SOUTH FLORIDA WATER MANAGEMENT DISTRICT

KISSIMMEE BASIN
Water Supply Plan
APPENDICES

2005-2006 UPDATE

sfwmd.gov

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A

Water Supply Development Projects

Table 1. Kissimmee Basin Planning Area Water User Proposed Water Supply Development Projects.

County	Utility / Entity	Project	Water Source	Total Water Produced (MGD)	Year Water is First Produced	Total Est. Capital Costs ($M)	Annual O&M Costs ($M)	Eligible for AWS Funding by SFWMD?
Okeechobee	Okeechobee County	L63N Reuse Piping	Reclaimed	2.50	2008	3.00	0.03	Y
Okeechobee	Okeechobee County	R-Bar Estates Reuse System	Reclaimed	0.85	2007	0.50	0.01	Y
Okeechobee	Okeechobee County	Raulerson and Sons Ranch Stormwater Reuse	Surface Supplies	1.15	2008	0.72	0.02	Y
Okeechobee	Okeechobee County	101 Ranch 17.2 Acre Reservior	Surface Supplies	0.20	2006	0.10	0.00	Y
Okeechobee	Okeechobee County	101 Ranch 44 Acre Reservior	Surface Supplies	0.20	2006	0.09	0.00	Y
Okeechobee	Okeechobee County	Cornerstone Farms Stormwater Irrigation	Surface Supplies	0.20	2006	0.11	0.00	Y
Okeechobee	Okeechobee County	DHW Sod & Cattle Stormwater Irrigation	Surface Supplies	0.20	2006	0.13	0.00	Y
Okeechobee	Four K Ranch	Rothert Farms Stormwater Recycling	Stormwater	2.00	2008	0.27	0.00	Y
Okeechobee	Joe Hall	Raulerson & Son Ranch Stormwater Recycling	Stormwater	1.15	2008	0.42	0.00	Y
Orange	CROT Regional	South Bermuda – Osceola Parkway Reclaimed Water Transmission Main	Reclaimed	2.70	2006	3.00	0.00	Y

* CROT Regional – a regional partnership between the utilities for the City of Cocoa, Reedy Creek Improvement District, Orange County Public Utilities and the Toho Water Authority.

Table 1. Kissimmee Basin Planning Area Water User Proposed Water Supply Development Projects (Continued).

County	Utility / Entity	Project	Water Source	Total Water Produced (MGD)	Year Water is First Produced	Total Est. Capital Costs ($M)	Annual O&M Costs ($M)	Eligible for AWS Funding by SFWMD?
Orange	CROT Regional	Osceola Parkway Reclaimed Water Transmission Main	Reclaimed	1.50	2010	1.40	0.00	Y
Orange	CROT Regional	Osceola Parkway Reclaimed Water Extension (TWA-RCID East)	Reclaimed	2.70	2009	1.10	0.00	Y
Orange	CROT Regional	Osceola Parkway Reclaimed Water Extension (TWA-RCID West)	Reclaimed	0.40	2008	0.30	0.00	Y
Orange	CROT Regional	Buenaventura Lakes Wetland Impoundment	Reclaimed	0.90	2008	3.00	0.00	Y
Orange	CROT Regional	Reedy Creek Augmentation System	Reclaimed	4.00	2008	6.00	0.00	Y
Orange	CROT Regional	Highway 532 Reclaimed Water Transmission Main	Reclaimed	7.00	2007	4.60	0.00	Y
Orange	CROT Regional	Vistana – RCID Reclaimed Water Transmission Main	Reclaimed	1.50	2008	0.90	0.00	Y
Orange	CROT Regional	RCID – Water Conser II/ Horizon West Reclaimed Water Transmission Main	Reclaimed	6.10	2011	0.30	0.00	Y
Orange	CROT Regional	WEDS – Osceola Parkway Reclaimed Water Transmission Main	Reclaimed	18.60	2008	2.70	0.00	Y

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Table 1. Kissimmee Basin Planning Area Water User Proposed Water Supply Development Projects (Continued).

County	Utility / Entity	Project	Water Source	Total Water Produced (MGD)	Year Water is First Produced	Total Est. Capital Costs ($M)	Annual O&M Costs ($M)	Eligible for AWS Funding by SFWMD?
Orange	CROT Regional	St. Cloud Wholesale	Reclaimed	2.40	2007	2.20	0.00	Y
Orange	CROT Regional	WEDS Impoundment	Reclaimed	0.90	2011	0.80	0.00	Y
Orange	CROT Regional	Partin Ranch Impoundment (Kings Highway)	Surface Supplies	1.00	2008	4.00	0.00	Y
Orange	CROT Regional	Shingle Creek Augmentation System Expansion	Surface Supplies	2.00	2007	2.50	0.00	Y
Orange	CROT Regional	RCID Surface Water Impoundment #1	Surface Supplies	2.20	2011	0.80	0.00	Y
Orange	CROT Regional	RCID Surface Water Impoundment #2	Surface Supplies	0.20	2011	0.80	0.00	Y
Orange	CROT Regional	St. Johns River at State Road 50 Water Supply Project	Surface Supplies	10.00	2016	100.00	4.35	Y
Orange	CROT Regional	St. Johns River/Taylor Creek Reservoir Water Supply Project	Surface Supplies	10.00 (est. SF portion)	2011	225.00	11.80	Y
Orange	Orange County Utilities	20-inch Reclaimed Water Main; CR 535 to John Young Parkway (JYP) – Vistana to JYP	Reclaimed	4.00	2009	8.50	0.01	Y
Orange	Orange County Utilities	Universal South Reuse Transmission Main	Reclaimed	9.00	2009	1.00	0.01	Y

* CROT Regional – a regional partnership between the utilities for the City of Cocoa, Reedy Creek Improvement District, Orange County Public Utilities and the Toho Water Authority.

Table 1. Kissimmee Basin Planning Area Water User Proposed Water Supply Development Projects (Continued).

County	Utility / Entity	Project	Water Source	Total Water Produced (MGD)	Year Water is First Produced	Total Est. Capital Costs ($M)	Annual O&M Costs ($M)	Eligible for AWS Funding by SFWMD?
Orange	Orange County Utilities	John Young Parkway Improvements Phase II; Town Center Blvd to Sand Lake Road	Reclaimed	5.00	2009	4.40	0.01	Y
Orange	Orange County Utilities	Southwest Wastewater Service Area Reclaimed Water System Expansion	Reclaimed	4.00	2010	5.75	0.03	Y
Orange	Orange County Utilities	Orangewood Blvd. Reclaimed Water Main	Reclaimed	6.00	2008	0.80	0.00	Y
Orange	Orange County Utilities	South Water Reclamation Facility Phase 5 Expansion (Reuse System Expansion)	Reclaimed	2.00	2011	25.50	0.14	Y
Orange	Orange County Utilities	Membrane Filtration System	Reclaimed	5.00	2009	11.40	3.29	Y
Orange	Orange County Utilities	East Service Area Reclaimed Water Storage and Repump Facility (Moss Park RW Storage and Repump)	Reclaimed	5.00	2008	2.20	0.01	Y
Orange	Orange County Utilities	Eastern Wastewater Reclamation Facility Public Access Reuse Storage and Pumping Facility	Reclaimed	1.60	2007	4.52	0.00	Y
Orange	Orange County Utilities	Holden Heights Phase 4 Wastewater Collection System (Lake June)	Reclaimed	1.00	2010	2.53	0.01	Y

Table 1. Kissimmee Basin Planning Area Water User Proposed Water Supply Development Projects (Continued).

County	Utility / Entity	Project	Water Source	Total Water Produced (MGD)	Year Water is First Produced	Total Est. Capital Costs ($M)	Annual O&M Costs ($M)	Eligible for AWS Funding by SFWMD?
Orange	Orange County Utilities	Horizon West Water Reclamation Facility	Reclaimed	5.00	2011	7.00	0.00	Y
Orange	Orange County Utilities	CR 535 Reclaimed Water Main from Reams to Grand Cypress Golf Course	Reclaimed	2.00	2008	2.15	0.01	Y
Orange	Orange County Utilities	South Service Area Reuse System Expansion	Reclaimed	5.00	2011	2.30	0.00	Y
Orange	Orange County Utilities	Horizons West Primary Reuse Transmission Mains to Villages H and I	Reclaimed	3.00	2016	2.50	0.01	Y
Orange	Orange County Utilities	Hidden Springs Storage and Repump Facility	Reclaimed	3.00	2008	0.70	0.00	Y
Orange	Orange County Utilities	Orange County Convention Center Stormwater Augmentation Project	Surface Supplies	0.35	2008	2.57	0.02	Y
Orange	Orange County Utilities	Southeast Reuse System Augmentation Project	Surface Supplies	10.00	2009	30.50	3.65	Y
Orange	Orange County Utilities	Southwest Wastewater Service Area Reclaimed Water System Expansion	Surface Supplies	2.00	2010	6.60	0.03	Y
Orange	Orlando Utilities Comm.	RENEW - Wastewater intercept from Iron Bridge and divert to Altamonte and Water Conserv II	Reclaimed	9.20	2011	65.06	0.00	Y

Table 1. Kissimmee Basin Planning Area Water User Proposed Water Supply Development Projects (Continued).

County	Utility / Entity	Project	Water Source	Total Water Produced (MGD)	Year Water is First Produced	Total Est. Capital Costs ($M)	Annual O&M Costs ($M)	Eligible for AWS Funding by SFWMD?
Orange	Orlando Utilities Comm.	Eastern Regional Reclaimed WDS	Reclaimed	10.00	2008	28.86	0.18	Y
Osceola	Poinciana	WWTP # 5 Reuse Expansion	Reclaimed	6.00	2009	5.50	0.00	Y
Osceola	Poinciana	WWTP # 3 Reuse Expansion	Reclaimed	4.00	2009	1.40	0.00	Y
Osceola	CROT Regional	Bull Creek Nonpotable Groundwater Supply	Brackish	15.00	2016	83.00	0.00	Y
Osceola	CROT Regional	Lake Tohopekaliga Nonpotable Water Supply	Surface Supplies	15.00	2016	35.00	0.00	Y
Osceola	CROT Regional	Lake Tohopekaliga Potable Water Supply	Surface Supplies	10.00	2016	61.00	0.00	Y
Osceola	St. Cloud	Sawgrass/Cord Avenue Reclaim Main	Reclaimed	3.00	2010	0.85	0.00	Y
Osceola	St. Cloud	West New Nolte – Michigan to Canoe Creek	Reclaimed	1.00	2007	0.30	0.00	Y
Osceola	St. Cloud	Reclaim Extension – Southern Water Reclamation Facility to Narcoossee Extension	Reclaimed	4.00	2008	0.70	0.00	Y
Osceola	St. Cloud	C-31 Canal Extension	Reclaimed	5.00	2011	1.50	0.00	Y
Osceola	St. Cloud	Narcoossee Extension – Bullis North to 192	Reclaimed	1.80	2011	0.60	0.00	Y
Osceola	St. Cloud	Narcoossee Extension – Bullis South to Alligator Lake Canal	Reclaimed	3.00	2011	1.10	0.00	Y

* CROT Regional – a regional partnership between the utilities for the City of Cocoa, Reedy Creek Improvement District, Orange County Public Utilities and the Toho Water Authority

Table 1. Kissimmee Basin Planning Area Water User Proposed Water Supply Development Projects (Continued).

County	Utility / Entity	Project	Water Source	Total Water Produced (MGD)	Year Water is First Produced	Total Est. Capital Costs ($M)	Annual O&M Costs ($M)	Eligible for AWS Funding by SFWMD?
Osceola	St. Cloud	West New Nolte – Michigan to Narcoossee Extension	Reclaimed	1.80	2011	0.60	0.00	Y
Osceola	St. Cloud	East Lake Toho Surface Water Potable Supply/Augmentation	Surface Supplies	6.00	2007	6.00	0.43	Y
Osceola	St. Cloud	Alligator Lake Surface Water Potable Supply/Augmentation	Surface Supplies	3.00	2016	5.00	0.00	Y
Osceola	St. Cloud	Lake Toho Surface Water Potable Supply/Augmentation	Surface Supplies	4.00	2016	6.00	0.00	Y
Osceola	St. Cloud	East Lake Toho Surface Water Expansion	Surface Supplies	4.00	2015	8.00	1.00	Y
Osceola	St. Cloud	Southern Water Reclamation Facility Reservoir Expansion	Reclaimed	2.00	2007 /2008	1.00	0.10	Y
Osceola	Toho Water Authority	North-Central Osceola County Brackish Wellfield and Treatment Facility	Brackish	15.00	2011	195.84	8.80	Y
Osceola	Toho Water Authority	Westside Reuse Main	Reclaimed	1.50	2007	3.30	0.00	Y
Osceola	Toho Water Authority	Parkway WRF Reuse Ground Storage Tank & Pumping Facility Improvements	Reclaimed	2.00	2007	1.50	0.01	Y
Osceola	Toho Water Authority	South-Central Osceola County Wellfield	Brackish	30.00	2011	45.80	8.80	Y

Table 1. Kissimmee Basin Planning Area Water User Proposed Water Supply Development Projects (Continued).

County	Utility / Entity	Project	Water Source	Total Water Produced (MGD)	Year Water is First Produced	Total Est. Capital Costs ($M)	Annual O&M Costs ($M)	Eligible for AWS Funding by SFWMD?
Osceola	Toho Water Authority	Osceola Parkway Reclaimed Water Main	Reclaimed	16.00	2006	0.00	0.00	Y
Osceola	Toho Water Authority	Shingle Creek Stormwater Reuse	Surface Supplies	6.00	2007	5.72	0.00	Y

Table 2. Projects Submitted to the SFWMD to Serve Future Demands Occurring Outside the SFWMD KB Planning Area.

