	2.81
WASD- Hialeah Preston	13-00037-W	60,875.50	76,723.00	166.78	210.20
REX (WASD-S Dade)	13-00040-W	2,209.80	17,395.90	6.05	47.66
Homestead	13-00046-W	2,354.09	5,694.00	6.45	15.60
North Miami	13-00059-W	2,622.19	3,252.55	7.18	8.91
North Miami Beach	13-00060-W	5,618.61	10,950.00	15.39	30.00
Opa Locka	13-00065-W	0	0	0	0
Homestead AFB	13-00068-W	377.80	0.00	1.04	0.00
Total for LECSA 3		141,408.37	225,041.15	387.41	616.55
LEC Planning Area Total		286,429.63	443,411.80	784.10	1,214.82

a. Demand figures are from surface water.

b. Demand figures are to supply Monroe County.

of this appendix beginning on **page F-5**. To represent the wedge-like shape of the saltwater interface (Sonenshein and Koszalka, 1996), the location of the boundary cells move inland in the deeper layers of the model. For planning simulations, the coastal boundary, like all of the other outer boundaries, was incorporated into the model using the General Head Boundary package.

Along the northern boundary, stages were based on water levels in canals while the conductance terms were computed in each model layer using the hydraulic conductivity values and dimensions of the boundary cells.

Along the western boundary, heads were fixed using historical and simulated data from District canals corresponding to the boundary. In areas along Alligator Alley, where a canal was not present, average values for northeastern WCA-3A were utilized. The conductance values for these sections of the model boundary were based on the same information used to compute conductance values along the northern and southern boundaries.

Model Calibration

The period of record selected for history matching was 1988-1995. This period of record includes a severe drought (1988-1990), an average condition (1992-1993), and an extreme wet condition (1994-1995). The primary objective for the history matching was to compare measured and computed water levels at monitoring sites and adjust model parameters as appropriate to reduce errors to an acceptable level.

Differences between computed and observed water levels are summarized in **Table F-8**. Also provided are mean, minimum, and maximum errors for each site. Due to time constraints and model coverage, calibration of the model in the eastern Boca Raton area was not considered at this time.

It is important to note that the statistics for each gage are based on the measured water level data available at that site within the calibration period of record. At some gages, data only exist over a fraction of the total period of record and result in statistics that may not be indicative of model accuracy over the entire period of record. Furthermore, the measured ground water levels are the daily maximum values (the only ground water levels published by the USGS) at each site and may not always be close to observed end-of-day ground water levels. In contrast, the model computes water levels at the end of each time step, which, in this case, is the end of each day. Additionally, one can generally not expect a finite-difference based model to replicate ground water levels observed in the immediate vicinity of a pumping well due to limitations imposed by the spatial resolution of the model. Finally, it should be emphasized that the calibration results depicted in **Table F-8** reflect the current status of the model and are subject to change as improvements to the model are made.

Recommendations and Conclusions

Model Capabilities and Limitations for Applications

The preceding discussions suggest that the model, in its current state, is adequate for comparative type analyses where water level based performance measures for various water supply alternatives are compared in order to select the most appropriate alternative(s) to undergo more detailed analyses. The locations of such performance measures should be within the evaluation area discussed previously. Furthermore, it is

Table F-8. Differences Between Computed and Observed Water Levels.

STATION	Minimum Difference	Average Difference	Maximum Difference	Percent
G-1260	0	1.234	3.69	44.95
G-2030	0	0.3916	1.92	94.087
G-2739	0	0.3696	2.4	96.7438
G-1213	0	0.7065	5.24	70.9022
G- 616	0	0.6586	4.3	80.2497
G-1315	0	0.9017	2.91	60.7533
G-1215	0	1.2699	4.9	50.4383
G-2031	0	0.3876	2.07	96.2377
G-2147	0	0.8442	2.95	60.5865
G-1316	0	0.5788	2.57	89.8757
G- 853	0	1.147	3.58	45.5946
G-2443	0	0.3285	2.01	97.479
G-2444	0	1.1182	8.59	53.52
G-2395	0	1.35	4.69	42.9821
G- 820A	0.02	1.4157	3.9	24.2903
G-2033	0	0.4002	3.39	95.292
G-2032	0	0.3639	2.86	95.3366
G-1220	0	0.431	2.64	92.9142
G-2376	0	0.7072	1.87	74.5623
S- 329	0	0.8324	4.15	64.1571
G- 561	0	0.8809	3.49	62.6502
G- 617	0	0.2951	2.3	97.2279
G-2494	0	0.3486	1.5	96.0674
G-2490	0	0.413	1.65	88.5942
G-1221	0	0.2503	4.89	96.7067
G-2488	0	0.6764	1.98	76.584
G-2487	0.01	0.6109	2.04	75
G-2491	0	0.4695	1.73	83.5106
G-2493	0	0.3266	1.19	96.2766
G-2492	0	0.3332	1.22	93.883
G-1224	0	0.7474	3.36	72.1079
G-1322	0	0.3564	1.39	97.0769
G-1223	0	0.4111	3.18	96.3976
G-2495	0	0.5801	1.97	87.381
G-2034	0	0.4525	2.46	91.761
G-2854	0.41	0.9081	1.67	63.8554
G-2615	0.34	0.7954	1.51	63.8554
G-2856	0.39	0.8787	1.44	58.6957
G-2614	0.16	0.7457	1.56	63.8554
G-1226	0	0.4904	7.87	91.2806

Table F-8. Differences Between Computed and Observed Water Levels.

STATION	Minimum Difference	Average Difference	Maximum Difference	Percent
G-2035	0	0.4712	3.88	91.4968
G-1225	0	0.5557	3.15	86.0888
G-1222	0	0.5006	2.4	89.6467
F- 291	0	0.4916	3.87	87.3575
G-1473	0	0.3636	3.52	93.2759
G-1472	0	0.4582	3.06	87.6667
G-1636	0	0.3191	2.18	97.5009
G- 970	0	0.3552	2.58	98.9183
G-1637	0	0.4488	1.79	93.7478
G-3571	0.01	0.5444	3.9	90.6801
S- 18	0	0.2469	2.32	99.2662
G- 852	0	0.2715	2.94	97.6349
G-1166	0	0.2358	2.31	98.3635
CA2B.T	0	1.5231	5.02	33.2188
CA2A300	0.02	1.0553	2.19	47.1976
2A-17_B	0	0.6866	1.89	75.9754
WCA2F1	0	0.8642	1.74	56.4815
WCA2F4	0	0.5317	1.3	92.8241
WCA2E4	0.01	0.4615	1.18	96.5358
WCA2U1	0	0.3433	1.24	96.0739
WCA2RT	0	0.3082	1.15	98.7245
WCA2E1	0.01	0.7699	1.49	63.109
2-15	0	0.5126	1.1	98.2911
2-17	0	0.8124	1.94	66.3317
3-63	0	0.343	1.76	97.2871
3-76	0	0.2799	1.11	99.4859
1-9	0	0.3175	1.17	96.1063
PB-0732	0	0.5067	2.17	87.3835
PB-1661	0	0.3231	3.13	95.8739
PB-1680	0	0.5655	2.88	86.1718
PB-1684	0.26	0.9488	2.79	67.5134
PB-0490	0	0.45	1.88	90
PB-0492	0.03	0.6194	3.7	84.058
PB-0567	0	0.5566	2.41	82.3529
PB-0948	0	0.5185	1.44	89.7436
PB-1006	0.01	0.3967	1.64	93.0233
PB-1063	0	0.5914	1.88	83.908
PB-0897	0.04	0.7574	2.38	69.7674

suggested that only water levels be used to formulate performance measures since all of the history matching work completed so far has been limited to water levels. Ground water flows and canal base flows computed by the model should be used with caution. In either case, it is recommended that the effect of uncertainties in model input on model based alternative comparisons be assessed prior to making any final decisions regarding alternative selections.

Future Improvements

Certain improvements to the model are recommended in order to enhance its ability to support future applications. Such enhancements should include, but not necessarily be limited to, the following:

- Calibration of the model in the east Boca Raton area
- Acquisition of data and ground truthing of canal base flows and canal-aquifer interaction of simulated to actual conditions
- Inclusion of a saltwater simulation package to provide a clear understanding of potential movement of the saline interface
- Improved water shortage trigger location and activation levels to provide adequate coverage for the model domain

North Miami-Dade County Ground Water Flow Model

Introduction

The North Miami-Dade County Ground Water Flow Model, sometimes referred to as version 3.0 of the Lake Belt ground water flow model, is the third in a series of ground water flow models developed for applications in northern Miami-Dade County. The first, version 1.0 of the Lake Belt ground water flow model (Wilsnack, 1995), was developed in support of the *Interim Plan for Lower East Coast Regional Water Supply* (SFWMD, 1998). The second, version 2.0 (Wilsnack et al., 1997; Wilsnack and Nair, 1998), was developed in support of the *Northwest Dade County Freshwater Lake Plan* (SFWMD, 1996). These two older versions of the model are no longer used by the District and are superseded by version 3.0. This current version is the first to include capabilities for simulating certain key surface water processes and was developed in support of both the Restudy and the LEC regional water supply planning effort.

Figure F-9 depicts the active model domain in relation to the predominant features of this area. The model domain was discretized horizontally using a finite-difference grid consisting of 328 rows, 364 columns, and 500-foot square cells. A subset of the active model domain was defined where the model results of planning based applications could be used for decisionmaking purposes.

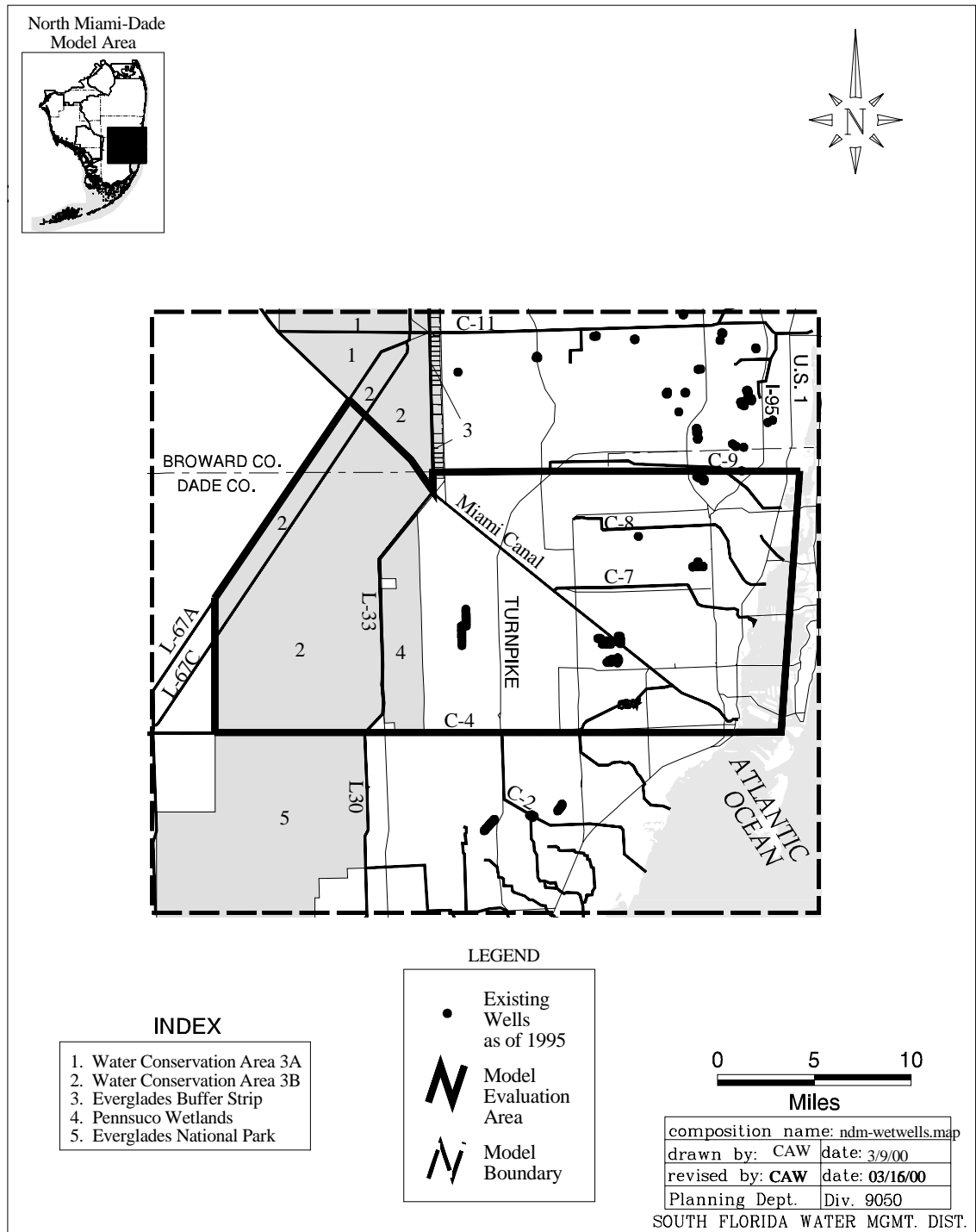


Figure F-9. Model Boundaries and Major Features of the North Miami-Dade County Ground Water Flow Model.

Physical Features

Hydrogeology and Model Layers

Only the SAS was included in the North Miami-Dade County Ground Water Model. The SAS within northern Miami-Dade County essentially consists of (in order of increasing depth) shallow sediments; the Miami Limestone (formerly referred to as the Miami Oolite); the Fort Thompson formation (which includes the Biscayne aquifer); the upper semiconfining unit of the Tamiami formation; the Gray Limestone aquifer; and the lower clastic sediments of the Tamiami formation. Deviations from this general sequence of units, however, can occur in the extreme eastern and western portions of the model domain. For further details, see Fish and Stewart (1991).

The vertical discretization of the SAS consists of eight model layers: a wetland layer (where extensive wetlands exist) extending from the wetland water surface down to an elevation of zero ft NGVD; a top aquifer layer extending from either the bottom of the wetland layer or land surface to an elevation of –10 ft NGVD; three middle layers with a constant thickness of 20 feet; and three deep layers with a constant thickness of 30 feet. In order to minimize disk space requirements and model execution times, the two bottommost layers were later combined into one layer, resulting in a total of seven model layers used in model calibration and applications.

Recharge and Evapotranspiration

The models used to simulate recharge and evapotranspiration are discussed in the General Subregional Model Features section earlier in this appendix. The stations used for the North Miami-Dade County Ground Water Flow Model are presented in **Figure F-10**.

Canals

Included within the model are all or portions of the following District canals: C-1W, C-1N, C-2, C-3, C-4, C-5, C-6, C-7, C-8, C-9, C-10, C-11, the C-100 canals, C-123, C-304, L-29, L-30, L-31N, L-33, L-67A, and L-67EXT (**Figure F-9**). In addition, numerous secondary canals owned and operated by Miami-Dade Department of Environmental Resource Management (DERM) are also contained within the model domain. This includes the canal system which protects the Northwest Wellfield. Water levels in all of these canals are controlled and maintained by a network of District and Miami-Dade DERM water control structures.

Canal-aquifer interactions are included in the model through use of the River and Drain packages. Canals were classified as either rivers or drains depending on their physical and operational properties. Most of the canals were classified as rivers. In either case, the required input data included canal stages along with conductance terms depicting the degree of hydraulic interaction between the canals and the aquifer. Canal stages were assigned to the various canal reaches by using measured water levels at stage monitoring stations to estimate hydraulic grade line elevations within each reach.

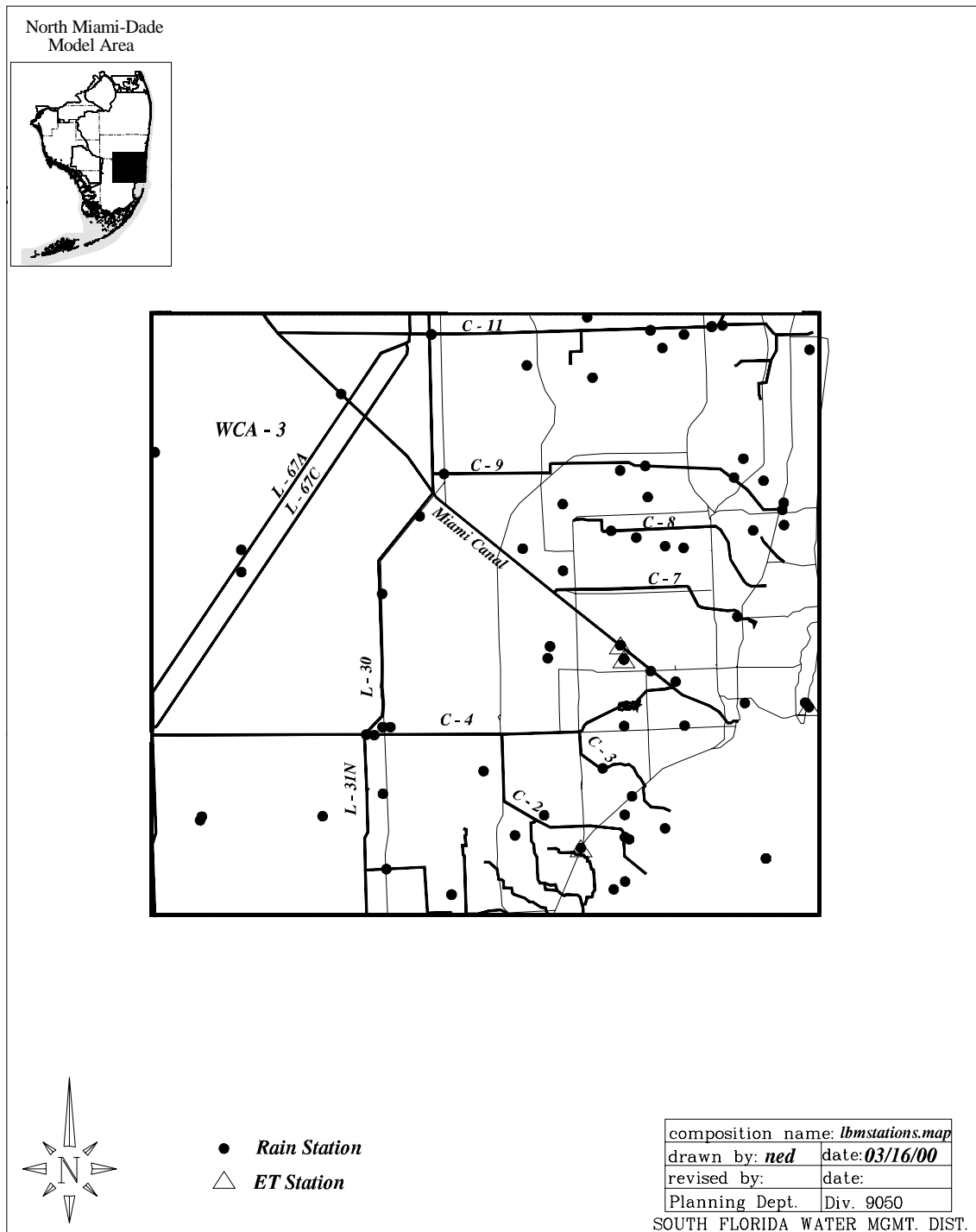


Figure F-10. Rainfall and Evapotranspiration Station Locations used in the North Miami-Dade Ground Water Flow Model.

Wetlands

The major wetland systems within the active model area include WCA-3A, WCA-3B, the northeast corner of Everglades National Park, the Pennsuco Wetlands, and the Bird Drive Wetland (**Figure F-9**). Surface water elevations within these wetlands are influenced by ground water levels, structure discharges, rainfall, ET, and topography.