County	Utility / Entity	Project	Water Source	Total Water Produced (MGD)	Year Water is First Produced	Total Est. Capital Costs ($M)	Annual O&M Costs ($M)	Eligible for AWS Funding by SFWMD?
Osceola	Poinciana	WTP #2 Expansion from 2.02 MGD to 12.0 MGD	Traditional	10.00	2008	9.10	0.00	N
Osceola	Poinciana	Addition of Storage for WTP#3	Traditional	0.50	2011	0.10	0.00	N
Osceola	Poinciana	Expansion of WTP #4	Traditional	0.00	2009	0.70	0.00	N
Osceola	Poinciana	Expansion of WTP #5	Traditional	12.00	2008	4.00	0.00	N
Osceola	Poinciana	Expansion of WTP #1	Traditional	0.00	2012	0.10	0.00	N
Osceola	Poinciana	Expansion of WTP #2	Traditional	4.80	2008	2.90	0.00	N
Osceola	Poinciana	Wellfield Capacity Additions	Traditional	2.90	2007	4.53	0.00	N
Osceola	Poinciana	Water Main Upgrades	Traditional	0.00	2007	8.63	0.00	N
Osceola	Poinciana	Water Plant #5 upgrade - Phase II	Traditional	2.50	2007	5.50	0.00	N
Osceola	Poinciana	Water Plant #2 upgrade - Phase II	Traditional	3.00	2009	11.05	0.00	N
Highland	Highland County	G62 Upper Floridan Aquifer Wellfield, SW Highlands County	Traditional	3.00	2011	10.78	0.45	N
Highland	Highland County	G63 Sebring Upper Floridan Aquifer Wellfield	Traditional	3.00	2011	9.78	0.45	N
Highland	Highland County	G64 Upper Floridan Aquifer Wellfield, Southeast Highlands County	Traditional	0.00	N/A	20.35	0.00	N

Table 2. Projects Submitted to the SFWMD to Serve Future Demands Occurring Outside the SFWMD KB Planning Area (Continued).

County	Utility / Entity	Project	Water Source	Total Water Produced (MGD)	Year Water is First Produced	Total Est. Capital Costs ($M)	Annual O&M Costs ($M)	Eligible for AWS Funding by SFWMD?
Polk	Polk County Utilities	Upper Floridan Aquifer Wellfield #1, Northeast Polk County	Traditional	15.00	2011	108.97	2.16	N
Polk	Polk County Utilities	Upper Floridan Aquifer Wellfield #2, Northeast Polk County	Traditional	15.00	2011	35.36	2.16	N
Polk	Polk County Utilities	Upper Floridan Aquifer Wellfield #1, Southeast Polk County	Traditional	22.50	2011	52.42	3.23	N
Polk	Polk County Utilities	Upper Floridan Aquifer Wellfield #2, Southeast Polk County	Traditional	15.00	2011	39.78	2.16	N
Polk	Polk County Utilities	Kissimmee River/Chain of Lakes Off-Stream Reservoir and ASR	Surface Supplies	35.00	2011	185.68	6.43	N

B

Information for Local Government Comprehensive Plans

The water supply plan updates contain a variety of water supply related information useful to local governments in the preparation and amendment of their comprehensive plans. Much of that information is contained within other appendices or chapters of this 2005–2006 Kissimmee Basin Plan Update (2005-2006 KB Plan Update) and can be found in the following locations:

Water Source Options	Chapters 5 and 7 and Appendix A
Utility Areas Served (2005 & 2025)	Appendices B, D and E
Population Projections (2005–2025)	Chapter 2 and Appendix D
Demand Projections (2005–2025)	Chapter 2 and Appendix D
Water Supply Projects (2005–2025)	Chapter 7 and Appendix A

Other information useful for comprehensive plans is provided as follows:

1. The South Florida Water Management District's (SFWMD or District) checklist of needed comprehensive plan data.
   a. Cited statutory provisions.
2. Tables showing which utilities serve which jurisdiction.
3. Maps of utility areas currently served (2005) and to-be-served (2025).

1. CHECKLIST OF NEEDED COMPREHENSIVE PLAN DATA

This section provides a general checklist of the type of data and information that the SFWMD will be looking for to review water supply issues in local government comprehensive plans. This listing is not all-inclusive, but provides a broad, general framework that should be used in combination with the more detailed, related guidelines developed by the Florida Department of Community

Affairs (FDCA), and case-by-case comments made by the SFWMD on specific water supply issues.

Checklist guidance is given for three water supply aspects of comprehensive plans:

A. Plan Amendments (Future Land Use Change).
B. 10-Year Water Supply Facilities Work Plan and Other Potable Water Sub-Element Revisions
C. Evaluation & Appraisal Report (EAR) Reporting Requirements.

A. Plan Amendments (Future Land Use Change)

Water Supply Demand Projections

- ☐ Address both raw and finished (i.e., after any losses due to water treatment) water supply needs for both potable and nonpotable (i.e., irrigation) demands, using professionally acceptable methodologies.
- ☐ Address existing and future conservation and reuse commitments, and levels of service, for both the proposed future land use change and the comprehensive plan.
- ☐ Address both the build-out time frame for a proposed future land use change, and the established planning time frame for the comprehensive plan.

Water Source Identification

- ☐ For existing demands, reflect water source(s) from supplier's consumptive use permit (CUP).
- ☐ For future demands covered by a supplier's commitment to provide service under remaining available capacity of an existing consumptive use permit, reflect the source(s) from the supplier's CUP.
- ☐ For future demands not covered by an existing CUP, provide sufficient planning level data and analysis to demonstrate the availability of a sustainable water source as identified in the appropriate District regional water supply plan.

Availability of Water Supply and Public Facilities

- ☐ Demonstrate that there is an availability of raw water supply from the proposed source(s) of raw supply for the future land use change, given all other approved land use commitments within the local government's jurisdiction over both the proposed amendment's build-out, and the established planning period of the comprehensive plan. (See Section 163.3167(13), F.S., and Subsection 163.3177(6)(a), F.S.)

- Demonstrate that there is an availability of both treatment facility capacity and permitted, available finished water supply for the future land use change, given all other commitments for that capacity and supply over the proposed build-out time frame.
- If the availability of either water supply and/or public facilities is not currently demonstrable, this will require either phasing of the future land use (see Subsection 163.3177(10)(h), F.S.), and/or appropriate amendments to the Capital Improvements Element, or to the Potable Water Sub-Element, to ensure the necessary capital planning and timely availability of the needed infrastructure and water supply. (See Subsections 163.3177(3)(a) and (6)(c), F.S.)

Related Comprehensive Plan Amendments

- Addressing a future land use change may also require amendments to other specific elements within the comprehensive plan if it requires an adjustment to either the plan's future population or demand projections; the comprehensive plan's established planning period; or, the water supply sources required to be addressed in the comprehensive plan. (See Section 163.3167(13), F.S. and Subsections 163.3177(5)(a), 163.3177(6)(a), 163.3177(6)(c), and 163.3177(6)(d), F.S.)

B. 10-Year Water Supply Facilities Work Plan and Other Potable Water Sub-Element Revisions

(Within 18 months following this update of the KB Water Supply Plan)

Water Supply Demand Projections

- Coordinate with the regional water supply plan's demand projections. Address both raw and finished (i.e., after any losses due to water treatment) water supply needs for both potable and nonpotable (i.e., irrigation) demands within the jurisdiction (regardless of supplier) for at least five-year intervals out to the established planning time frame of the comprehensive plan.
- Address existing and future conservation and reuse commitments and levels of service for the established planning time frame of the comprehensive plan.
- Identify existing and future utility service areas (i.e., areas to be actually served) for each provider within the jurisdiction.
- Identify areas and amounts of any self-supply (i.e., supply by single-family individual wells) separately.

Water Source Identification

- Address the water supply sources necessary to meet and achieve the existing and projected water use demand for the established planning period, considering the regional water supply plan.

Water Supply Project Identification and Selection

- Identify sufficient conservation, reuse, alternative water supply projects and traditional water supply projects necessary to meet projected demands.
- Select and incorporate into the comprehensive plan alternative water supply project(s) selected by the local government from those identified in the regional water supply plan, or propose alternatives.
- Based upon projected demands, include a water supply facilities work plan, covering at least a 10-year planning period, but preferably out to the established planning period, for building all public, private and regional water supply facilities that will provide water supply service within the local government's jurisdiction (e.g., if it is a water provider to land uses within the jurisdiction, its facility planning must be addressed in the work plan).
- Appropriate amendments to the Capital Improvements Element may be required. (See Subsection 163.3177(3)(a), F.S.)

C. Evaluation & Appraisal Report (EAR) Subsection 163.3191(2)(L), F.S.

(Submitted after the adoption of a 10-Year Water Supply Facilities Work Plan)

Water Supply Project Identification and Selection

- Identify the extent to which the local government has been successful in identifying alternative water supply projects and traditional water supply projects, including conservation and reuse, necessary to meet projected demands.
- Evaluate the degree to which the 10-Year Water Supply Facilities Work Plan has been implemented for building all public, private and regional water supply facilities within the jurisdiction necessary to meet projected demands.

1a. CITED STATUTORY PROVISIONS (RELEVANT PORTIONS)

163.3167(13), F.S.: Each local government shall address in its comprehensive plan, as enumerated in this chapter, the water supply sources necessary to meet and achieve the existing and projected water use demand for the established planning period, considering the applicable plan developed pursuant to s. 373.0361.

163.3177(3)(a), F.S.: The comprehensive plan shall contain a capital improvements element designed to consider the need for and the location of public facilities in order to encourage the efficient utilization of such facilities and set forth:

1. A component which outlines principles for construction, extension, or increase in capacity of public facilities, as well as a component which outlines principles for correcting existing public facility deficiencies, which are necessary to implement the comprehensive plan. The components shall cover at least a 5-year period.

2. Estimated public facility costs, including a delineation of when facilities will be needed, the general location of the facilities, and projected revenue sources to fund the facilities.

3. Standards to ensure the availability of public facilities and the adequacy of those facilities including acceptable levels of service.

4. Standards for the management of debt.

5. A schedule of capital improvements which includes publicly funded projects, and which may include privately funded projects for which the local government has no fiscal responsibility, necessary to ensure that adopted level-of-service standards are achieved and maintained. For capital improvements that will be funded by the developer, financial feasibility shall be demonstrated by being guaranteed in an enforceable development agreement or interlocal agreement pursuant to paragraph (10)(h), or other enforceable agreement. These development agreements and interlocal agreements shall be reflected in the schedule of capital improvements if the capital improvement is necessary to serve development within the 5-year schedule. If the local government uses planned revenue sources that require referenda or other actions to secure the revenue source, the plan must, in the event the referenda are not passed or actions do not secure the planned revenue source, identify other existing revenue sources that will be used to fund the capital projects or otherwise amend the plan to ensure financial feasibility.

6. The schedule must include transportation improvements included in the applicable metropolitan planning organization's transportation improvement program adopted pursuant to s. 339.175(7) to the extent that such improvements are relied upon to ensure concurrency and financial feasibility. The schedule must also be coordinated with the

applicable metropolitan planning organization's long-range transportation plan adopted pursuant to s. 339.175(6).

163.3177(5)(a), F.S.: Each local government comprehensive plan must include at least two planning periods, one covering at least the first 5-year period occurring after the plan's adoption and one covering at least a 10-year period.

163.3177(6)(a), F.S.: A future land use plan element designating proposed future general distribution, location, and extent of the uses of land for residential uses, commercial uses, industry, agriculture, recreation, conservation, education, public buildings and grounds, other public facilities, and other categories of the public and private uses of land… . The future land use plan shall be based upon surveys, studies, and data regarding the area, including the amount of land required to accommodate anticipated growth; the projected population of the area; the character of undeveloped land; the availability of water supplies, public facilities, and services; … .

163.3177(6)(c), F.S.: A general sanitary sewer, solid waste, drainage, potable water, and natural groundwater aquifer recharge element correlated to principles and guidelines for future land use, indicating ways to provide for future potable water, drainage, sanitary sewer, solid waste, and aquifer recharge protection requirements for the area. The element may be a detailed engineering plan including a topographic map depicting areas of prime groundwater recharge. The element shall describe the problems and needs and the general facilities that will be required for solution of the problems and needs. The element shall also include a topographic map depicting any areas adopted by a regional water management district as prime groundwater recharge areas for the Floridan or Biscayne aquifers. These areas shall be given special consideration when the local government is engaged in zoning or considering future land use for said designated areas. For areas served by septic tanks, soil surveys shall be provided which indicate the suitability of soils for septic tanks. Within 18 months after the governing board approves an updated regional water supply plan, the element must incorporate the alternative water supply project or projects selected by the local government from those identified in the regional water supply plan pursuant to s. 373.0361(2)(a) or proposed by the local government under s. 373.0361(7)(b). If a local government is located within two water management districts, the local government shall adopt its comprehensive plan amendment within 18 months after the later updated regional water supply plan. The element must identify such alternative water supply projects and traditional water supply projects and conservation and reuse necessary to meet the water needs identified in s. 373.0361(2)(a) within the local government's jurisdiction and include a work plan, covering at least a 10-year planning period, for building public, private, and regional water supply facilities, including development of alternative water supplies, which are identified in the element as necessary to serve existing and new development. The work plan shall be updated, at a minimum, every 5 years within 18 months after the governing board of a water management district approves an updated regional water supply plan. Amendments to incorporate the work plan do not count toward the limitation on the frequency of adoption of amendments to the comprehensive plan. Local governments, public and private utilities, regional water supply authorities, special districts and water management districts are encouraged to cooperatively plan for the development of multijurisdictional water supply facilities that are sufficient to meet projected demands for established planning periods, including the development of alternative water sources to supplement traditional sources of groundwater and surface water supplies.