The Wetlands package (Restrepo et al., 1998) was used to simulate overland flow within the wetland systems along with interactions between the surface water and ground water. In this case, the option to include both ponded surface water and shallow geology within the wetland layer (Restrepo and Montoya, 1997) was used in order to both minimize the number of model layers, and to avoid the periodic drying of cells. As mentioned previously, this includes all of the sediments and stratigraphic units between land surface and zero ft NGVD. This latter elevation was chosen since it is typically within the range of elevations where the dense limestone layers of the Miami Limestone and upper Fort Thompson formation are situated (Krupa, 1997). These shallow layers, where present, can have a significant influence on interactions between ground water and surface water (Klein and Sherwood, 1961).

Water Use

Most of the ground water withdrawals in northern Miami-Dade County are for PWS purposes and occur at the wellfield locations shown in **Figure F-9**. Pumpage for golf course irrigation and local domestic supplies also occurs at various locations. The primary source of PWS in this region is the Biscayne aquifer, although withdrawals from the gray limestone aquifer also occur at certain wellfields located within the western portions of the model domain (e.g., the Northwest Wellfield).

Daily pumpage from major wellfields within Miami-Dade County was estimated over the 1993-94 period of record. These estimates were based on wellfield operation records maintained by the Miami-Dade Water and Sewer Department (WASD) along with pump capacities. Estimates of daily pumpage based on these data, however, will generally be too high since head losses incurred within the water distribution system are not taken into account. For this reason, the resulting pumpage rates were reduced during the model calibration process.

Daily pumpage was not estimated over the 1988-89 calibration period of record. Instead, information contained in monthly water use reports submitted to the District was used to assign monthly pumpage rates to each water use permit. The resulting mean daily pumpage for each permit was then divided among its wells according to a specified percentage for each well.

Quarries

The region within northern Miami-Dade County commonly known as the Lake Belt can be seen in **Figure F-11**, where the January 1994 mining configuration is compared with the 1988 mining configuration. Located within this area are numerous

limestone mining quarries that typically range from about 30 to 80 feet in depth. These quarries can generally be characterized as having very steep (nearly vertical) side walls that are in direct contact with the aquifer. Input data sets to the Lake package were constructed so as to reflect this conceptualization of the quarries.

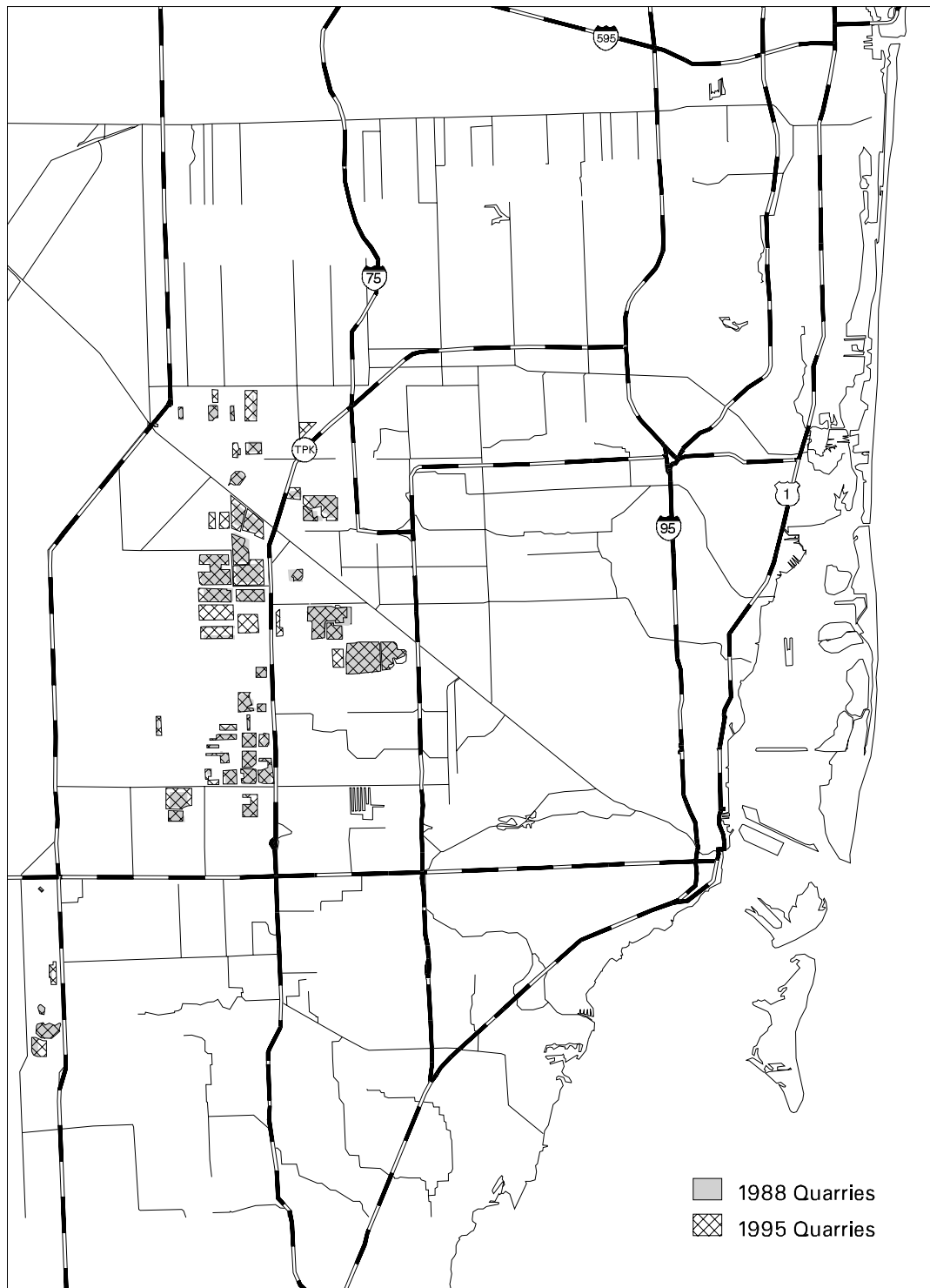


Figure F-11. Quarries Located Within the Lake Belt in 1988 and 1994.

Features of the Outer Boundary

As shown in **Figure F-1**, the portion of the outer model boundary located east of the levees consists of:

- A coastal boundary
- A northern boundary located along the C-11 Canal
- A southern boundary that contains portions of the C-1W, C-1N, C-100, and C-100A canals

Each of these boundaries was incorporated into the model using the General Head Boundary package. Along the coastal boundary, the required stages and conductance values were determined in the manner explained earlier in this appendix. Along the northern and southern boundaries, stages were based on water levels in canals while the conductance terms were computed in each model layer using the hydraulic conductivity values and dimensions of the boundary cells.

West of the levee system, the boundary traverses portions of WCA-3A, the L-67A Borrow Canal, the L-67EXT Borrow Canal, and Everglades National Park (**Figure F-9**). The conductance values for these sections of the model boundary were based on the same information used to compute conductance values along the northern and southern boundaries. Boundary stages applied west of the levee system were the closest available measured stages.

Model Calibration

The periods of record selected for history matching were 1988-89 (relatively dry hydrologic conditions) and 1993-94 (relatively wet hydrologic conditions). For each of these periods of record, the objectives for the history matching consist of the following:

- Comparing measured and computed water levels at monitoring sites and adjusting model parameters as appropriate to reduce errors to an acceptable level (Phase I)
- Comparing measured and computed base flows of selected canal reaches and adjusting model parameters as appropriate to reduce errors to an acceptable level while maintaining water level errors within an acceptable level (Phase II)

Given the time frame for completing the model applications needed to support the LEC Plan, only the Phase I calibration goals were attempted. Phase II of the calibration will be completed at a later date.

Differences between computed and observed water levels are summarized in **Table F-9** for the wet period of record while **Table F-10** contains the water level residuals for the dry period of record. Also provided are mean error, or bias, and residual standard deviation for each site. In order to minimize any effects of initial conditions on these

results, the residuals for the first two months of each period of record were not used in the analysis.

It is important to note that the statistics for each gage are based on the measured water level data available at that site within the calibration period of record. At some gages, data only exist over a fraction of the total period of record and result in statistics that may not be indicative of model accuracy over the entire period of record. Furthermore, the measured ground water levels are the daily maximum values (the only ground water levels published by the USGS) at each site and may not always be close to observed end-of-day ground water levels. In contrast, the model computes water levels at the end of each time step (i.e., day). Additionally, one can generally not expect a finite-difference based model to replicate ground water levels observed in the immediate vicinity of a pumping well due to limitations imposed by the spatial resolution of the model. Similarly, limitations in boundary conditions can affect model results at sites located near the boundaries. Finally, it should be emphasized that the calibration results depicted in **Tables F-9** and **F-10** only reflect the current status of the model and are subject to change as improvements to the model are made.

Table F-9. North Miami-Dade County Calibration Statistics for the Wet Period of Record (1993-94).

Gage Name	Percent of Days		Mean Error (Bias) (feet)	Standard Deviation (feet)	Notes
	Within Minimum Criterion (+/- 1.0 ft)	Within Desired Criterion (+/- 0.5 ft)			
3B-SE_B	100.00	71.46	-0.29	0.37	Surface water station
F-179	98.77	95.28	0.05	0.29	
F-239	92.64	27.71	0.61	0.36	Elevation of measuring point may be questionable
F-291	98.08	81.06	0.22	0.36	
F-319	99.78	96.53	-0.16	0.18	
F-45	98.36	81.52	0.16	0.37	
G-1074B	0.00	0.00	5.23	0.93	Within the Alexander Orr Wellfield Complex
G-1166	98.96	95.41	-0.00	0.22	
G-1223	95.89	64.48	-0.49	0.30	Located near the northern boundary
G-1224	94.39	29.11	-0.63	0.24	Located near the northeast boundary and a wellfield
G-1225	95.77	71.13	-0.32	0.37	See Note 1
G-1226	97.20	31.83	-0.59	0.26	Located near the northeast boundary and a wellfield
G-1359	99.33	63.33	-0.28	0.37	Period of Record (POR) starts 8/1/94; located near a mining lake
G-1368A	16.20	14.07	3.26	1.60	Located within Preston-Hialeah/Miami Springs Wellfield
G-1473	98.15	81.31	0.14	0.39	
G-1487	99.58	62.92	-0.46	0.20	Located near the southern boundary; See Note 1

Note 1. A possible error occurred in the measuring point datum, or maximum daily measured water levels (published) may not be representative of end-of-day water levels (computed by the model and measured values not published).

Note 2. A discrepancy exists between the SFWMD and USGS surveyed elevation of the measuring point.

Note 3. A possible overestimation of pumping rates was made at nearby pumping well(s).

Table F-9. North Miami-Dade County Calibration Statistics for the Wet Period of Record (1993-94).
(Continued)

Gage Name	Percent of Days		Mean Error (Bias) (feet)	Standard Deviation (feet)	Notes
	Within Minimum Criterion (+/- 1.0 ft)	Within Desired Criterion (+/- 0.5 ft)			
G-1488	100.00	89.83	0.15	0.23	
G-1636	96.57	69.38	-0.32	0.35	See Note 1
G-1637	100.00	78.19	0.31	0.21	
G-2034	93.50	82.06	-0.16	0.43	
G-2035	70.12	5.30	-0.93	0.33	Located near the northeast boundary and a wellfield
G-2495	57.69	11.54	-0.94	0.37	Located near the northern boundary
G-3	10.27	1.44	1.48	0.43	Located within Preston-Hialeah-Miami Springs Wellfield
G-3073	92.45	71.91	0.33	0.41	Influenced by pumping
G-3074	48.46	31.42	1.31	1.18	Located near the PWS well within the Snapper Creek Complex
G-3253	76.34	39.43	-0.06	0.80	Located within Northwest Wellfield Complex; See Notes 2 and 3
G-3259A	80.90	46.61	-0.53	0.45	Located near the Northwest Wellfield Complex; See Notes 2 and 3
G-3264A	100.00	87.27	0.25	0.22	
G-3327	99.18	97.33	-0.05	0.23	
G-3328	100.00	97.85	-0.00	0.20	
G-3329	98.45	91.61	-0.14	0.43	
G-3439	99.72	95.25	-0.11	0.21	
G-3465	99.37	47.47	0.44	0.33	Located near the Preston-Hialeah/Miami Springs Wellfield
G-3466	67.85	27.25	0.74	0.46	Located within Preston-Hialeah/Miami Springs Wellfield
G-3467	99.18	96.10	0.11	0.23	
G-3473	99.13	92.16	-0.12	0.24	
G-3551	100.00	100.00	0.03	0.15	
G-3552	98.91	92.36	-0.00	0.30	
G-3553	99.36	95.85	0.04	0.25	
G-3554	98.75	94.38	-0.02	0.31	
G-3555	99.28	89.53	0.16	0.28	
G-3556	100.00	99.33	0.03	0.21	
G-3557	100.00	98.48	-0.05	0.24	
G-3558	100.00	92.66	-0.10	0.23	
G-3559	100.00	98.79	-0.07	0.17	
G-3560	99.27	92.36	0.15	0.26	See Notes 2
G-3561	92.45	53.77	-0.08	0.63	Located near the southern boundary; POR begins 2/94
G-3562	31.97	29.51	-1.26	0.89	POR begins 9/1/94; See Note 1
G-3563	96.69	74.38	-0.39	0.29	

Note 1. A possible error occurred in the measuring point datum, or maximum daily measured water levels (published) may not be representative of end-of-day water levels (computed by the model and measured values not published).

Note 2. A discrepancy exists between the SFWMD and USGS surveyed elevation of the measuring point.

Note 3. A possible overestimation of pumping rates was made at nearby pumping well(s).

Table F-9. North Miami-Dade County Calibration Statistics for the Wet Period of Record (1993-94).
(Continued)

Gage Name	Percent of Days		Mean Error (Bias) (feet)	Standard Deviation (feet)	Notes
	Within Minimum Criterion (+/- 1.0 ft)	Within Desired Criterion (+/- 0.5 ft)			
G-3564	90.16	41.80	0.45	0.57	POR begins 9/1/94; See Note 1
G-3565	93.39	16.53	-0.66	0.23	POR begins 9/1/94; See Note 1
G-3566	94.26	85.25	-0.18	0.47	
G-3567	100.00	71.31	-0.23	0.43	POR begins 9/1/94; See Note 2
G-3568	99.11	91.07	0.24	0.30	
G-3570	60.33	10.74	-1.05	0.60	POR begins 9/1/94; See Note 1
G-3571	91.18	75.00	-0.05	0.78	
G-3572	97.52	70.25	-0.35	0.31	POR begins 9/1/94; See Note 1
G-551	86.45	23.00	-0.46	0.59	Located within the Southwest Wellfield Complex; See Note 3
G-553	99.15	75.21	-0.46	0.14	
G-580	98.53	94.55	-0.11	0.33	
G-618	100.00	89.62	0.33	0.14	
G-852	97.69	92.61	-0.07	0.33	
G-855	97.26	88.81	0.23	0.28	
G-968	100.00	90.61	-0.10	0.25	See Note 2
G-970	99.76	92.40	-0.25	0.18	
G-972	97.73	64.77	0.07	0.50	
G-973	100.00	90.70	0.28	0.21	
G-975	100.00	87.60	0.12	0.30	
G-976	100.00	78.98	-0.32	0.22	
NESRS1	100.00	57.70	0.45	0.21	Surface water station; located near southwest boundary
NESRS2	99.79	19.71	0.63	0.21	Surface water station
NESRS3_B	100.00	100.00	-0.22	0.15	Surface water station
S-18	97.55	92.87	-0.14	0.31	
S-19	99.59	48.76	0.44	0.32	Located within Preston-Hialeah/Miami Springs Wellfield
S-68	33.04	9.13	1.18	0.46	Located within Preston-Hialeah/Miami Springs Wellfield
SHARK.1_H	100.00	58.59	0.38	0.25	Surface water station
SITE_34	100.00	92.81	-0.04	0.26	Surface water station
SITE_71	100.00	30.39	0.64	0.22	Surface water station
SITE_76	100.00	56.46	0.46	0.19	Surface water station

Note 1. A possible error occurred in the measuring point datum, or maximum daily measured water levels (published) may not be representative of end-of-day water levels (computed by the model and measured values not published).

Note 2. A discrepancy exists between the SFWMD and USGS surveyed elevation of the measuring point.

Note 3. A possible overestimation of pumping rates was made at nearby pumping well(s).

Table F-10. North Miami-Dade County Calibration Statistics for the Dry Period of Record (1988-89).

Gage Name	Percent of Days		Mean Error (Bias)	Standard Deviation	Notes
	Within Minimum Criterion (+/- 1.0 ft)	Within Desired Criterion (+/- 0.5 ft)			
3B-SE_B	100.00	87.16	-0.28	0.19	Surface water station
F-179	99.79	87.27	0.07	0.28	
F-239	85.01	4.52	0.82	0.19	Elevation of measuring point may be questionable
F-291	97.54	78.85	0.31	0.30	
F-319	99.18	95.69	-0.10	0.19	
F-45	100.00	93.84	0.17	0.17	
G-1074B	15.20	7.8	2.77	2.25	Within the Alexander Orr Wellfield Complex; See Note 4
G-1166	100.00	100.00	0.13	0.10	
G-1222	94.58	78.92	0.04	0.52	
G-1223	99.59	74.33	-0.44	0.15	Located near the northern boundary
G-1224	97.13	86.24	-0.30	0.29	Located near the northeast boundary and a wellfield
G-1225	100.00	94.87	0.24	0.20	
G-1226	97.13	60.99	-0.48	0.48	Located near the northeast boundary and a wellfield
G-1368A	69.40	54.62	0.70	0.86	Within Preston-Hialeah/Miami Springs Wellfield; See Note 4
G-1472	97.74	86.24	0.24	0.31	
G-1473	98.36	90.76	0.20	0.28	
G-1487	93.43	71.46	-0.36	0.37	Located near the southern boundary
G-1488	100.00	69.61	-0.35	0.25	See Note 1
G-1636	95.48	77.00	-0.20	0.42	
G-1637	99.79	97.54	0.18	0.19	
G-2034	94.05	74.95	0.04	0.50	Located near the northern boundary; See Note 4
G-2035	91.77	18.11	-0.73	0.25	Located near the northeast boundary and a wellfield
G-3	100.00	97.54	0.18	0.19	Located within Preston-Hialeah/Miami Springs Wellfield
G-3074	42.30	36.14	0.95	0.84	Located near the PWS well within Snapper Creek Complex
G-3253	21.97	9.45	1.61	1.02	Located within Northwest Wellfield Complex; See Note 4
G-3259A	91.17	37.78	0.44	0.47	Located near the Northwest Wellfield Complex; See Notes 2 and 4
G-3264A	98.97	94.66	-0.16	0.23	

Note 1. A possible error occurred in the measuring point datum, or maximum daily measured water levels (published) may not be representative of end-of-day water levels (computed by the model and measured values not published).

Note 2. A discrepancy exists between the SFWMD and USGS surveyed elevation of the measuring point.

Note 3. A possible overestimation of pumping rates was made at nearby pumping well(s).

Note 4. The use of monthly pumpage rates may also be contributing to errors.