163.3177(6)(d), F.S.: A conservation element for the conservation, use, and protection of natural resources in the area, including air, water, water recharge areas, wetlands, waterwells, estuarine marshes, soils, beaches, shores, flood plains, rivers, bays, lakes, harbors, forests, fisheries and wildlife, marine habitat, minerals, and other natural and environmental resources. Local governments shall assess their current, as well as projected, water needs and sources for at least a 10-year period, considering the appropriate regional water supply plan approved pursuant to s. 373.0361, or, in the absence of an approved regional water supply plan, the district water management plan approved pursuant to s. 373.036(2). This information shall be submitted to the appropriate agencies… .

163.3177(10)(h), F.S.: It is the intent of the Legislature that public facilities and services needed to support development shall be available concurrent with the impacts of such development in accordance with s. 163.3180. In meeting this intent, public facility and service availability shall be deemed sufficient if the public facilities and services for a development are phased, or the development is phased, so that the public facilities and those related services which are deemed necessary by the local government to operate the facilities necessitated by that development are available concurrent with the impacts of the development. The public facilities and services, unless already available, are to be consistent with the capital improvements element of the local comprehensive plan as required by paragraph (3)(a) or guaranteed in an enforceable development agreement. This shall include development agreements pursuant to this chapter or in an agreement or a development order issued pursuant to chapter 380. Nothing herein shall be construed to require a local government to address services in its capital improvements plan or to limit a local government's ability to address any service in its capital improvements plan that it deems necessary.

163.3191(2)(l), F.S.: The extent to which the local government has been successful in identifying alternative water supply projects and traditional water supply projects, including conservation and reuse, necessary to meet the water needs identified in s. 373.0361(2)(a) within the local government's jurisdiction. The report must evaluate the degree to which the local government has implemented the work plan for building public, private and regional water supply facilities, including development of alternative water supplies, identified in the element as necessary to serve existing and new development.

2. TABLES SHOWING WHICH UTILITIES SERVE WHICH JURISDICTIONS

This portion of Appendix B contains two tables showing local government jurisdictions and the utilities that provide raw or finished water to those local governments. **Table 1** is listed by local governments within the KB Planning Area. **Table 2** is listed by utility serving specific local government jurisdictions within the KB Planning Area.

Table 1. The Local Governments in the KB Planning Area and the Utilities Serving Them.

Local Government	County	Utility Serving Local Government
Glades County (unincorporated)	Glades	Brighton Reservation serving the Lakeport Water Association Area (unincorporated)
Highlands County (unincorporated)	Highlands	Spring Lake Improvement District (unincorporated)
Okeechobee County (unincorporated)	Okeechobee	Okeechobee Utility Authority Serves both the County and City of Okeechobee (interlocal agreement)
Okeechobee City	Okeechobee	Okeechobee Utility Authority
Orange County (unincorporated)	Orange	Taft Water Association
Bay Lake	Orange	Reedy Creek Improvement District
Lake Buena Vista	Orange	Reedy Creek Improvement District; Orange County Utilities
Ocoee	Orange	Orange County Utilities (wastewater only)
Orlando	Orange	Orlando Utilities Commission and Orange County Utilities
Reedy Creek	Orange	Reedy Creek Improvement District
Windermere	Orange	Orange County Utilities
Winter Garden	Orange	Orange County Utilities (reclaimed only)
Osceola County (unincorporated)	Osceola	Toho Water Authority, City of St. Cloud Utilities, O&S Water Company, Poinciana Utilities
Kissimmee	Osceola	Toho Water Authority
St. Cloud	Osceola	City of St. Cloud Utilities
Polk County (unincorporated)	Polk	Toho Water Authority (bulk agreement through 2009)

Table 2. The Utilities and the Local Governments They Serve in the KB Planning Area.

Utility Name	County	Local Governments Served (raw & finished)
Seminole Tribe of Florida	Glades	Lakeport Water Association (unincorporated)
Spring Lake Improvement District	Highlands	Spring Lake Improvement District (unincorporated)
Okeechobee Utility Authority	Okeechobee	City of Okeechobee, Okeechobee County
Orange County Utilities	Orange	Orange County Unincorporated, Ocoee, Winter Garden, Lake Buena Vista,
Orlando Utilities	Orange	City of Orlando, parts of Orange County
Reedy Creek Improvement District	Orange	Reedy Creek Improvement District, Lake Buena Vista
Taft Water Association	Orange	Taft Area (unincorporated Orange)
Poinciana Utilities	Osceola	Poinciana Area (unincorporated Osceola County)
City of St. Cloud Utilities	Osceola	St. Cloud, Osceola County
Toho Water Authority	Osceola	Osceola County, Kissimmee
O&S Water Company	Osceola	Pleasant Hill Estates (unincorporated Osceola County)
Poinciana Utilities	Polk	Poinciana Area (unincorporated Polk)
Polk County Utilities	Polk	Polk County – Oak Hill Estates

3. MAPS OF UTILITY AREAS CURRENTLY SERVED (2005) AND TO-BE-SERVED (2025)

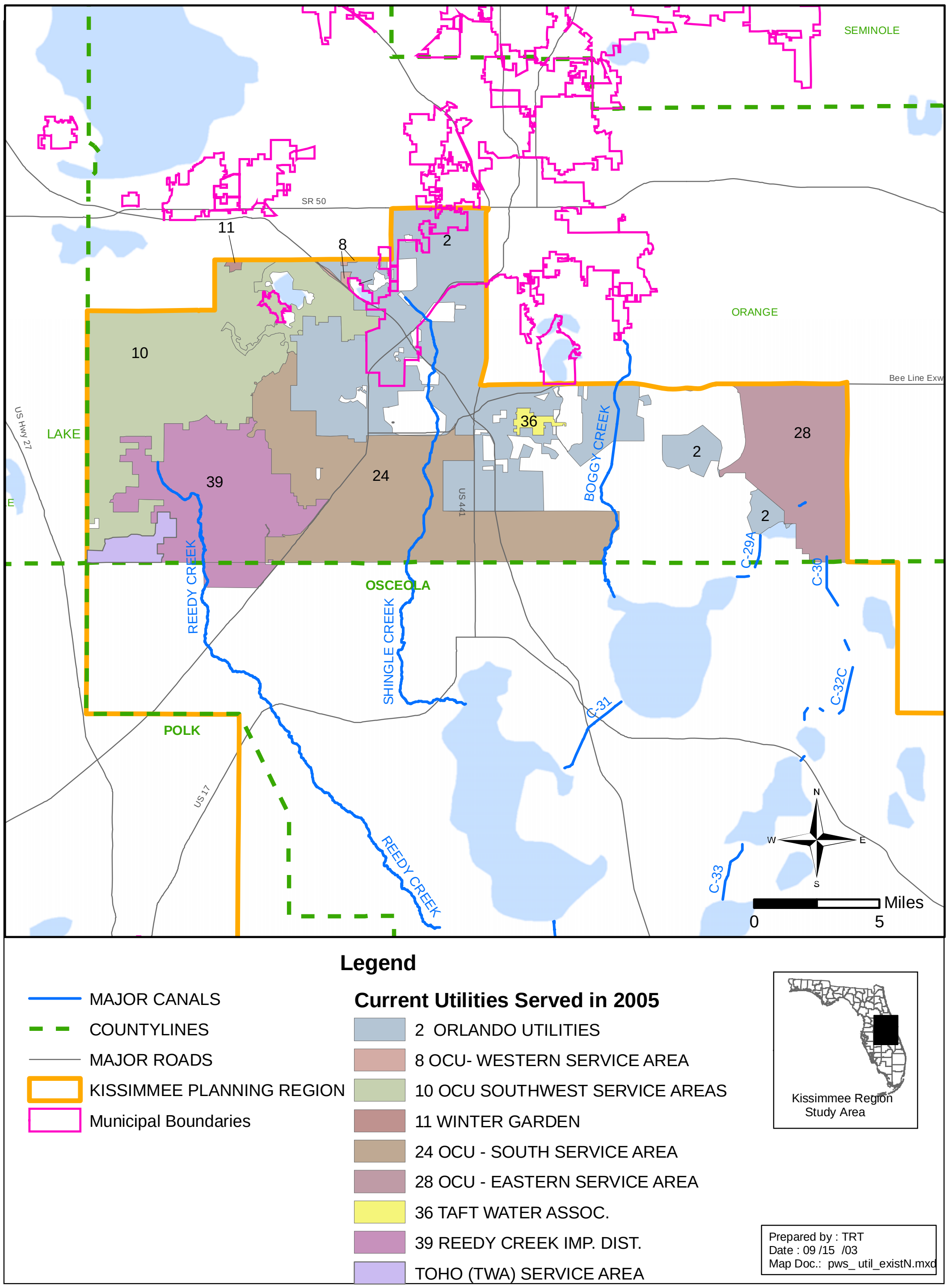

Figure 1. 2005 Utility Areas Served in Orange County.

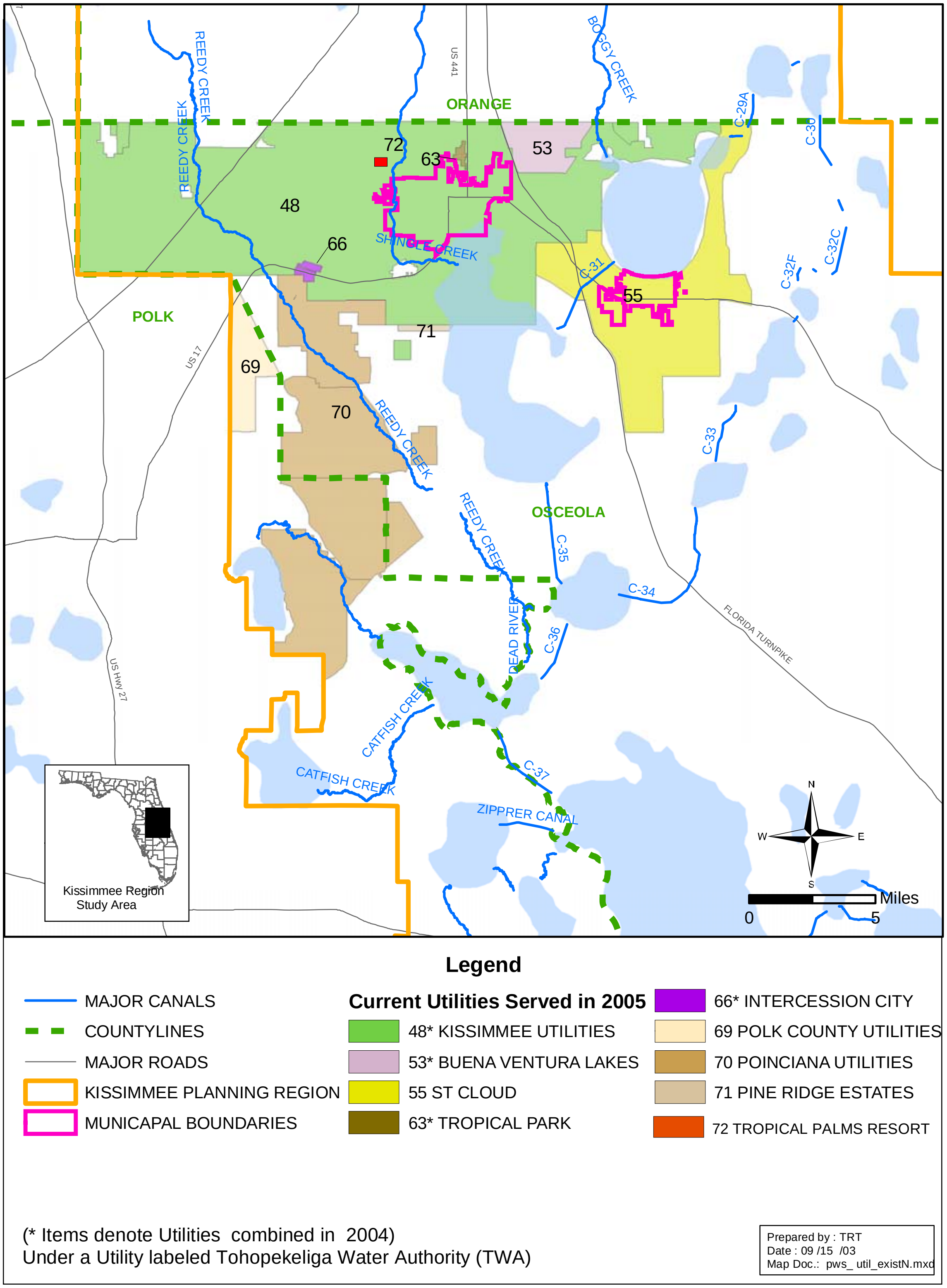

Figure 2. 2005 Utility Areas Served in Osceola and Polk Counties.