Table F-10. North Miami-Dade County Calibration Statistics for the Dry Period of Record (1988-89). (Continued)

Gage Name	Percent of Days		Mean Error (Bias)	Standard Deviation	Notes
	Within Minimum Criterion (+/- 1.0 ft)	Within Desired Criterion (+/- 0.5 ft)			
G-3327	100.00	86.65	0.37	0.15	
G-3328	100.00	97.95	0.29	0.10	
G-3329	99.79	96.71	-0.10	0.13	
G-3439	100.00	77.82	0.18	0.30	
G-3465	100.00	95.28	0.16	0.17	Located near the Preston-Hialeah/Miami Springs Wellfield
G-3466	99.79	87.27	0.34	0.20	Located within Preston-Hialeah/Miami Springs Wellfield
G-3467	100.00	88.09	0.36	0.15	
G-551	66.59	7.86	-0.86	0.30	Located within the Southwest Wellfield Complex; See Notes 1 and 3
G-553	98.77	93.02	-0.31	0.15	
G-580	99.38	94.87	0.03	0.23	
G-596	97.33	77.82	0.04	0.45	
G-618	100.00	100.00	0.24	0.07	
G-852	97.13	93.63	-0.002	0.38	
G-855	100.00	94.87	0.24	0.20	
G-858	97.54	63.24	-0.48	0.23	Located near the southern boundary; See Note 1
G-968	100.00	84.82	-0.22	0.27	See Note 2
G-970	99.18	91.38	-0.27	0.18	
G-972	84.36	16.67	-0.72	0.27	
G-973	100.00	98.36	0.10	0.14	
G-974	99.38	62.83	0.12	0.50	
G-975	74.95	33.88	-0.74	0.38	See Note 1
G-976	71.05	35.11	-0.74	0.46	See Note 1
NESRS1	94.46	89.12	0.04	0.40	Surface water station; located near the southwest boundary
NESRS2	94.05	72.90	0.10	0.45	Surface water station
NESRS3_B	100.00	66.60	-0.28	0.39	Surface water station
S-18	100.00	100.00	0.09	0.10	
S-19	100.00	95.07	0.14	0.18	
S-68	99.18	87.47	0.27	0.25	
SHARK.1_H	100.00	94.25	0.16	0.21	Surface water station

Note 1. A possible error occurred in the measuring point datum, or maximum daily measured water levels (published) may not be representative of end-of-day water levels (computed by the model and measured values not published).

Note 2. A discrepancy exists between the SFWMD and USGS surveyed elevation of the measuring point.

Note 3. A possible overestimation of pumping rates was made at nearby pumping well(s).

Note 4. The use of monthly pumpage rates may also be contributing to errors.

Recommendations and Conclusions

Model Capabilities and Limitations for Applications

The preceding discussions suggest that the model, in its current state, is adequate for comparative type analyses where water level based performance measures for various water supply alternatives are compared in order to select the most appropriate alternative(s) to undergo more detailed analyses. The locations of such performance measures should be within the evaluation area discussed previously. Furthermore, it is suggested that only water levels be used to formulate performance measures since all of the history matching work completed so far has been limited to water levels. Ground water flows and canal base flows computed by the model should be used with caution. In either case, it is recommended that the effect of uncertainties in model input on model based alternative comparisons be assessed prior to making any final decisions regarding alternative selections.

In addition to the caveats mentioned above, it should be emphasized that the eastern boundary of the model is based on a simplistic representation of the saltwater-freshwater interface within the SAS. The characteristics, position, and movement of this interface are all based on complex factors and principles (e.g., density-driven flow) that cannot be readily incorporated into a ground water flow model that only accounts for freshwater flow. Consequently, the model cannot directly support any performance measures that relate to, or are contingent upon, the shape, position, or movement of the saltwater wedge that, in reality, constitutes the eastern boundary of the ground water flow system.

Future Improvements

Certain improvements to the model are recommended in order to enhance its ability to support future applications. Such enhancements should include, but not necessarily be limited to, the following:

- The resolution of any outstanding data quality issues related to measured water levels (e.g., correcting errors in measuring point elevations)
- A Phase II calibration that addresses canal base flow and water budgets
- A sensitivity analysis of calibrated model results
- The incorporation of additional surface water modules that would allow canal stages and rainfall recharge to be simulated by the model
- An improved representation of the saltwater-freshwater interface located along the coastal boundary

South Miami-Dade County Ground Water Flow Model

Introduction

In 1999, the District contracted with the Hydrological Modeling Center of Florida Atlantic University (FAU) for construction of a ground water flow model of the SAS to encompass the area of Miami-Dade County south of the C-4 Canal. Contractual work on the model was completed in January 2000.

Figure F-12 depicts the active model domain in relation to the predominant features of this area. The model domain was discretized horizontally using a finite-difference grid consisting of 430 rows, 367 columns, and 500-foot square cells. It was calibrated to observed water-levels from the period from January 1988 to December 1990.

Physical Features

Hydrogeology and Model Layers

Only the SAS was included in the South Miami-Dade County Ground Water Flow Model. The SAS within southern Miami-Dade County essentially consists of (in order of increasing depth): shallow sediments; the Miami Limestone (formerly referred to as the Miami Oolite); the Fort Thompson formation; the upper unit of the Tamiami formation; the Gray Limestone aquifer; and the lower clastic sediments of the Tamiami formation. Deviations from this general sequence of units, however, can occur in the extreme eastern and western portions of the model domain. For further details, see Fish and Stewart (1991) and Causaras (1987).

The vertical discretization of the South Miami-Dade model corresponds to the hydrostratigraphy described above. The model has four model layers. The top layer, corresponding to the Miami Limestone unit, extends from land surface to an elevation of -1 to -17 ft NGVD. Layers two and three encompass the Biscayne aquifer, and correspond to the Fort Thompson formation and upper unit of the Tamiami formation. Layer four encompasses the Gray Limestone aquifer in the west, and the coastal equivalent of the lower Tamiami aquifer.

Recharge and Evapotranspiration

The models used to simulate recharge and evapotranspiration are discussed in the General Subregional Model Features section earlier in this appendix. The stations used for the South Miami-Dade County Ground Water Flow Model are presented in **Figure F-13**.

Canals

The predominant canal network within the South Miami-Dade County model domain is shown in **Figure F-12**. In addition to all major District canals, it includes numerous lakes and secondary canals, including the vast network of cooling canals

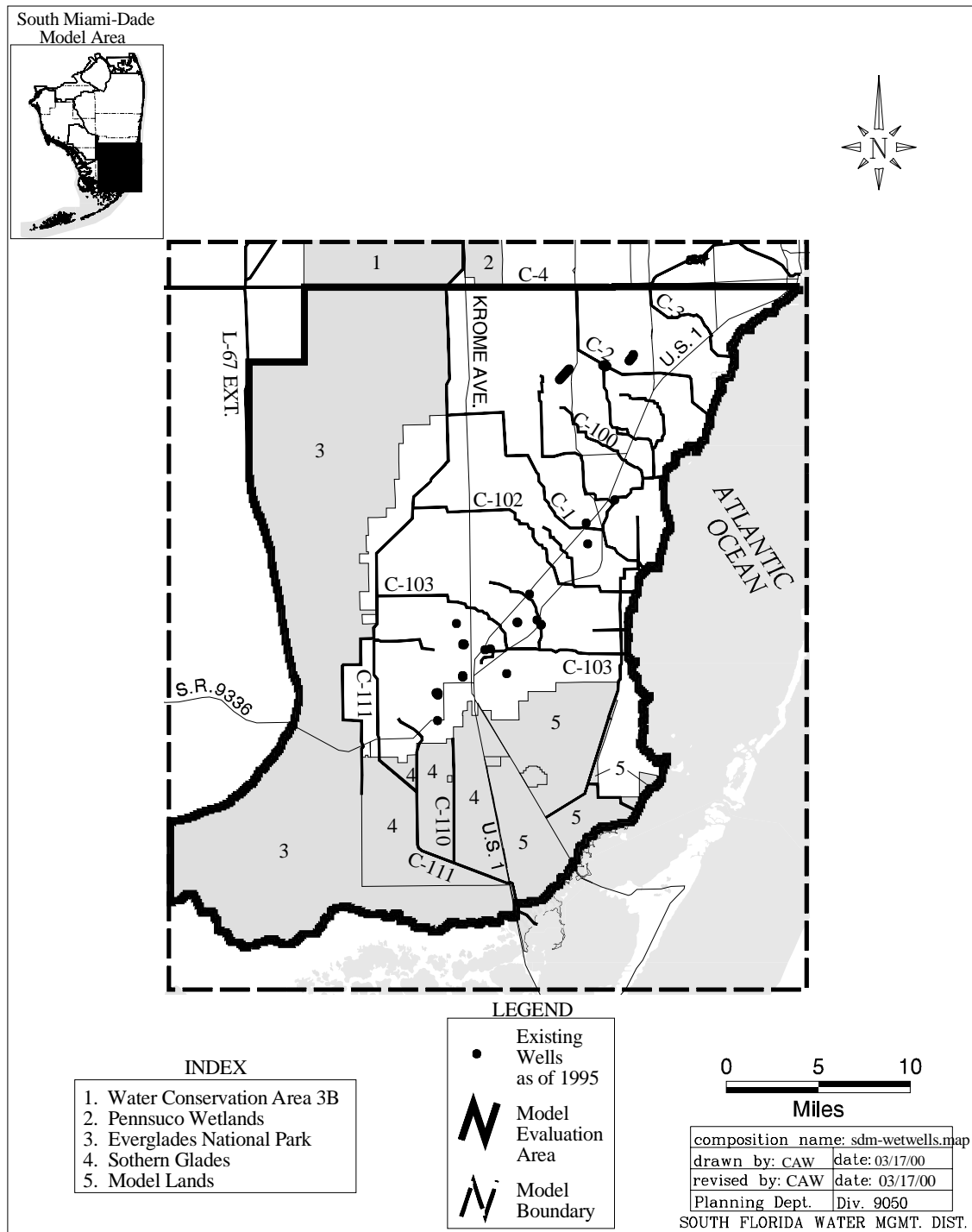


Figure F-12. Model Boundaries and Major Features of the South Miami-Dade County Ground Water Flow Model.