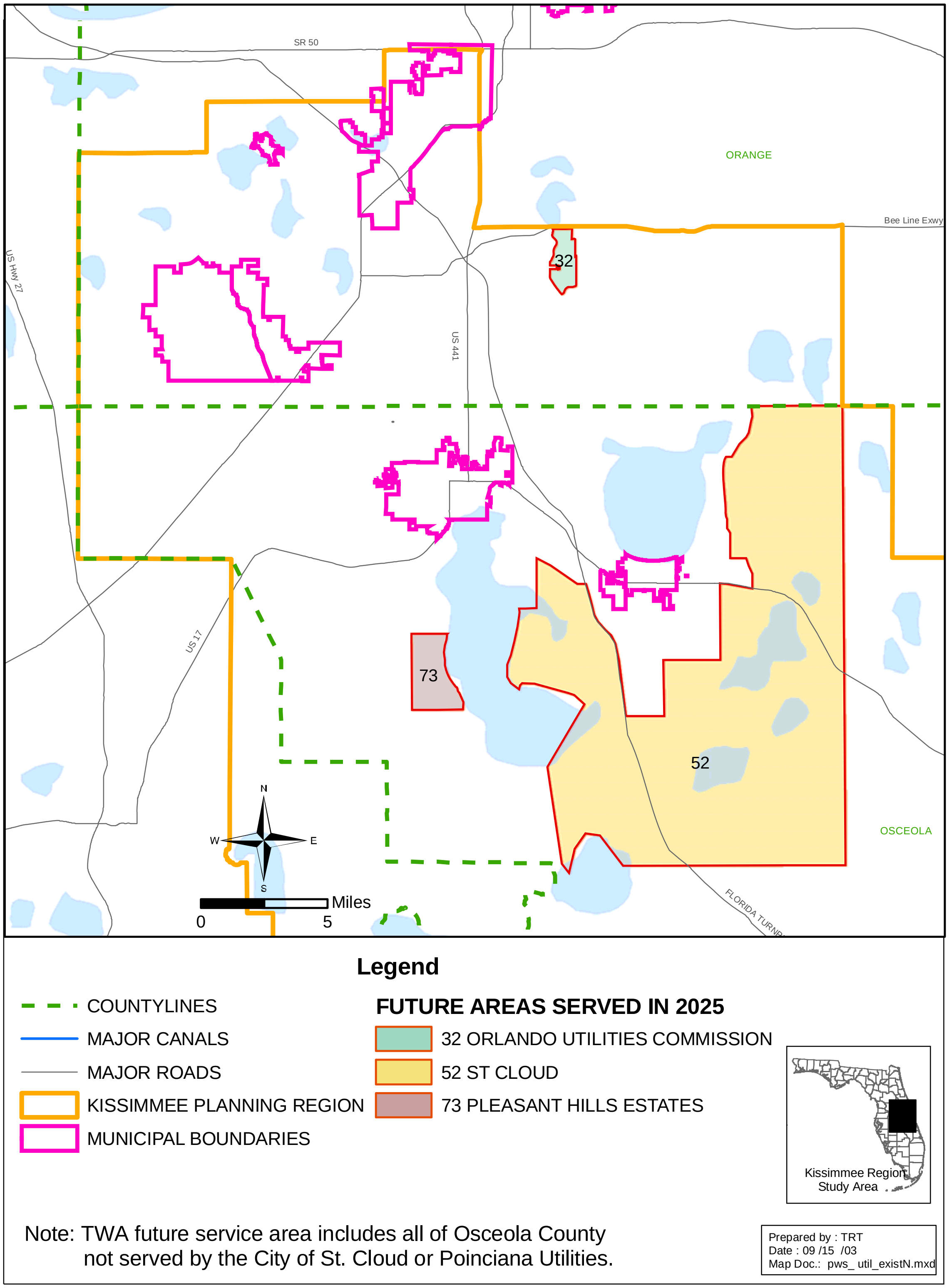

Figure 3. 2025 Utility Areas To-Be-Served in Orange, Osceola and Polk Counties.

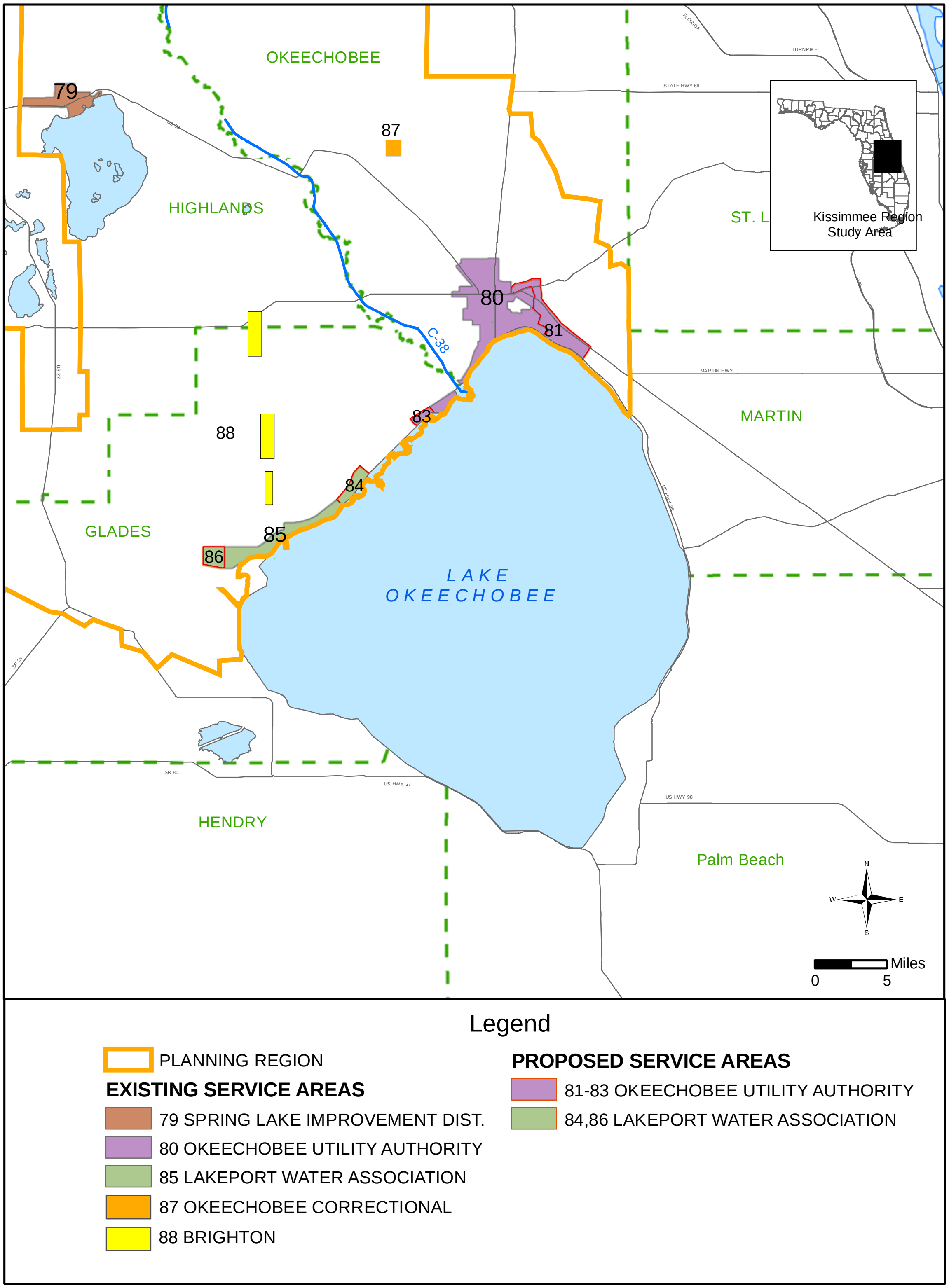

Figure 4. Utility Service Areas in the Southern Kissimmee Basin.

C
Accomplishments

OVERVIEW

In preparing the *2000 Kissimmee Basin Water Supply Plan* (2000 KB Plan), the planning process analyses identified key regional issues. To resolve these issues, the 2000 KB Plan contained seven strategies, which included 11 water resource development recommendations with 30 subtasks. In addition, three water supply development recommendations were made. These recommendations were developed to either address unresolved issues, advance efforts in defining alternative water supplies or make suggested changes in the South Florida Water Management District's (SFWMD or District) regulatory rules. The 2000 KB Plan recommendations, although varied, were organized into four general categories:

- Hydrologic investigations.
- Resource protection criteria refinements.
- Alternative supply development.
- Regulatory changes and inter-District coordination.

The recommendations had regional, as well as local responsibilities. Twenty-three of the 30 tasks listed under the recommendations were initiated. The remaining seven tasks were not implemented due to lack of feasibility or delayed implementation of related projects.

The following summarizes the recommendations in the 2000 KB PLan and the progress of these recommendations.

Implementation of 2000 KB Plan Recommendations

1.0 Minimize Drawdown Through Floridan Aquifer Recharge

1.1 Develop a Regional Reclaimed Water Optimization Plan

1.1.a Develop a Reuse Plan

Recommendation: The District will participate, along with local utilities and other water management districts, in the development of a regional wastewater reuse plan to optimize the use of reclaimed water to offset Floridan Aquifer drawdown and avoid potential harm to the resources. Components of this plan will address storage; supplemental sources; utility interconnects; institutional framework and interlocal agreements; local, District and Florida Department of Environmental Protection (FDEP) regulations; funding incentives; off-peak reclaimed water use; and, water conservation.

Progress: The District completed an inventory of existing and projected water reclamation facilities to document existing and estimate future supplies of reclaimed water, and to examine future reclaimed water demands of the central Florida area in 2005. As part of this work, the District collected baseline information from each utility within Osceola and Orange counties, and in portions of Polk and Lake counties. The data included existing and projected information on infrastructure, disposal methods and customer use. The data was then used to estimate the impacts of aquifer recharge and demand reduction on future water supply. Information about future land use planning was acquired to predict potential locations of new residential growth. This information was used to make predictions about wastewater generation amounts and to identify corridors for new reclaimed water reuse.

1.1.b Hydrologic Investigations of the Surficial, Intermediate and Floridan Aquifers

Recommendation: The District will complete hydrologic investigations, in cooperation with local, state and federal agencies, on the Surficial, Intermediate and Floridan aquifers in support of recharge optimization modeling. The focus of these studies should be on Orange, Osceola, and Polk counties and in areas where the risk of harm to the resources is estimated to be the greatest.

Progress: Starting in Fiscal Year 2001, the District began a program of installing and monitoring "paired" well sites. The focus of these efforts was in Orange and Osceola counties, but also included developing sites in Polk and Okeechobee counties.

From 2002 to 2005, the SFWMD invested nearly $1.1 million to place paired shallow and Floridan Aquifer wells at 32 sites. Each station contains continuous water level recorders monitored by the District. Each site contained, at a minimum, one well in the Surficial Aquifer and one well in the Floridan Aquifer. Several sites included a nested well set that also monitored the intermediate confining units and the Lower Floridan Aquifer.

In addition, the District initiated a contract for the construction and testing of six Upper and Lower Floridan Aquifer wells. Along with the U.S. Geologic Survey (USGS), the District hired a vendor to conduct hydrologic studies of Orange and Polk counties and entered into an agreement to monitor monthly water levels of 16 additional Floridan Aquifer wells. This information was used to update previous modeling efforts.

1.1.c Reclaimed Water Injection Aquifer Recharge Pilot Study

Recommendation: The District should, in conjunction with a local government, evaluate the benefits of deep aquifer injection of treated reclaimed water as a means of addressing water storage problems. A Deep Injection Aquifer Recharge Pilot Study is proposed, in partnership with a local sponsor, to investigate the feasibility of injecting treated reclaimed water into the Floridan Aquifer as a form of aquifer recharge.

Progress: In Fiscal Year 2002, the District contracted with a vendor to conduct a feasibility assessment of an indirect potable reuse project for central Florida. The study focused on the injection of potable quality reclaimed water into the freshwater portions of the Floridan Aquifer System (FAS). The feasibility portion of the study, completed in May 2002, demonstrated development and operational costs similar to that of other water supply alternatives. As part of this work, a pilot-testing program was developed. Efforts to begin pilot-testing with an exploratory well were postponed due to lack of local support.

1.2 Stormwater Reuse Plan

1.2.a Evaluate Stormwater Systems

Recommendation: Evaluate the regional stormwater drainage systems to determine if water is available to augment wastewater reuse systems or to be used for local irrigation. Components of this plan will address storm water routing, water quality, collection of water to supplement reclaimed water systems and the use of drainage wells to enhance aquifer recharge.

Progress: A study of two tributaries and two lakes, which are part of the Kissimmee Chain of Lakes, was completed in 2005. Evaluations of the Lake Tohopekaliga, East Lake Tohopekaliga and its tributaries, Boggy and Shingle creeks were conducted to determine the availability of water supplies from these sources.

The study, completed in 2005 suggests that significant volumes of water might be withdrawn from the Kissimmee Chain of Lakes, while causing limited changes to the identified environmental criteria. The findings also show this source is drought prone and that development of storage is likely an important component of source reliability. Additional studies are warranted before a final determination of source availability can be made. **Appendix I** provides the Executive Summary of these studies and links to the full report.

1.2.b Artificial Recharge Project

Recommendation: Continue participation in the Artificial Recharge Demonstration Project to evaluate the regulatory, water quality and recharge aspects of drainage wells by participating in demonstration projects. This is a cooperative effort between the SFWMD, the St. Johns River Water Management District (SJRWMD), Orange County, the City of Orlando and other local governments.

Progress: In 2002 and 2003, the District participated with the SJRWMD in their Artificial Recharge Project investigating passive treatment options for lake and street drainage wells, and methods for maximizing recharge through infiltration basins.

The SJRWMD has made progress in monitoring the reduction of chemical and biological contaminate concentrations of injected stormwater drainage wells. The Central Florida Aquifer Recharge Enhancement project has identified areas most likely to offset potential impacts through recharge. These areas include the ridge areas of western Orange and Osceola Counties.

1.2.c Drainage Well Treatment Pilot

Recommendation: The District should, in conjunction with local and state governmental agencies, evaluate the benefits of alternative treatment methods for storm water entering drainage wells. The quality of water entering existing and proposed drainage wells is of critical concern. Water entering new or modified drainage wells must meet primary and secondary drinking water standards. Proposed is a demonstration project in conjunction with Orange County Utilities to identify drainage wells receiving the worst quality water and to devise cost-effective treatment to meet the Florida Department of Environmental Protection (FDEP) and U.S. Environmental Protection Agency (USEPA) water quality requirements for injection.

Progress: In Fiscal Year 2002, the District, in conjunction with the SJRWMD and Orange County Utilities, contracted with a local consulting firm to complete an inventory of drainage wells located in Orange, Seminole, Lake and Osceola counties.

The purpose of this study was to create a GIS-based inventory and database of information about central Florida drainage wells, identify potential sites for pilot testing, develop a single digital source of information of all known wells and provide a preliminary design of a treatment system option for the full treatment of storm water prior to entry into area wells. The study was completed in February 2003.

In 2004 and 2005, the Nashville Street drainage well was selected as the site for testing a combined storage area and storm-scepter™ concept to improve water quality. The construction, done in conjunction with Orange County, was completed in 2005. Water quality sampling is ongoing by the County.

2.0 Minimize Floridan Aquifer Drawdown Through Reduction of Demands

2.1. Comprehensive Water Conservation Program

2.1.a Appoint Water Conservation Coordinator

Recommendation: The District should appoint two water conservation coordinators who would be responsible for developing a comprehensive water conservation program for the District. The program will be designed to coordinate local government and water management district efforts in water conservation education.

Progress: In 2002, the District created a new section within the Water Supply Department to address water conservation initiatives. This new section manages the Alternative Water Supply Funding Program, Mobile Irrigation Labs (MILs), Water Savings Incentive Program (WaterSIP) and conservation outreach programs.

The Alternative Water Supply Funding Program was opened to the Kissimmee Basin Planning Area in 2003. Since then, over $2 million in funding has been awarded to support alternative water supply projects. Additionally, the District's WaterSIP provides funds for local conservation initiatives, such as weather station irrigation controllers, plumbing retrofits and outreach programs.

District staff is also actively involved in the Florida Water Conservation Initiative led by the Florida Department of Environmental Protection (FDEP). The SFWMD continues to participate on the Statewide Reuse Coordinating Committee to discuss statewide reuse issues.

2.1.b Conservation Plans for Individual Utilities

Recommendation: The District will encourage and assist in the development of effective water conservation plans for individual public water supply utilities.

Progress: District staff has worked with utilities to identify opportunities for water conservation through the District's conservation and water use regulation divisions. Tracking of individual public water supply utility water conservation plans has not occurred.

3.0 Optimize Use of the Floridan Aquifer and Develop Alternative Sources

3.1 Evaluate Alternate Water Supplies

3.1.a. Surface Water Availability

Recommendation: For the following surface water bodies, the District should conduct a comprehensive research project to:

1. Determine the amount of water available for allocation without causing harm.

2. Determine appropriate minimum flows and levels (MFLs).

3. Recommend integration of these minimum flows and levels with the Water Shortage Program.

4. Propose a quantity of water in the Kissimmee River, which should be reserved from use under Section 373.223(3), Florida Statutes (F.S.).

Each of the research project's recommendations should be implemented after incorporating the same in District rules. The following water bodies should be the subject of this comprehensive research project: Kissimmee River and Lake Kissimmee in 2004 and by 2006 for East Lake Tohopekaliga, Lake Tohopekaliga, Lake Hatchineha, Cypress Lake, Fish Lake, Lake Jackson, Lake Marian, Lake Pierce, and Lake Rosalie.

Progress: An evaluation of Lake Tohopekaliga, East Lake Tohopekaliga and its tributaries, Boggy Creek and Shingle Creek, was completed to determine water availability for supplies. The study, completed in 2004, suggests that significant volumes of water might be withdrawn from the Kissimmee Chain of Lakes, while causing limited changes to the identified environmental criteria. The findings also show this source is drought-prone and that development of storage is likely an important component of source reliability.

Beginning in 2003, the District entered into an agreement with the City of Kissimmee to construct facilities to withdraw up to 4 million gallons per day (MGD) from Shingle Creek for use in reuse augmentation and groundwater recharge. The District also sponsored this project in 2004, 2005 and 2006. The project was completed in the fall of 2006.

Each year the District updates the list of priority water bodies for the establishment of minimum flows and levels (MFLs). In December 2005, the District adopted a MFL for Lake Istokpoga. The most recent MFLs priority list postponed the setting of MFLs for the Kissimmee River, Lake Kissimmee, Cypress Lake, Lake Rosalie, Lake Marian, Lake Jackson and Lake Hatchineha to beyond 2010.

Setting a MFL for the Floridan Aquifer in central Florida was postponed indefinitely to allow for the gathering of additional information to specify such a MFL.

3.1.b Coordinate with SJRWMD on St. Johns River

Recommendation: The District should coordinate with the SJRWMD on the investigation of the St. Johns River as a water supply option for the central Florida area.

Progress: The District has coordinated efforts with the SJRWMD about the investigation of the St. Johns River at the State Road 50 crossing, the development of supplies from the Taylor Creek Reservoir, and efforts to investigate the Kissimmee Chain of Lakes. In addition, the SFWMD entered into an agreement with the SJRWMD and local project sponsors for the District to provide $1 million in funding to assist in the design of a water production facility on the joint Taylor Creek/St. Johns River Project.

3.2 Optimize Use of Floridan Aquifer

3.2.a Hydrologic Investigations

Recommendation: The District, in partnership with local governments and state and federal agencies, will complete hydrologic investigations of the aquifer systems within the basin in support of the development of new or revised groundwater modeling tools. The focus of these studies should be on Orange, Osceola and Polk counties and in areas where the risk of harm to the resources is estimated to be the greatest.

Progress: From Fiscal Years 2000–2006, the District budgeted over $3 million for the construction and testing of a series of wells designed to obtain new information about the FAS in central Florida, particularly the lower portion of the aquifer.

Thirteen wells were constructed and tested in the Floridan Aquifer. Six of the wells were constructed into the Lower Floridan Aquifer. These sites were constructed in cooperation with the Reedy Creek Improvement District, Orange County, Orlando Utilities Commission and the SJRWMD.

3.2.b Groundwater Modeling

Recommendation: New or revised groundwater models should be developed to make better predictions for the next planning cycle. These models should be developed in cooperation with the USGS, local governments and other water management districts.

Progress: In 2002, the SJRWMD and SFWMD reached an agreement to use the previously developed East Central Florida (ECF) groundwater model as the basis for future water use simulations for Orange, Osceola, Polk, Lake and Seminole counties.

A modeling plan for updating the ECF model was cooperatively developed between the two Districts with SFWMD taking the initial lead in converting the model to simulate transient conditions. Work on this transient groundwater model was completed in Fiscal Year 2006 with a peer review of the updated model to be completed in early Fiscal Year 2007.

4.0 Development of Alternative Water Resources

4.1 Develop Backpumping Plan for Indian Prairie Basin

4.1.a-e Southern Indian Prairie Basin Operation Plan

Recommendation: Recommendations (a-e) are all related to developing operation plans for pumps G-207, G-208 and for a possible new pump at G-84 Structure.

Progress: During 2003, the District began work on the development of a Southern Indian Prairie Operation Plan (SIPOP) with the purpose of identifying the operational conditions for District pumps G-207 and G-208 that move water from Lake Okeechobee to the Lower Indian Prairie Basin. Work on the SIPOP was halted in 2005 to allow for the completion of a new surface water model covering Lake Istokpoga and to account for the MFL being proposed for the lake. In 2005, the District's effort to make improvements in surface water runoff to Lake Okeechobee included a review of the current Lake Istokpoga regulation schedule. In 2006, development of the SIPOP was placed on hold, indefinitely, due to the District's efforts to revise Lake Okeechobee's regulation schedule.

4.2 Kissimmee River Water Availability

4.2.a Availability of Water from the Kissimmee River

Recommendation: The District should conduct a comprehensive research project to determine water reservations for the Kissimmee River, determine the amount of water available from the river for allocation without causing harm, and establish a MFL for the river.

Progress: The District is currently developing a Long-Term Management Plan for the upper lakes in the Kissimmee Chain of Lakes. This plan and its adoption are expected to be completed in 2008. The key components of the plan are establishing the volume and timing of water releases from the Kissimmee Chain of Lakes to the river. As part of this evaluation, the availability of water for consumptive uses is being evaluated.

4.2.b. Kissimmee River Reservation of Water

Recommendation: Propose a quantity of water in the Kissimmee River that should be reserved from use under Section 373.223(3), F.S.

Progress: The reservation of water for the Kissimmee River will be considered at the completion of the Kissimmee River Long Term Management Plan (scheduled for completion in 2008) and after the U.S. Army Corps of Engineers (USACE) has approved recommended operational changes proposed by the plan, which is anticipated to occur in or near 2010.

5.0 Develop a Water Management Plan for the Lake Istokpoga-Indian Prairie Basin

5.1 Lake Istokpoga Management Plan

5.1.a Revise Operation Plan for Lake Istokpoga

Recommendation: The District should work with the USACE in revising the operational plan for Lake Istokpoga and the Indian Prairie system. This work is proposed to be conducted as part of the Comprehensive Everglades Restoration Plan (CERP).

Progress: The District began work on the Lake Istokpoga Management Plan in 2003; however, any management plan developed for the lake requires consideration of the possible revisions to the regulation schedule, potential new releases through the S-67 replacement structure on the Istokpoga Canal, and the minimum levels being researched for the lake. While the MFL for the lake has been resolved, the revised regulation schedule for the lake and construction and use of the S-67 Structure are unresolved in 2006. The District has postponed further work on the Lake Istokpoga Management Plan until such time these issues are resolved.

Beyond the development of the management plan, the District installed new monitoring gauges on Lake Istokpoga. In 2005, the District installed two new monitoring stations in the lake and integrated these stations into the remote monitoring network to provide data needed for operational decision-making of S-68 Structure.

5.1.b Evaluate Minimum Flows

Recommendation: The District should evaluate the need for the minimum operation flow requirements under Chapter 40E-22, Florida Administrative Code (F.A.C.), and modify them accordingly. Depending on the results of the evaluation, the District should initiate rulemaking efforts to modify Chapter 40E-22, F.A.C., to incorporate the revised flows.

Progress: A review of the minimum flow requirements as set forth in 40E-22, F.A.C., indicates that the flows were established as a means to maintain the historic runoff from the Indian Prairie Basin to Lake Okeechobee. Records show that these flows are generally met in drought years no greater than a 1-in-10 year condition. In the drier years, the canal flows are usually met in the summer, but less often in the winter months or during periods of drought recovery.

5.1.c Complete MFL Technical Work for Lake Istokpoga

Recommendation: The District should complete the technical work on establishing a MFL for Lake Istokpoga no later than 2003.

Progress: The SFWMD initially targeted 2004 for the adoption of a MFL on Lake Istokpoga. In December 2005, the District adopted a MFL for Lake Istokpoga.

5.2 Evaluate Regional Storage (near Lake Istokpoga)

5.2.a Lake Istokpoga Aquifer Storage and Recovery

Recommendation: Enter into an agreement with Southwest Florida Water Management District (SWFWMD) to conduct a feasibility assessment on an Aquifer Storage and Recovery (ASR) type facility on or near Lake Istokpoga. The District should work with the SWFWMD to assess the potential for interdistrict transfers of water.

Progress: After initially identifying the possible application of ASR at Lake Istokpoga, the SWFWMD chose not to pursue this water supply option. The SWFWMD will pursue other solutions.

Since that time, however, the issue of interdistrict transfers has become an important issue to address due to the proposal of multiple wellfields within the KB Planning Area to serve demands within the SWFWMD. Coordination among the districts is key in these cases as impacts from the source potentially extend into both Districts.

5.2.b North of Lake Okeechobee Reservoir

Recommendation: The District will review the potential for placing the regional storage reservoir, identified in the Central and Southern Florida Flood Control Project (C&SF Project) Restudy to be located north of Lake Okeechobee, in a location that may assist in supplying water to the Indian Prairie Basin. The timing of this review will be coordinated with the implementation of the CERP effort.

Progress: As part of the CERP Lake Okeechobee Watershed Project (LOWP), and the Lake Okeechobee & Estuary Recovery (LOER) Plan, the District is investigating several locations for the construction of a reservoir facility. At the time of this report, several sites had been short-listed as possible locations for the Indian Prairie Basin and adjacent areas north of Lake Okeechobee. The identification of a reservoir site is in progress. This reservoir, when completed, may supply water to the Indian Prairie Basin.

6.0 Coordination Among Water Management Districts

6.0 Interdistrict Coordination

Recommendation: The SFWMD will coordinate with the SJRWMD, SWFWMD and the FDEP for the purpose of developing consistent criteria and maximizing approaches toward the following:

- Resource protection criteria.
- Hydrologic investigations.
- Local sources first.
- Minimum flows and levels.
- Water shortage declarations.

Progress: The three water management districts of central Florida participate in several cooperative efforts. Among these efforts are:

- The Water Planning Coordination Group, which includes members of the State of Florida's five water management districts and the FDEP. Its purpose is to develop consistency in water planning.
- The Interdistrict Framework Group, which looks at consistency in the determination of MFLs.
- The Interdistrict Irrigation Water Use Working Group, which develops consistent methods for determining agricultural water use projections.

Additionally, the SFWMD and the SWFWMD participated in a public process known as the East Central Florida Water Initiative during 2002–2003. This effort brought together local elected officials and the general public to discuss water supply issues facing central Florida.

The SFWMD, SJRWMD, SWFMWD and FDEP continue to meet regularly under a Memorandum of Understanding (MOU), which addresses water supply planning, hydrologic investigations, water shortage declarations and water use permitting.

During the 2000–2001 drought, the SFWMD and the SJRWMD coordinated water shortage declarations for Orange County to provide a consistent message to the public.