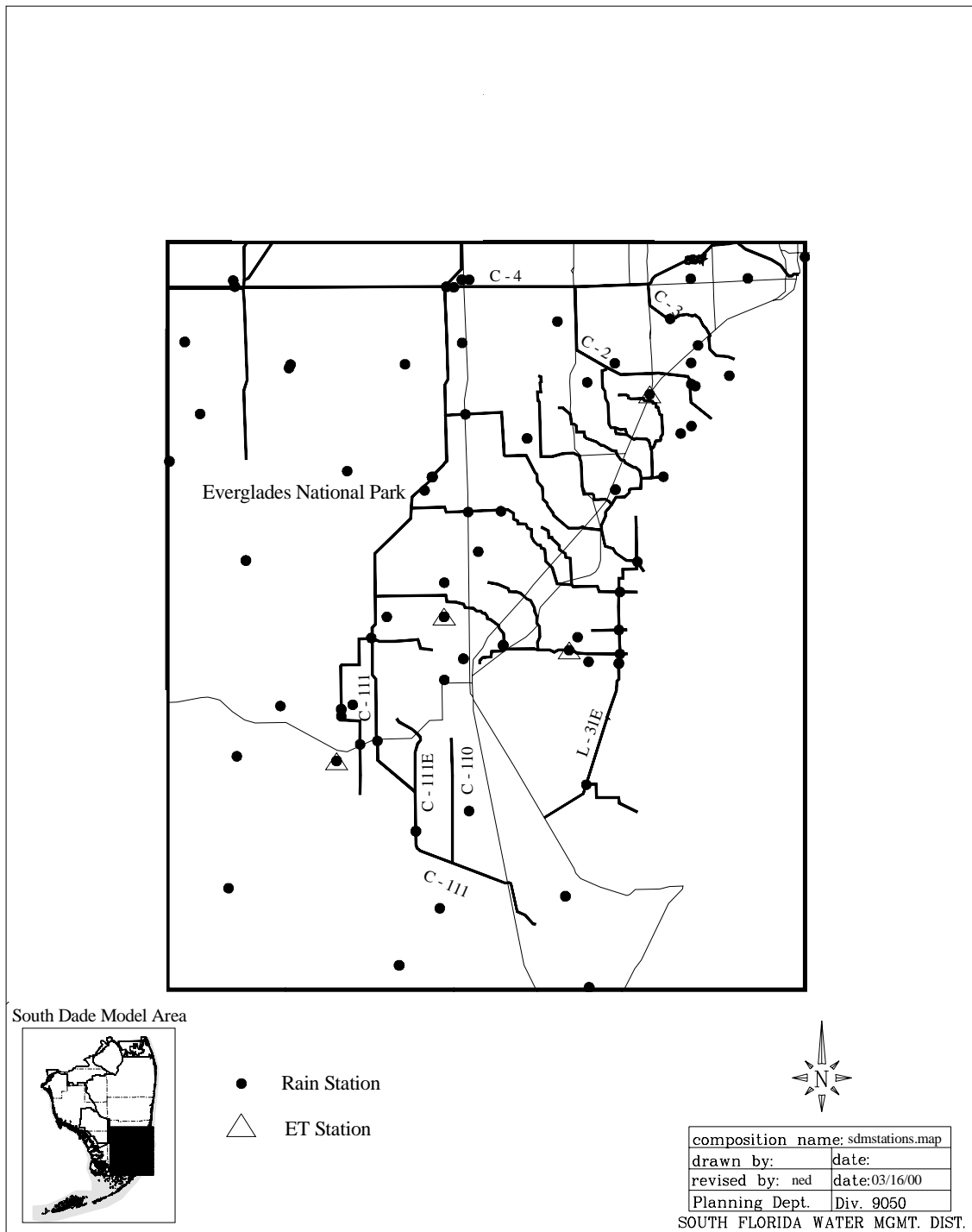


Figure F-13. Rainfall and Evapotranspiration Station Locations used in the South Miami-Dade Ground Water Flow Model.

operated by the Turkey Point power plant. Water levels in all of these canals are controlled and maintained by a network of District and Miami-Dade DERM water control structures.

Canal-aquifer interactions are included in the model through use of the River and Drain packages. Canals were classified as either rivers or drains depending on their physical and operational properties. Most of the canals were classified as rivers. In either case, the required input data included canal stages along with conductance terms depicting the degree of hydraulic interaction between the canals and the aquifer. Canal stages were assigned to the various canal reaches by using measured water levels at stage monitoring stations to estimate hydraulic grade line elevations within each reach.

Wetlands

The major wetland systems within the active model area include large portions of Everglades National Park, the Bird Drive Basin, the Model Lands, and the wetland margins of Biscayne Bay (**Figure F-12**). Ground water levels, structure discharges, rainfall, ET, and topography influence surface water elevations within these wetlands.

The Wetlands package (Restrepo et al., 1998) was used to simulate overland flow within the wetland systems along with interactions between the surface water and ground water. Topographic features influencing the rate of movement through the wetlands (i.e., levees, sloughs, and air boat trails) are explicitly represented in the wetlands package.

Water Use

Ground water withdrawals in southern Miami-Dade County are for PWS and golf course, landscape, and agricultural irrigation. The location of these wells are shown in **Figure F-12**. All permitted withdrawals are explicitly represented in the modeling through the Wells package. In addition to permitted users, there are a significant number of unpermitted agricultural irrigators within the south Miami-Dade agricultural area. The demands from these users are represented implicitly through the Evapotranspiration package.

Demands for irrigation users were based on estimated daily potential ET and corresponding supplemental crop requirement. For PWS users, information contained in monthly water use reports submitted to the District was used to assign monthly pumpage rates to each water use permit. The resulting mean daily pumpage for each permit was then divided among its wells according to a specified percentage for each well.

Features of the Outer Boundary

As shown in **Figures F-1** and **F-12**, the portion of the outer model boundary located east of the levees consists of the following:

- A coastal boundary
- A northern boundary located along the C-4 Canal

- A western boundary corresponding the approximate location of the east-west ground water divide depicted in USGS Open-File Report 95-705 (Sonenshein and Koszalka, 1996)

Along the coastal boundary, the required stages and conductance values were determined in the manner explained in the General Subregional Model Features section of this appendix. To represent the wedge-like shape of the saltwater interface (Sonenshein, 1995), the location of the boundary cells move inland in the deeper layers of the model. During model calibration, this boundary was represented as a constant head condition. For planning simulations, the coastal boundary, like all of the other outer boundaries, was incorporated into the model using the General Head Boundary package.

Along the northern boundary, stages were based on water levels in canals while the conductance terms were computed in each model layer using the hydraulic conductivity values and dimensions of the boundary cells.

Along the western boundary, heads were fixed using historical data from wells G-3354 and G-3437. The conductance values for these sections of the model boundary were based on the same information used to compute conductance values along the northern and southern boundaries.

Model Calibration

The period of record selected for history matching was 1988-1989, which had relatively dry hydrologic conditions. Objectives for the history matching were to compare measured and computed water levels at monitoring sites and to adjust model parameters as appropriate to reduce errors to an acceptable level.

Differences between computed and observed water levels are summarized in **Table F-11**. Also provided are mean error, or the bias, and residual standard deviation for each site. In order to minimize any effects of initial conditions on these results, the residuals for the first two months of each period of record were not used in the analysis.

It is important to note that the statistics for each gage are based on the measured water level data available at that site within the calibration period of record. At some gages, data only exist over a fraction of the total period of record and result in statistics that may not be indicative of model accuracy over the entire period of record. Furthermore, the measured ground water levels are the daily maximum values (the only ground water levels published by the USGS) at each site and may not always be close to observed end-of-day ground water levels. In contrast, the model computes water levels at the end of each time step, which, in this case, is at the end of each day. Additionally, one can generally not expect a finite-difference based model to replicate ground water levels observed in the immediate vicinity of a pumping well due to limitations imposed by the spatial resolution of the model. Finally, it should be emphasized that the calibration results depicted in **Table F-11** reflect the current status of the model and are subject to change as improvements to the model are made.

Table F-11. South Miami-Dade County Calibration Statistics for the Period of Record (1993-94)

Gage Name	Percent of Days		Mean Error (Bias) (feet)	Standard Deviation (feet)	Notes
	Within Minimum Criterion (+/- 1.0 ft)	Within Desired Criterion (+/- 0.5 ft)			
G-618	90.96	54.61	-0.390	0.444	
G-3439	61.19	20.00	0.882	0.456	
G-1074B	6.30	3.56	-5.537	2.333	Within Alexander Orr Wellfield Complex
G-3073	78.08	15.98	0.792	0.336	
G-3074	73.52	32.42	0.292	0.831	Located near PWS well within Snapper Creek Complex
G-551	86.73	55.41	0.499	0.444	
G-1487	84.29	42.47	-0.156	0.729	
G-855	91.32	50.50	-0.032	0.623	
G-580A	96.44	73.70	0.316	0.319	
G-580	96.44	73.70	0.316	0.319	
G-553	76.16	33.15	0.710	0.351	
G-858	76.99	45.66	0.620	0.529	
G-596	81.37	48.40	-0.368	0.660	
G-3273	80.27	58.72	-0.218	0.709	
G-860	98.08	67.12	0.294	0.370	
G-1502	82.56	57.08	-0.081	0.702	
G-1362	90.59	64.57	-0.024	0.586	
G-757A	95.43	55.16	-0.184	0.550	
G-3437	85.30	57.17	-0.220	0.616	
G-614	96.89	74.34	-0.215	0.425	
G-1363	95.80	67.58	-0.211	0.484	
G-1486	99.63	75.62	0.172	0.362	
G-789	91.69	66.39	-0.345	0.432	
G-1183	94.43	62.37	0.410	0.376	
G-864	92.15	63.56	0.415	0.422	
G-864A	94.70	73.97	0.292	0.442	
G-3356	72.58	26.96	0.825	0.460	
G-613	97.44	84.38	0.033	0.382	
G-3355	63.63	19.17	0.951	0.563	
G-1251	77.35	56.62	0.552	0.511	
G-3354	54.62	26.90	0.926	0.480	
G-3353	99.52	73.73	0.054	0.406	

Recommendations and Conclusions

Model Capabilities and Limitations for Applications

The preceding discussions suggest that the model, in its current state, is adequate for comparative type analyses where water level based performance measures for various water supply alternatives are compared in order to select the most appropriate alternative(s) to undergo more detailed analyses. The locations of such performance measures should be within the evaluation area discussed previously. Furthermore, it is suggested that only water levels be used to formulate performance measures since all of the history matching work completed so far has been limited to water levels. Ground water flows and canal base flows computed by the model should be used with caution. In either case, it is recommended that the effect of uncertainties in model input on model based alternative comparisons be assessed prior to making any final decisions regarding alternative selections.