Most recently, in 2006, the three water management districts agreed to a cooperative water supply planning work program for the central Florida region. The region includes all of Orange, Osceola, Polk and Seminole counties and portions of Lake and Brevard counties. The region, known as the Central Florida Coordination Area (CFCA), was proposed to devise a consistent strategy for regulatory actions, alternative water supply development and funding in the CFCA region.

7.0 Consistency Between Planning and Water Use Permitting

7.0.a-b Continue Rulemaking Efforts and 20-Year Permits

Recommendation: Continue ongoing rule development, rulemaking and consideration of granting 20-year permits for currently demonstrated non-harmful uses.

Progress: In August 2003, the SFWMD's Governing Board adopted the "B" list revisions to the water use rules. The rules became effective in September 2003. Nearly two dozen revisions to the rules were made. These included permit duration, wetland criteria, groundwater model evaluations, use of reclaimed water, supplemental irrigation requirements, aquifer storage and recovery, wellfield operation plans, pasture irrigation, and use of local sources.

7.0.c Lift Moratorium For Lake Istokpoga

Recommendation: The District should consider lifting the moratorium identified in 3.2.1(A) of the *Basis of Review for Water Use Permit Applications* for the Lake Istokpoga-Indian Prairie system after addressing the issues discussed in Recommendation 4.1.

Progress: Lifting the moratorium on new surface water uses from Lake Istokpoga is dependant on the development of a Southern Indian Prairie Basin Operational Plan. The review of source availability from Lake Istokpoga shows that while additional water may be released from the lake without causing harm, the amount of water is limited and the agricultural area is still prone to drought, requiring identification of dependable backup sources. Possible changes to the Lake Okeechobee operational schedule prompts the uncertainty of the availability of these backup sources and the need to identify new alternatives. The development of the SIPOP is on hold until the issues regarding these backup sources are resolved. Until this plan is complete, the lifting of the moratorium identified in 3.2.1(A) will be postponed.

7.0.d Resource Protection Criteria Rulemaking

Recommendation: The District should continue the research and rulemaking efforts directed toward the development and adoption of wetlands resource protection criteria.

Progress: The Water Use Wetland Protection Rule was adopted during the August 2003 SFWMD Governing Board meeting. This rule establishes criteria for the protection of wetlands from drawdown associated with water withdrawals. The rule identifies three categories of wetlands. Two of these categories have narrative standards, while the third has a numerical limitation of 1.0 feet.

7.0.e Sinkhole Investigation

Recommendation: The District should complete a hydrogeologic investigation to further refine the relationship between water levels, geologic conditions and the formation of sinkholes. Results from this and existing studies will be the basis for future rulemaking efforts on sinkholes.

Progress: In 2001, the SFWMD entered into an agreement with the SJRWMD to evaluate the relationship between sinkholes and Floridan Aquifer levels. Phase I of the project was to update the older sinkhole database and to establish a statistical relationship between the development of sinkholes and aquifer levels. The study was completed in 2002 and led to the development of a GIS-based inventory.

The updated database includes approximately 570 documented sinkhole occurrences in central Florida from 1954 to 2001. These updates improved the accuracy of the calculations for determining statistical correlations between sinkhole occurrence and Floridan Aquifer levels, but they provided only limited insight for improving the current sinkhole criteria.

D

Urban and Agricultural Demand Projections

DEMAND ASSESSMENTS AND PROJECTIONS

Demand assessments for Year 2000 and projections for Year 2025 were made for the following water use categories:

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

Water demand projections through the Year 2025 included analyses under average rainfall conditions and 1-in-10 year drought conditions. These projections are based on current trends and circumstances. Projections should therefore be understood as best estimates based on current knowledge of production, market and growth trends. The projections are not constrained by supply availability or demand management (conservation). Therefore, there is the opportunity to reduce these projected demand levels through policies and activities.

Of the six use categories listed above, categories 1 and 2 use population as an independent variable for projection purposes. Population estimates by county came from the U.S. Bureau of the Census 2000. Medium range county population projections published by the University of Florida Bureau of Economic and Business Research (BEBR 2004) were used for the Year 2025 time horizon. Some adjustments to the public water use estimates were made based on subsequent discussions with the individual service providers.

The Agricultural Field Scale Irrigation Requirements Simulation (AFSIRS) model was used to estimate demands for agricultural and recreational uses. Irrigation requirements were calculated for average and 1-in-10 year droughts. Irrigation requirements are equal to the difference between evapotranspiration and effective rainfall. Effective rainfall is equal to the rainfall that is stored in the plant root zone. Changing rainfall levels and timing therefore affect irrigation requirements. However, observed demand levels will vary based on irrigation managers' perceptions and responses to changing rainfall patterns. Realistically, some may allow plants to experience some level of stress before changing irrigation schedules, while other managers may habitually over water at a level that satisfies irrigation demands even during drought events.

For agricultural and recreational irrigation demands, the Year 2000 assessed and Year 2025 projected irrigated acreages were applied to the average and 1-in-10 year drought demand rates at the appropriate rainfall station and general soil type.

For Public Water Supply and Domestic Self-Supply 1-10 demands, the Year 2000 demand per capita rates were considered to represent the drought level demand rates (per capita). These demand rates were applied to the relevant projected populations. Projected average demands were reached by subtracting 6 percent (based on consultations with FDEP).

Average and 1-in-10 Year Rainfall

An average rainfall year is defined as a year with rainfall equal to the mean annual rainfall for the period of record. A l-in-10 year drought condition is defined as below normal rainfall with a 90 percent probability of being exceeded over a 12-month period. This means there is a 10 percent chance that less than this amount will be received in any given year. Section 373.0361(2)(a)l, F.S. states the level of certainty planning goal associated with identifying demands shall be based on meeting demands during a l-in-10 year drought event.

CATEGORIES OF WATER USE

(l & 2) Public Water Supply and Domestic Self-Supply Demands

Public Water Supply and Domestic Self-Supply demand assessments and projections were developed for Year 2000 through Year 2025. The Domestic Self-Supply category includes small public supply systems with projected demands of less than 0.1 million gallons per day (MGD) in Year 2025, as well as residents that supply their own water needs. Self-supplied residents may be within utility service area boundaries or outside of these boundaries. Water demands were forecast by multiplying population projections by per capita water use rates. Per capita water use rates were calculated based on Year 2000 population data from the U.S. Bureau of the Census (2000) and the water production reported for each utility by the U.S. Geological Survey (USGS 2003). The population projections for Year 2025 for each county were based on the medium range forecasts published by the University of Florida Bureau of Economic and Business Research (BEBR 2004).

The Year 2000 and projected Year 2025 utility-served areas used in this analysis were obtained from the utilities. Adjustments were made to account for the known future expansion of the current served areas. It was assumed that all projected population growth within areas being served by a utility would be connected to that Public Water Supply system. The proportions of populations within utility-served areas into Public Water Supply and Domestic Self-Supply categories were modified in several instances based on utility input.

Per Capita Rates

Per capita water use rates for Year 2000 for each utility were calculated by dividing raw water pumped by the permanent resident population served by Public Water Supply utilities. The U.S. Geological Survey (USGS) and the South Florida Water Management District (SFWMD or District) pumpage reports provided raw water withdrawal data. Total population and the number of individuals served by the utilities were determined by the above-mentioned methodology.

These per capita rates include total use, incorporating use by seasonal residents and tourists, commercial and industrial utility supplied use, and the losses incurred in water delivery, in addition to the use by permanent residents. Irrigation demand for Public Water Supply served households using private well water for their landscape irrigation was not assessed due to lack of available data.

The Year 2000 was considered as a drought year that was slightly greater than a 1-in-10 year drought level of recurrence. For this reason, per capita rates for Year 2000 were used to develop the 1-in-10 year drought Year 2025 utility demand projections. Adjustments were then made to these projections to normalize them for average rainfall conditions. Per capita rates used in the demand projections were not adjusted for additional conservation efforts beyond the Year 2000 level.

Domestic Self-Supply per capita rates within Public Water Supply utility-served area boundaries were assumed the same as for the utility serving that service area. The per capita rates for the Domestic Self-Supply users in areas not served by public utilities were assumed to be a weighted average of the Public Water Supply per capita rates for the county.

Public Water Supply and Domestic Self-Supply Average and l-in-10 Year Drought Adjustments

Indoor use categories need no adjustment from the Year 2000 (drought) observed values to an average year, as these categories would have no demand shifts related to drought. Unadjusted base demand for a utility was projected by multiplying a base year per capita rate by a projected population. If desired, the withdrawal distribution (by month) can be derived from historical demand curves for the utility. The difference between the monthly demand for the base year and the unconstrained demand for an average year, or a l-in-10 year, will directly depend on the changes in the outdoor use, specifically, changes in demand for landscape irrigation. If the base year is an average year, then there is no need for an adjustment from base to average. However, if the base year is significantly wetter or drier than average, then unconstrained demands for outdoor use will adjust proportionally.

Population Served

2000 Population

U.S. Census data were used as the basis for the Year 2000 population and the distribution of that population. Block level information from the census count was used as the basic unit of analysis. Total population, occupied housing units and persons per occupied housing unit were retrieved from census data. In the absence of a self-supplied unit count in the Year 2000 Census, the self-supplied population within utility-served areas was taken as a constant based on the 1990 Census (which included household water source on its long form).

The geographic areas represented by the census blocks and the utility-served areas were input as polygon layers into the SFWMD Geographic Information System (GIS). The two layers were overlaid to determine if census blocks were inside or outside the area served by each utility. Imagery was used to review decisions when necessary. Population assessments of Public Water Supply served and Domestic Self-Supply served then calculated. The populations for each utility-served area were then totaled.

2025 Population Projections

The medium range county projections as published by the Bureau of Economic and Business Research (BEBR 2004) were used as county population projection control totals for Year 2025. However, Osceola County justified to the Florida Department of Community Affairs its use of the BEBR July 2004 high value for projecting water demand and population growth. The geographic distribution of the Year 2025 population was assessed using the ratio of traffic analysis zone population growth for the areas covered by traffic analysis zones. The geographic distribution of the Year 2025 population for areas not covered by traffic analysis zones was based on the population distribution in the Year 2000 census block data. Total county population was limited to the county total from the BEBR medium range projections, with the exception of Osceola County.

The two layers were overlaid to determine if traffic analysis zones were inside or outside the area served by each utility. Population estimates were then recalculated for the new attribute by deciding which polygons were inside or outside of utility-served boundaries. The populations for each utility-served area were then totaled and limited not to exceed the BEBR medium range population projection for each county.

Any growth in population within an area being served by a utility was assigned to that utility. This means that within utility-served areas, the Domestic Self-Supply population was assumed to remain the same from Year 2000 to Year 2025. Any growth in population within an area not planned to be served by a utility was assigned to the Domestic Self-Supply category.

Table 1 provides the Year 2000 and Year 2025 population changes by county for Public Water Supply and Domestic Self-Supply users. **Table 2** and **Table 3** show the current and projected 1-in-10 year drought water demand by county and utility supplier for those counties within the Kissimmee Basin (KB) Planning Area. Water use in **Table 3** includes use within the KB Planning Area and some portions of water use in Orange County supplied by Orange County Utilities and the Orlando Utilities Commission. This additional water use is identified as St. Johns River Water Management District (SJRWMD) demands in **Table 3**.

Table 1. Population Estimates by County for the Public Water Supply and Domestic Self-Supply Demand.

2000					
County	Countywide Population	SFWMD Portion	SFWMD PWS Population	DSS Population	
Glades*	10,576	3,665	2,529	1,136	
Highlands	87,366	7,636	1,722	5,914	
Okeechobee*	35,910	33,321	19,742	13,579	
Orange	896,344	220,065	216,508	3,557	
Osceola	172,493	171,416	152,180	19,236	
Polk	483,924	13,726	6,389	7,337	
Total	1,686,613	449,829	399,070	50,759	
2025					
County	Countywide Population	SFWMD Portion	SFWMD PWS Population	DSS Population	% Change SFWMD 2000-2025
Glades*	14,300	4,956	3,324	1,632	35%
Highlands	123,500	10,794	2,168	8,626	41%
Okeechobee*	46,400	43,055	28,557	14,498	29%
Orange	1,542,400	513,619	491,118	22,510	133%
Osceola	525,000	517,000	489,206	27,803	202%
Polk	694,200	22,508	14,971	7,537	64%
Total	2,945,800	1,111,932	1,029,344	82,606	147%

* Portions of population within Kissimmee Basin Planning Area only.

Table 2. Public Water Supply and Domestic-Supply 1-in-10 Year Demand Projections by County.

2000				
County	**SFWMD Total Demand (MGD)**	**SFWMD PWS Demand (MGD)**	**DSS Demand (MGD)**	
Glades*	0.60	0.39	0.21	
Highlands	1.27	0.23	1.04	
Okeechobee*	4.92	2.46	2.46	
Orange	80.12	78.75	1.37	
Osceola	33.34	29.60	3.74	
Polk	4.55	2.07	2.48	
Total	124.80	113.50	11.30	
2025				
County	**SFWMD Total Demand (MGD)**	**SFWMD PWS Demand (MGD)**	**DSS Demand (MGD)**	**% Change Total Demand 2000-2025**
Glades*	0.68	0.47	0.21	13%
Highlands	1.72	0.31	1.41	35%
Okeechobee*	6.65	4.15	2.50	35%
Orange	135.56	132.06	3.50	69%
Osceola	108.63	104.30	4.33	226%
Polk	8.00	6.98	3.67	76%
Total	261.24	248.27	15.62	109%

* Portions of population within Kissimmee Basin Planning Area only.

Table 3. Public Water Supply and Domestic Self-Supply 1-in-10 Year Demand Projections by Utility.