Future Improvements

Certain improvements to the model are recommended in order to enhance its ability to support future applications. Such enhancements should include, but not necessarily be limited to, the following:

- The resolution of any outstanding data quality issues related to measured water levels (e.g., correcting errors in measuring point elevations)
- A Phase II calibration (see previous discussion) that addresses canal base flow and water budgets
- A sensitivity analysis of calibrated model results
- The incorporation of additional surface water modules that would allow canal stages and rainfall recharge to be simulated by the model

REFERENCES

- Causaras, C.R. 1985. *Geology of the Surficial Aquifer System, Broward County, Florida*. Water Resources Investigations Report 84-4068, U.S. Geological Survey, 2 sheets.
- Causaras, C.R. 1987. *Geology of the Surficial Aquifer System, Dade County, Florida*. Water-Resources Investigations Report 86-4126, U.S. Geological Survey, 240 pp, 3 sheets.
- Council, G.W. 1998. A Lake Package for MODFLOW. In EDITORS, *Proceedings for MODFLOW'98*, Colorado School of Mines, CO, October 4-8, 1998, Volume II, pp. 675-682.
- Fish, J.F. and M.J. Stewart. 1991. *Hydrogeology of the Surficial Aquifer System, Dade County, Florida*. U.S. Geological Survey Water Resources Investigations Report

- 86-4126. Books and Open-File Reports Section, U.S. Geological Survey, Federal Center, Denver, CO, 50 pp, 11 sheets.
- Klein H. and C.B. Sherwood 1961. *Hydrologic Conditions in the Vicinity of Levee 30, Northern Dade County, Florida*. Report of Investigations No. 24, Part I, Florida Geological Survey, Tallahassee, FL, 24 pp.
- Krupa, A.J. 1997. *Results of Literature Review and Assessment of Geologic Logs to Determine the Extent of the Dense Limestone Layer in the Upper in the Upper Portion of the Biscayne Aquifer in the Pennsuco Area, Dade County*. Draft Memorandum, Planning Department, South Florida Water Management District, West Palm Beach, FL, 27 pp.
- Lal, A.M.W. In press. Selection of Spatial and Temporal Discretization of Ground Water and Overland Flow Models. *Water Resources Research*.
- McDonald, M.G. and A.W. Harbaugh. 1988. A Modular, Three-Dimensional Finite-Difference Ground Water Flow Model. *Techniques of Water Resources Investigations of the United States Geological Survey, Book 6*. U.S. Government Printing Office, Washington, D.C.
- Nair, S.K. and M.M. Wilsnack. 1998. A Comparison of Two Approaches for Simulating Lake-Ground Water Interactions with MODFLOW. In *Proceedings for MODFLOW'98*, Colorado School of Mines, CO, October 4-8, 1998, Volume II, pp. 871-878.
- Perkins. 1977. Depositional Framework of Pleistocene Rocks in South Florida. In: Enos, P. and Perkins, R.D, *Quaternary Sedimentation in South Florida*, Geological Society of America Memoir 147: 131-196.
- Restrepo, J., C. Bevier, and D. Butler. 1992. *A Three-dimensional Finite Difference Ground Water Flow Model of the Surficial Aquifer System, Broward County, Florida*. Technical Publication 92-05, South Florida Water Management District, West Palm Beach, FL.
- Restrepo, J.I. and J.B. Giddings. 1994. Physical Based Methods to Estimate ET and Recharge Rates Using GIS. In: *Effects of Human-Induced Changes on Hydrologic Systems*, American Water Resources Association, Bethesda, Maryland.
- Restrepo, J.I. and A.M. Montoya. 1997. *MODFLOW Wetland Module: Final Report*. Department of Geography and Geology, Florida Atlantic University, Boca Raton, FL, 86 pp.
- Restrepo, J.I., A.M. Montoya, and J. Obeysekera. 1998. A Wetland Simulation Module for the MODFLOW Ground Water Model. *Ground Water*, Vol. 36, No. 5, September-October, 1998, pp. 764-770.
- SFWMD. 1998. *Interim Plan for Lower East Coast Regional Water Supply*, Planning Department, South Florida Water Management District, West Palm Beach, FL.
- SFWMD. 1996. *Northwest Dade County Freshwater Lake Plan*. South Florida Water Management District, West Palm Beach, FL.

- Shine, M.J., D.G.J. Padgett, and W.M. Barfknecht. 1989. *Ground Water Resource Assessment of Eastern Palm Beach County, Florida*. Technical Publication 89-4, South Florida Water Management District, West Palm Beach, FL.
- Smajstrla, A.G. 1990. *Technical Manual for the Agricultural Field Scale Irrigation Requirements Simulation Model, Version 5.5*. Agricultural Engineering Department, University of Florida, Gainesville, FL.
- Sonenshein, R.S. 1995. *Delineation and Extent of Saltwater Intrusion in the Biscayne Aquifer, Eastern Dade County, Florida*. Water-Resources Investigations Report 96-4285, U.S. Geological Survey, 1 sheet.
- Sonenshein, R.S. and E.J. Koszalka. 1996. *Trends in Water-table Altitude (1984-93) and Saltwater Intrusion (1974-93) in the Biscayne Aquifer, Dade County, Florida*. Open-File Report 95-705, U.S. Geological Survey, 2 sheets.
- Swayze, L.J., and W.L. Miller. 1984. *Hydrogeology of a Zone of Secondary Permeability in the Surficial Aquifer of Eastern Palm Beach County, Florida*. USGS Water Resources Investigations Report 83-4249, Books and Open-File Reports Section, U.S. Geological Survey, Federal Center, Denver, CO.
- Wilsnack, M.M. 1995. The Use of ARC/INFO and MODFLOW to Evaluate the Feasibility of Using Limestone Mining Quarries in Southern Florida as Ground Water Recharge Basins. In *Proceedings of the Seventh Biennial Symposium on the Artificial Recharge of Ground Water: the Role of Recharge in Integrated Water Management*. Tempe, AZ, pp. 199-213.
- Wilsnack, M.M. and S.K. Nair. 1998. Designing an ARC/INFO Database for a MODFLOW Model: a Case Study in the Limestone Mining Belt of Southern Florida. In *Proceedings for MODFLOW'98*. Colorado School of Mines, CO, October 4-8, 1998, Volume II, pp. 649-656.
- Wilsnack, M.M., S.K. Nair, and J. Obeysekera. 1997. *Hydrologic Modeling of Initial Lake Belt Alternative Configurations: Ground Water Modeling*. Hydrologic Systems Modeling Division, South Florida Water Management District, West Palm Beach, FL, 66 pp.
- Yan, J.J., C. Bevier, and K.A. Smith, 1995. *Revision and Recalibration of the Three-Dimensional Ground Water Model of Palm Beach County, Florida*. Technical Publication DRE 322, South Florida Water Management District, West Palm Beach, FL.

Appendix G

ENGINEERING DESIGN AND COST ESTIMATES

CAPACITY

The minimum and maximum capacity of each water resource development project expected to be in operation by 2020 was estimated. These capacities are listed in **Table 53 (Chapter 5)** of the Planning Document. The original estimates were developed in the early stages of the Central and Southern Florida Project Comprehensive Review Study (Restudy). The capacities are based on preliminary land suitability analysis used in conjunction with a Geographic Information System (GIS). The analysis included location, land availability, need of the project, and other decisive parameters.

This preliminary analysis and information was assembled as data used in the regional and subregional models. Results regarding sizes, capacities, location, and other parameters were gathered from the models and refined. Other factors such as policies, discussions regarding land acquisition, and other constraints were included in the original estimates.

The capacities of each component are given in acre-feet (ac-ft) and/or million gallons per day (MGD). Surface storage is usually measured in ac-ft to describe an area (acres) filled with water at a certain depth (feet). When a component deals with pumpage, ground water, or Aquifer Storage and Recovery (ASR) the units are presented in MGD to represent a volume of water (million gallons) that are moved in a day.

COST ESTIMATES

The Restudy projects are being refined and implemented in the Comprehensive Everglades Restoration Plan (CERP). The estimated total costs, federal and nonfederal, of each of the CERP projects within the LEC Planning Area and the Caloosahatchee Basin are provided in **Table G-1**. This table also breaks down the costs by Project Implementation Report (PIR), real estate acquisition, design, plans and specifications, and construction costs. Annual estimates of nonfederal funding responsibility for fiscal years 2001 to 2005 and the total cost nonfederal through FY 2020 for these projects are provided in **Tables 93 and 94 (Chapter 6)** of the Planning Document. These projects are described in detail in **Appendix C**.