Utility	Estimated Daily Flow (MGD)	Projected Average Daily Flow (MGD)					% Change 2000-2025
	2000	2005	2010	2015	2020	2025	
Glades County							
Brighton Public Water System	0.39	0.41	0.42	0.44	0.45	0.47	20.5%
Domestic Self-Supply	0.21	0.21	0.21	0.21	0.21	0.21	0.0%
Highlands County							
Spring Lake Development	0.23	0.25	0.26	0.28	0.29	0.31	34.8%
Domestic Self-Supply	1.04	1.11	1.19	1.26	1.34	1.41	35.6%
Okeechobee County							
Okeechobee Utility Authority	2.34	2.68	3.02	3.35	3.69	4.03	72.2%
Okeechobee Correctional	0.12	0.12	0.12	0.12	0.12	0.12	0.0%
Domestic Self-Supply	2.46	2.50	2.50	2.50	2.50	2.50	1.6%
Orange County							
Orange County Public Utilities SFWMD Portion	18.13	24.13	30.13	36.13	42.13	48.13	165.5%
Orlando Utilities Commission SFWMD Portion	40.65	49.50	56.40	60.10	60.20	60.20	48.1%
Reedy Creek Imp. District							
Groundwater	19.70	20.44	21.18	21.92	22.66	23.40	18.8%
Taft Water Association	0.27	0.29	0.30	0.31	0.32	0.33	22.2%
Domestic Self-Supply	1.37	1.80	2.22	2.65	3.07	3.50	155.5%

Table 3. Public Water Supply and Domestic Self-Supply 1-in-10 Year Demand Projections by Utility (Continued).

Utility	Reported Daily Flow (MGD)	Projected Average Daily Flow (MGD)					% Change 2000-2025
	2000	2005	2010	2015	2020	2025	
Osceola County							
Toho Water Authority City of Kissimmee	21.87	33.26	44.65	56.05	67.44	78.83	260.4%
Florida Water Services	2.34	2.73	3.12	3.51	3.90	4.29	83.3%
Poinciana Utilities (Osceola)	1.76	2.52	3.03	3.71	4.42	5.14	192.1%
St. Cloud	3.29	5.73	8.17	10.62	13.06	15.5	371.1%
O&S Water Company	0.00	0.18	0.38	0.42	0.42	0.42	N/A
Tropical Palms Resort	0.12	0.12	0.12	0.12	0.12	0.12	0.0%
Domestic Self-Supply	3.74	3.86	3.98	4.09	4.21	4.33	15.8%
Polk County							
Poinciana Utilities (Polk)	1.57	2.20	2.83	3.46	4.09	4.72	200.6%
Oakhill Estates (Polk Utility)	0.45	0.69	1.20	1.44	1.68	2.01	346.7%
Westgate River Ranch	0.05	0.12	0.21	0.25	0.25	0.25	400.0%
Domestic Self-Supply	2.48	2.72	2.96	3.19	3.43	3.67	48.0%
Kissimmee Basin Total	124.68	157.56	188.37	217.45	240.72	263.89	111.5%

(3) Agricultural Self-Supply

Agricultural Self-Supply demand calculations for the *2005–2006 Kissimmee Basin Water Supply Plan Update* (2005–2006 KB Plan Update) were made using the Agricultural Field Scale Irrigation Requirement Simulation (AFSIRS) model. This is a change from the *2000 Kissimmee Basin Water Supply Plan* (2000 KB Plan), which used a modified Blaney-Criddle model to estimate supplemental requirements for irrigation.

The agricultural demand assessment involved establishing acreages through collecting data from the Florida Agricultural Statistics Service (FASS), the SFWMD's Geographic Information System (GIS) land use maps, and the Institute of Food and Agricultural Sciences (IFAS). For those counties located partially within two water management districts or two planning regions, acreage estimates were made countywide and then divided between the planning regions based on a flat percentage of the county lying within the respective planning region.

Those techniques chosen to project crop acreages were those that were judged to best reflect the specific crop scenario in each county. This led to some variation in projection techniques between crop types and methods between counties. The acreage projections developed here reflect a combination of methods. This is consistent with the way in which crop acreage is projected by IFAS and other water management districts.

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

Average and 1-in-10 year drought event irrigation requirements were calculated using the District's AFSIRS model. Historical weather data from the rainfall station considered to best represent the crop/county combination were used to calculate irrigation requirements.

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

Gross Irrigation Requirement = Net Irrigation Requirement / Irrigation Efficiency

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

Available water capacity and depth of soil have a direct impact on effective rainfall. An additional factor considered explicitly by the AFSIRS model, but combined with soil properties, is on-farm irrigation management strategy. The AFSIRS model, defines eight "generic" soil types representing the major kinds of soils found in Florida. All model runs were made using the generic sandy soil type as defined by the AFSIRS model.

Irrigated Crop Types

The irrigated commercially grown crop categories were based on the categories developed by the Water Demand Projection Subcommittee, made up of representatives from Florida's five water management districts. These categories are: 1) citrus, 2) other fruits and nuts, 3) vegetables, melons and berries, 4) field crops, 5) sod, 6) greenhouse/nursery, 7) pasture and 8) miscellaneous. All of these crops are grown commercially within the SFWMD, but not all crops are grown within the Kissimmee Basin Planning Area. Crop acreage projections were initially made by District staff based on statistical trends, and then sent out and reviewed by the local IFAS extension offices.

Citrus

All categories of citrus (oranges, grapefruit, tangerines, limes, etc.) were grouped together for projection purposes. Historical citrus acreage data were gathered from volumes of the *Florida Agricultural Statistics Service Commercial Citrus Inventory* (FASS 2002–2004a), which is published biennially.

Citrus is by far the dominant agricultural crop in the KB Planning Area, and occupies over 70 percent of the irrigated agricultural acreage in the region. Significant citrus acreage declines have been experienced in the northern areas of the Kissimmee Basin (southern Orange, western Osceola and eastern Polk counties), while areas in the south of the Kissimmee Basin (northern Glades, western Okeechobee and eastern Highlands) have experienced growth. Continued projected decline in citrus acreage in the north is somewhat offset by stability and increased acreage in the south, resulting in a slight projected overall decline in citrus acreage for the KB Planning Area from Year 2000 to Year 2025. Declines in the north are largely the result of urban pressure and intermittent freezes combined with citrus market conditions.

Citrus acreage in the planning area is projected to decline from 52,164 acres in Year 2000 to 46,475 acres in Year 2025. This decline in acreage represents a decrease in average citrus irrigation requirements from 55.9 MGD in Year 2000 to 51.1 MGD in Year 2025. Acreage is projected to continue to decline more significantly in the northern portion of the planning area.

Other Fruits and Nuts

Within the SFWMD, non-citrus fruit crops (avocados, mangos, papaya, etc.) are produced commercially, but there is no significant production of these crops in the Kissimmee Basin.

Vegetables, Melons and Berries

Vegetable crops grown in the planning area include squash, cucumbers, peppers, tomatoes, watermelons, potatoes and Latin vegetables. Blueberries are also grown in Highlands County. Different types of vegetables are often grown interchangeably. In Year 2000, there were 12,890 acres of land used for vegetable, melon and berry production. This is projected to remain relatively constant through Year 2025, and represents an average irrigation requirement of 21.6 MGD. Information was provided from the SFWMD GIS land use maps.

Field Crops

Sugarcane is the only field crop with significant acreage in the KB Planning Area. Glades and Highlands counties are the only counties in the KB Planning Area where sugarcane is grown commercially. In Year 2000, there were 3,338 acres of production, which were all in Glades County. Since Year 2000, there has been an expansion of about 2,100 acres, of which about 1,000 acres have been in Highlands County, and no further growth is anticipated. As a result of the cultivation practices used for sugarcane (ratoon and fallow), about 20 percent of the land used for sugarcane production is fallowed in any given year. This fallow land does not require irrigation and is not included in the demand projections presented here.

The Year 2000 production of 3,338 acres had an associated average irrigation requirement of 10.0 MGD in Year 2000. And, based on the addition of 2,100 acres planted since Year 2000, projected demands are 15.3 MGD through Year 2025. Historical sugarcane acreage data were gathered from annual volumes of the *Field Crops Summary* (FASS 2002–2004b) and were used to provide statistical estimates of future production.

Sod

There is some variation in the production practices of sod within the Kissimmee Basin. Some sod may be harvested from pastureland, which is not irrigated. Estimates of irrigated sod acreage were made using the District's water use permits and GIS land maps.

In Year 2000, there were a total of 2,950 acres of irrigated sod production in the planning area, with an estimated irrigation requirement of 9.1 MGD. Sod production is projected to remain at its Year 2000 acreage through Year 2025.

Greenhouse/Nursery

Varieties of greenhouse and nursery crops are grown within the Kissimmee Basin. Historical commercial nursery acreage data for each county were used to make projections using functional forms that correlated nursery acreage with a time trend variable. Historical commercial nursery acreage data were gathered from annual volumes of the Florida Department of Agricultural and Consumer Services, *Division of Plant Industry's Annual Reports* (FDACS 1996–2003).

In addition to nursery plants, there is also a region within the Kissimmee Basin that uses land to produce caladium bulbs. Future acreages of caladium bulbs were projected based on input from the local IFAS extension office.

In Year 2000, there were 3,160 acres of greenhouse/nursery operations in the planning area, and this is projected to increase to 4,247 acres by the year Year 2025. Average demands by nurseries in the planning area are projected to increase from 7.2 MGD in Year 2000 to 9.7 MGD in Year 2025.

Pasture

Improved pasture is defined by the SFWMD as pasture that has the facilities in place to carry out irrigation. In Year 2004, there were approximately 200,000 acres in the KB Planning Area with water use permits issued by the SFWMD for pasture irrigation. Irrigation of pasture lands is believed to be limited and based more on sales opportunities and extreme drought maintenance, and not as part of regular crop maintenance. The water supply planning assumption that improved pasture is not irrigated does not preclude ranchers from acquiring consumptive use permits from the SFWMD or from carrying out pasture irrigation.

Miscellaneous

Cattle Watering

Demand for cattle watering and barn washing is associated with cattle production (which is in turn associated with pasture acreage). Water required for cattle watering was calculated as a function of the number and type of cattle (beef or dairy). Cattle numbers for Year 2000 were obtained from Florida Agricultural Statistics Services.

Aquaculture

Aquaculture (fish farming) withdraws water for circulation purposes and to replace evaporative losses. Withdrawals to replace evaporative losses are approximately 1.5 MGD, and were determined from existing consumptive use permits.

Demand Projections

Citrus

Historical citrus acreage data (**Table 4**) were gathered from volumes of the *Commercial Citrus Inventory* (FASS 2002–2004a).

Projected citrus acreage is shown in **Table 5**. Statistical methods were used to project county-level citrus acreage. The ratios of crop acreages for counties within the Kissimmee Basin were kept constant through Year 2025.

In Orange, Polk and Highlands counties citrus acreage was projected using log damped trend exponential smoothing. Time series data at two-year increments were used to estimate the damped trend exponential smoothing model. Citrus acreage in Osceola County was projected using robust regression. In northern Glades County, citrus acreage is expected to remain constant.

Table 6 shows the projected irrigation demands associated with the Year 2000 and projected citrus acreages in each county.

Table 4. Historical Citrus Acreage Countywide.

Year	Orange County	Osceola County	Polk County	Glades County	Okeechobee County	Highlands County
1966	65,817	18,921	149,287	1,413	2,508	37,409
1968	68,005	19,363	150,249	1,461	3,329	39,110
1970	65,961	19,051	150,122	1,572	3,597	38,803
1972	65,067	11,587	144,153	1,639	3,676	37,765
1974	56,320	17,115	141,475	1,661	4,087	37,996
1976	54,007	16,922	137,693	1,615	4,162	37,375
1978	51,174	16,231	134,261	1,613	4,171	37,105
1980	50,673	16,457	132,124	3,395	4,281	37,767
1982	48,547	17,959	133,545	4,026	6,954	37,661
1984	16,670	16,133	129,912	5,141	8,044	44,030
1986	14,692	13,035	106,993	6,076	7,449	46,012
1988	17,356	14,114	108,546	6,235	8,124	48,569
1990	8,399	16,101	99,718	7,523	8,541	57,048
1992	9,470	15,625	91,899	9,136	10,439	62,217
1994	10,402	15,654	104,007	9,270	11,270	74,035
1996	10,029	15,404	103,884	9,402	12,206	76,586
1998	9,188	15,535	102,457	10,776	12,244	75,909
2000	8,095	10,090	101,484	10,506	12,170	78,132
2002	6,884	7,964	100,202	10,384	12,035	77,391

Table 5. Projected Citrus Acreage in Portions of Counties within the Kissimmee Basin Planning Area*.

County	Year						
	2000	2002	2005	2010	2015	2020	2025
Southern Orange*	4,497	3,824	3,090	2,336	1,762	1,316	914
Western Osceola*	9,333	7,367	7,301	7,193	7,091	6,993	6,899
Eastern Polk*	2,537	2,505	2,452	2,339	2,233	2,134	2,041
Northern Glades*	5,043	4,984	4,984	4,984	4,984	4,984	4,984
Western Okeechobee*	3,408	3,370	3,606	4,143	4,540	4,924	5,078
Eastern Highlands*	27,346	27,087	26,721	26,637	26,954	26,571	26,559
Total	52,164	49,137	48,154	47,632	47,564	46,922	46,475

*Note: The following portions of citrus acreage are within the Kissimmee Basin: 55.5% of the acreage within Orange County; 92.5% of the acreage within Osceola County; 2.5% of the acreage within Polk County; 48% of the acreage within Glades County, 28% of the acreage within Okeechobee County and 35% of the acreage within Highlands County.

Table 6. Irrigation Requirements for Projected Citrus Acreage.