Table G-1. Estimated Total Costs of CERP Projects.^a

Component	Project Implementation Report	Real Estate Acquisition	Design	Plans and Specs.	Construction	Total
Lake Okeechobee						
Lake Okeechobee Water Supply and Environmental Schedule	\$0	\$0	\$0	\$0	\$0	\$0
Lake Okeechobee ASR	\$45,705,000	\$7,515,001	\$22,851,999	\$7,617,002	\$1,013,623,000	\$1,097,312,002
Lake Okeechobee Service Area						
Lake Okeechobee Watershed Water Quality Treatment Facilities	\$1,970,000	\$14,448,000	\$985,000	\$328,000	\$44,516,000	\$62,247,000
North Of Lake Okeechobee Storage Reservoir	\$3,921,000	\$189,720,001	\$1,961,000	\$654,001	\$88,597,999	\$284,854,001
C-44 Basin Storage Reservoir ^b	\$902,000	\$90,675,000	\$451,000	\$150,000	\$20,384,000	\$112,562,000
C-43 Basin Storage Reservoir with ASR	\$12,926,001	\$132,621,000	\$6,463,000	\$2,154,001	\$286,031,000	\$440,195,002
L-8 Project	See PIR for Storage and ASR Storage	\$4,290,000	\$1,441,000	\$480,000	\$65,105,000	\$71,316,000
Lake Okeechobee Tributary Sediment Dredging	\$157,000	\$900,000	\$78,000	\$26,000	\$3,539,000	\$4,700,001
Taylor Creek/Nubbin Slough Storage and Treatment Area (STA)	\$3,064,000	\$29,700,000	\$1,532,000	\$511,000	\$69,220,000	\$104,027,000
Caloosahatchee Backpumping with STA	\$2,874,000	\$13,179,000	\$1,437,001	\$479,000	\$64,926,000	\$82,895,001
Estuaries						
Environmental Water Supply Deliveries to the Caloosahatchee Estuary	\$0	\$0	\$0	\$0	\$0	\$0
Environmental Water Supply Deliveries to the St. Lucie Estuary	\$0	\$0	\$0	\$0	\$0	\$0
C-23/C-24/Northfork and Southfork Storage Reservoirs ^b	\$11,590,000	\$429,048,000	\$5,795,000	\$1,932,000	\$261,858,000	\$710,223,000
Everglades Agricultural Area						
Everglades Agricultural Area (EAA) Storage Reservoir	\$14,432,001	\$86,536,000	\$7,216,000	\$2,405,000	\$326,059,001	\$436,648,002
Revised Holey Land Wildlife Management Area (WMA) Operation Plan	\$0	\$0	\$0	\$0	\$0	\$0
Modified Rotenberger WMA Operation Plan	\$0	\$0	\$0	\$0	\$0	\$0
North Palm Beach Service Area						
C-17 Backpumping	\$0	\$10,367,001	\$607,001	\$67,000	\$9,149,001	\$20,190,003
Pal-Mar/Corbett WMA Hydropattern Restoration	\$0	\$8,000,000	\$155,000	\$17,000	\$2,328,000	\$10,500,000

Table G-1. Estimated Total Costs of CERP Projects.^a (Continued)

Component	Project Implementation Report	Real Estate Acquisition	Design	Plans and Specs.	Construction	Total
C-51 and Southern L-8 Reservoir	See PIR for Storage and ASR Storage	\$27,351,000	\$6,464,001	\$2,155,000	\$292,086,001	\$328,056,002
Lower East Coast Service Area 1						
Hillsboro (Site 1) Impoundment	\$0	\$23,587,000	\$924,000	\$103,000	\$13,921,000	\$38,535,000
Hillsboro (Site 1) ASR	\$4,197,999	\$0	\$2,099,001	\$700,000	\$85,847,000	\$92,844,000
Acme Basin B Discharge	\$0	\$8,500,000	\$717,000	\$80,000	\$10,803,000	\$20,100,000
C-51 Backpumping and Treatment	\$0	\$13,475,000	\$1,185,001	\$132,000	\$17,840,000	\$32,632,001
C-51 Regional Ground Water ASR	See PIR for Storage and ASR Storage	\$9,945,000	\$2,522,000	\$841,000	\$113,983,000	\$127,291,000
Lake Worth Lagoon Restoration	\$82,000	\$300,000	\$41,000	\$14,000	\$1,863,000	\$2,300,000
Winsburg Farms Wetlands Restoration	\$412,000	\$4,140,000	\$206,000	\$69,000	\$9,313,001	\$14,140,001
Protect/Enhance Existing Wetlands along Loxahatchee National Wildlife Refuge (Strazzulla)	\$0	\$48,972,001	\$235,000	\$26,000	\$3,539,000	\$52,772,001
Palm Beach County Agricultural Reserve Reservoir with ASR	See PIR for Storage and ASR Storage	\$57,657,000	\$1,369,000	\$456,000	\$61,877,000	\$121,359,000
Lower East Coast Service Area 2						
Western C-11 Diversion Impoundment and Canal	\$0	\$82,520,000	\$2,616,000	\$291,001	\$39,410,000	\$124,837,001
C-9 STA/Impoundment	\$0	\$62,939,001	\$1,620,000	\$180,000	\$24,407,001	\$89,146,002
Broward County Secondary Canal System	\$453,001	\$1,919,999	\$226,001	\$75,000	\$10,224,001	\$12,898,002
Lower East Coast Service Area 3						
North Lake Belt Storage Area (NLBSA)	See PIR for Lake Belt Storage and Conveyance	\$154,868,001	\$7,855,999	\$2,618,000	\$335,004,000	\$500,346,000
Central Lake Belt Storage Area (CLBSA)	See PIR for Lake Belt Storage and Conveyance	\$100,359,000	\$8,154,001	\$2,718,000	\$355,494,001	\$466,725,000
C-4 Control Structures	\$76,000	\$495,001	\$38,001	\$13,000	\$1,708,000	\$2,330,002
Pineland and Hardwood Hammocks Restoration	\$25,000	\$0	\$12,000	\$4,000	\$559,000	\$600,000
Bird Drive Recharge Area	\$0	\$71,624,999	\$3,243,000	\$360,001	\$48,855,001	\$124,083,001
L-31N Levee Improvements for Seepage Management	See PIR for Levee Seepage Management	\$0	\$1,414,000	\$471,000	\$63,897,000	\$65,782,000
Dade-Broward Levee/Pennsuko Wetlands	\$0	\$8,676,000	\$624,000	\$69,000	\$9,409,000	\$18,778,000
Reroute Miami-Dade County Water Supply Deliveries	See PIR for WCA Connectivity	\$25,800,000	\$1,057,001	\$352,001	\$47,764,000	\$74,973,000

Table G-1. Estimated Total Costs of CERP Projects.^a (Continued)

Component	Project Implementation Report	Real Estate Acquisition	Design	Plans and Specs.	Construction	Total
C-111N Spreader Canal	\$1,990,000	\$45,766,001	\$995,000	\$332,000	\$44,952,001	\$94,035,002
South Miami-Dade County Reuse	\$14,827,000	\$3,324,000	\$7,413,001	\$2,471,001	\$334,989,001	\$363,024,003
West Miami-Dade County Reuse	\$17,972,000	\$3,540,001	\$8,986,001	\$2,995,000	\$403,744,000	\$437,237,002
Water Conservation Area 1						
Loxahatchee National Wildlife Refuge Internal Canal Structures	\$453,000	\$345,001	\$0	\$50,000	\$6,821,000	\$7,669,001
Everglades Rain-Driven Operations	\$0	\$0	\$0	\$0	\$0	\$0
Water Conservation Area 2						
Divert Flows from Water Conservation Area (WCA) 2 to CLBSA	See PIR for Lake Belt Storage and Conveyance	\$13,013,000	\$1,357,000	\$452,001	\$61,334,000	\$76,156,001
Water Conservation Area 3						
WCA-3A and WCA-3B Levee Seepage Management	See PIR for Levee Seepage Management	\$85,126,000	\$313,000	\$104,000	\$14,164,000	\$99,707,000
Additional S-345 Structures	See PIR for WCA Connectivity	\$0	\$999,000	\$333,001	\$45,121,000	\$46,453,001
Construction of S-356 Structures and Relocation of a Portion of L-31N Borrow Canal	See PIR for Levee Seepage Management	\$94,704,000	\$431,001	\$144,000	\$19,467,000	\$114,746,001
Decomartmentalize WCA-3	\$2,440,000 (Phase II) For Phase I see PIR for WCA Connectivity	\$479,000	\$1,765,000	\$589,000	\$79,786,001	\$85,059,001
Flow to Northwest and Central WCA-3A	\$855,000		\$427,000	\$142,000	\$19,315,000	\$20,739,000
Divert Flows from WCA-3 to CLBSA	See PIR for Lake Belt Storage and Conveyance	\$308,000	\$10,000	\$3,000	\$444,000	\$765,000
Divert Flows from CLBSA to WCA-3B	See PIR for Lake Belt Storage and Conveyance	\$0	\$141,000	\$47,000	\$6,356,000	\$6,544,000
G-404 Pump Station Modification	\$418,000	\$209,000		\$70,000	\$9,441,000	\$10,138,000
Bays						
Biscayne Bay Coastal Wetlands	\$3,871,001	\$205,655,000	\$1,936,001	\$645,000	\$87,476,001	\$299,583,003
Florida Keys						
Florida Keys Tidal Restoration	\$49,000	\$51,000	\$25,000	\$8,000	\$1,118,000	\$1,251,000
Big Cypress Basin						
Big Cypress/L-28 Interceptor Modifications	\$1,486,000	\$6,700,000	\$743,000	\$248,000	\$33,574,000	\$42,751,000
Micosukee Tribe Water Management Plan	\$937,001	\$1,718,000	\$469,000	\$156,000	\$21,179,001	\$24,459,002

Table G-1. Estimated Total Costs of CERP Projects.^a (Continued)

Component	Project Implementation Report	Real Estate Acquisition	Design	Plans and Specs.	Construction	Total
Seminole Tribe Big Cypress Reservation Water Conservation Plan	\$2,867,000	\$5,735,000	\$1,433,000	\$478,000	\$64,775,000	\$75,288,000
Systemwide						
Melaleuca Eradication Project and Other Exotic Plants	\$0	\$0	\$357,000	\$40,000	\$5,375,001	\$5,772,001
Combined Project Implementation Reports						
PIR for Storage and ASR Storage	\$23,593,999	\$0	\$0	\$0	\$0	\$23,593,999
PIR for Lake Belt Storage and Conveyance	\$35,043,000	\$0	\$0	\$0	\$0	\$35,043,000
PIR for WCA Connectivity	\$5,202,000	\$0	\$0	\$0	\$0	\$5,202,000
PIR for Levee Seepage Management	\$4,317,000	\$0	\$0	\$0	\$0	\$4,317,000

a. Costs are in October 1999 dollars (USACE and SFWMD, 1999).

b. Costs of this project are not included in Table 93 in Chapter 6 of the LEC Plan Planning Document. They will be included in the next update of the Upper East Coast Water Supply Plan.

REFERENCES

USACE and SFWMD. 1999. *Central and Southern Florida Flood Control Project Comprehensive Review Study Final Integrated Feasibility Report and Programmatic Environmental Impact Statement*. U.S. Army Corps of Engineers, Jacksonville District, Jacksonville, FL, and South Florida Water Management District, West Palm Beach, FL.