County/Acreage/Demand	2000	2005	2010	2015	2020	2025
Southern Orange County						
Acreage	**Acres**					
Irrigated Acreage	4,497	3,090	2,336	1,762	1,316	974
Net Irrigation Requirement	**MGD**					
Annual Based on Average Rainfall Year (9.92 in.)	4.34	2.98	2.26	1.70	1.27	0.94
Annual Based on 1-in-10 Rainfall Year (22.00 in.)	9.62	6.61	5.00	3.77	2.82	2.09
Western Osceola County						
Acreage	**Acres**					
Irrigated Acreage	9,333	7,301	7,193	7,091	6,993	6,899
Net Irrigation Requirement	**MGD**					
Annual Based on Average Rainfall Year (8.13 in.)	7.19	5.62	5.54	5.46	5.39	5.32
Annual Based on 1-in-10 Rainfall Year (19.76 in.)	17.48	13.67	13.47	13.28	13.10	12.92
Eastern Polk County						
Acreage	**Acres**					
Irrigated Acres	2,537	2,452	2,339	2,233	2,134	2,041
Net Irrigation Requirement	**MGD**					
Annual Based on Average Rainfall Year (11.58 in.)	2.63	2.55	2.43	2.32	2.22	2.18
Annual Based on 1-in-10 Rainfall Year (22.70 in.)	5.16	4.99	4.76	4.54	4.34	4.15
Eastern Highlands County						
Acreage	**Acres**					
Irrigated Acreage	27,346	26,721	26,637	26,954	26,571	26,559
Net Irrigation Requirement	**MGD**					
Annual Based on Average Rainfall Year (12.11 in.)	30.42	29.72	29.63	29.98	29.56	29.54
Annual Based on 1-in-10 Rainfall Year (26.00 in.)	65.31	63.81	63.61	64.37	63.45	63.43

Table 6. Irrigation Requirements for Projected Citrus Acreage (Continued).

County/Acreage/Demand	2000	2005	2010	2015	2020	2025
Northern Glades County						
Acreage	**Acres**					
Irrigated Acreage	5,043	4,984	4,984	4,984	4,984	4,984
Net Irrigation Requirement	**MGD**					
Annual Based on Average Rainfall Year (14.20 in.)	7.50	7.42	7.42	7.42	7.42	7.42
Annual Based on 1-in-10 Rainfall Year (28.01in.)	14.80	14.63	14.63	14.63	14.63	14.63
Western Okeechobee County						
Acreage	**Acres**					
Irrigated Acreage	3,408	3,606	4,153	4,540	4,924	5,078
Net Irrigation Requirement	**MGD**					
Annual Based on Average Rainfall Year (12.33 in.)	3.84	4.06	4.67	5.11	5.54	5.71
Annual Based on 1-in-10 Rainfall Year (25.21 in.)	7.84	8.30	9.56	10.45	11.33	11.69

Vegetables, Melons and Berries

Vegetable crops were grouped together for projection purposes. This was warranted by the lack of significant difference between the irrigation requirements of the different types of vegetables cultivated in the KB Planning Area, and the production practices used on vegetable farms (different types of vegetables are sometimes grown interchangeably). Vegetables in the KB Planning Area are grown commercially in Osceola, Polk, Highlands, Glades and Okeechobee counties.

Vegetable fields are planted and harvested sequentially, and some portion of the total acreage used for vegetable production is commonly vacant. This temporary area of vegetable land vacancy effects total irrigation requirements, but it is difficult to quantify. Production timing may change for several reasons. For example, growers may enter into a contract to harvest vegetables during a specific window of time, which would in turn determine their growing season. In addition, as seepage irrigation is the predominant type of irrigation system used for vegetable production, some of these vacant fields are unavoidably irrigated, either in part or completely. With these constraints in mind, cultivation schedules were developed to calculate irrigation requirements.

In addition to vegetable crops (which typically use seepage irrigation systems), there are also about 200 acres of blueberries (on microirrigation) in eastern Highlands County. **Table 7** outlines the seasonal vegetable and blueberry acreage and irrigation requirements in the KB Planning Area, and **Table 8** shows blueberry irrigation demands.

Table 7. Irrigation Requirements for Projected Vegetable Acreage.

County	2000 Irrigated Acreage	Average		1-in-10 Year	
		Net Irr. Req. (in.)	MGD	Net Irr. Req. (in.)	MGD
Western Osceola	2,432	10.0	3.62	13.2	4.78
Eastern Polk	588	9.6	0.84	12.3	1.08
Eastern Highlands	3,445	10.4	5.33	13.7	7.02
Northern Glades	1,248	11.3	2.10	13.8	2.56
Western Okeechobee	4,977	13.3	9.45	13.3	9.45
Southern Orange	0	0.0	0.00	0.0	0.00

Table 8. Irrigation Requirements for Blueberry Acreage in Eastern Highlands County.

County	2000 Irrigated Acreage	Average		1-in-10 Year	
		Net Irr. Req. (in.)	MGD	Net Irr. Req. (in.)	MGD
Eastern Highlands	200	12.2	0.21	26.0	0.45

Field Crops

Field crops grown within the SFWMD include sugarcane, rice, seed corn, soybean and sorghum. Sugarcane is one of the largest commercially grown field crops in the Kissimmee Basin. Historically, sugarcane was produced in northern Glades County, but recently about 300 acres were planted in Highlands County.

Sugarcane is initially propagated by planting stalk cuttings. The first harvest takes place approximately 13 months after planting. Sugar production per unit of land surface declines gradually with each additional rotation and in approximately four years (one planting and three ratoons) the increased yields associated with replanting outweigh the costs. Because land may lay fallow for several months between crop rotation cycles, approximately 20 percent of the land associated with sugarcane production will not be reported as production by the Florida Agricultural Statistics Service. This land does not require irrigation and is not included in these projections.

Table 9 presents historical sugarcane acreage data gathered from annual volumes of the *Field Crops Summary* (FASS 2002–2004b). There has been some fluctuation in sugarcane acreage in Glades County. Discussions with local growers and extension agents suggest that 2,000 acres of growth is expected by Year 2025. This acreage has been distributed equally among Glades and Highlands counties. **Table 10** shows the mean and 1-in-10 year drought event irrigation requirements for sugarcane in Glades and eastern Highlands counties.

While sugarcane is the single largest field crop within the KB Planning Area, other field crops including rice, seed corn, soybean and sorghum are grown in the region. The SFWMD used aerial photography and satellite imagery to estimate the acreages. In Year 2000, the acreage associated with rice, seed corn, soybean, sorghum and similar crops totaled 2,401 within the KB Planning Area. The future acreage of these crops is expected to remain at the Year 2000 levels.

Table 9. Historical Sugarcane Acreage in Glades County.

Year	Glades County
1975	16,636
1976	18,545
1977	16,842
1978	18,260
1979	19,454
1980	20,096
1981	22,908
1982	22,904
1983	22,924
1984	26,015
1985	15,599
1986	17,165
1987	20,020
1988	20,321
1989	20,119
1990	19,633
1991	19,633
1992	19,633
1993	19,633
1994	19,633
1995	19,633
1996	19,633
1997	19,633
1998	19,633
1999	20,942
2000	19,633

Table 10. Irrigation Requirements for Projected Sugarcane Acreage in the Kissimmee Basin.

	Northern Glades County			Eastern Highlands County	
	2000		2005-2025	2005-2025	
Irrigated Acreage	3,338		4,438	1,000	
Irrigation Requirement	**Net Irr. Req. (in.)**	**MGD**	**MGD**	**Net Irr. Req. (in.)**	**MGD**
Average	20.2	10.02	13.32	13.3	1.98
1-in-10 Year	26.3	13.04	17.33	17.9	2.66

Sod

The sod projections presented here refer to irrigated sod. There is additional sod harvested from pastureland, which is not irrigated. Sod in the KB Planning Area is grown commercially in Osceola, Polk, Highlands, Glades and Okeechobee counties. **Table 11** presents irrigation requirements for projected sod acreage in the Kissimmee Basin.

Table 11. Irrigation Requirements for Projected Sod Acreage in the Kissimmee Basin.

County	Irrigated Acreage	Average		1-in-10 Year	
		Net Irr. Req. (in.)	MGD	Net Irr. Req. (in.)	MGD
Western Osceola	500	20.5	1.53	23.4	1.74
Eastern Polk	1,000	20.0	2.98	30.7	4.55
Eastern Highlands	900	20.8	2.79	33.7	4.51
Northern Glades	300	22.8	1.02	36.6	1.63
Western Okeechobee	250	20.3	0.76	26.4	0.98
Southern Orange	0	17.9	0.00	22.2	0.00

Greenhouse/Nursery

Ornamental nurseries within the KB Planning Area are found in Orange, Osceola, Highlands and Okeechobee counties. Highlands County also has a significant amount of caladium farm acreage, which has been grouped under this nursery category.

Orange County ornamental nursery acreage has increased relatively steadily despite minor declines that occurred in the aftermath of major freezes. Overall, the trend of ornamental nursery acreage has been upward at a rate of approximately 40 acres per year countywide, with a slightly increased rate per year for the last 10 years. The linear exponential smoothing statistical model was selected to project ornamental acreage. This model extrapolates an increase of about 50 acres of nurseries per year in Orange County. An estimated 25 percent of this nursery acreage increase is anticipated to be within the SFWMD. This increase was kept constant throughout the projection period.

All nursery acreage in Osceola County is within the Kissimmee Basin Planning Area (western Osceola County). County ornamental nursery acreage peaked at 271 acres in 1998. Since 1998, Osceola nursery acreage has declined slightly. A damped trend exponential smoothing model was estimated and a slight long-term decline in nursery acreage from about 246 acres to a long-term acreage of about 232 acres was projected.

Highlands County ornamental nursery acreage has increased rapidly since about 1990. In 1991, there were 166 acres of ornamental nurseries. By 1993, the ornamental acreage increased to 1,349 acres, and by Year 2000, the acreage increased to 2,226 acres. A linear exponential smoothing model gave the best fit to the observed acreage. Based on this model, ornamental nursery acreage in Highlands County is projected to increase to 4,449 acres by Year 2025. This represents slightly less than a doubling of ornamental nursery acreage from its Year 2000 level. About 20 percent of the ornamental nursery acreage in Highlands County (eastern Highlands County) is within the Kissimmee Basin, and the increase was kept constant throughout the projection period.

Eastern Highlands County also has a significant acreage of caladiums, producing over 90 percent of the world's caladium bulbs. The production area is within the KB Planning Area, located just south of Lake Istokpoga. The acreage used by the caladium industry has stabilized between 1,200 and 1,500 acres, and is projected to remain relatively constant through Year 2025. This acreage is not included as nursery acreage by the FDACS Division of Plant Industry Annual Reports (FDACS various issues). **Table 12** shows demands for 1,500 acres of caladiums included with greenhouse/nursery acreage demands.

All nursery acreage in Okeechobee County is within the Kissimmee Basin (western Okeechobee County). Since the 1990s, Okeechobee County ornamental nursery acreage has increased relatively steadily at a rate of about 20 acres per year, reaching 815 acres in Year 2000. The statistical model with a best-fit linear projection was used to estimate acreage for Year 2025.

Table 13 summarizes the estimated greenhouse/nursery acreage and irrigation requirements for each of the counties within the KB Planning Area. The portion of each county's total acreage that falls within the KB Planning Area is estimated at 25 percent for Orange County; 100 percent for Osceola County; 60 percent for Highlands County; and, 100 percent for Okeechobee County.

Table 12. Historical and Projected Greenhouse/Nursery Acreage Countywide and within Portions of Counties in the Kissimmee Basin.

Year	Historical Orange County Acreage	Projected Orange County Acreage	Historical Osceola County Acreage	Projected Osceola County Acreage	Historical Highlands County Acreage	Projected Highlands County Acreage	Historical Okeechobee County Acreage	Projected Okeechoee County Acreage
1972	682		30				5	
1973	711		29				4	
1974	688		29				6	
1975	922		30		167		5	
1976	842		20		171		6	
1977	907		22		173		6	
1978	946				144		7	
1979	985		24		152		8	
1980	985		35		159		48	
1981	1,097		166		229		40	
1982	1,155		191		180		16	
1983	1,187		200		185		18	
1984	1,090		230		202		20	
1985	1,110		204		216		29	
1986	1,203		358		435		36	
1987	1,319		329		272		159	
1988	1,183		461		187		20	
1989	1,285		498		281		74	
1990	1,312		477		176		86	
1991	1,224		365		166		241	
1992	1,261		350		168		491	
1993	1,292		168		1,349		494	
1994	1,338		113		1,577		452	
1995	1,307		106		1,587		714	
1996	1,428		168		1,627		730	
1997	1,550		229		1,667		746	
1998	1,636		267		1,778		680	
1999	1,689		271		1,882		787	
2000	1,806	1,806	248	248	2,226	2.226	815	815
2005		2,043		199		2,879		912
2010		2,214		199		3,272		1,009
2015		2,385		198		3,664		1,107
2020		2,555		198		4,057		1,204
2025		2,626		198		4,449		1,302

Table 13. Irrigation Requirements for Projected Greenhouse/Nursery Acreage in the Kissimmee Basin.

County/Acreage/Demand	2000	2005	2010	2015	2020	2025
Southern Orange County						
Acreage	**Acres**					
Irrigated Acres	452	511	554	596	639	657
Net Irrigation Requirement	**MGD**					
Annual Based on Average Rainfall Year (20.8 in.)	0.93	1.05	1.14	1.23	1.32	1.36
Annual Based on 1-in-10 Rainfall Year (25.0 in.)	1.12	1.27	1.38	1.48	1.58	1.63
Western Osceola County						
Acreage	**Acres**					
Irrigated Acres	248	199	199	198	198	198
Net Irrigation Requirement	**MGD**					
Annual Based on Average Rainfall Year (23.4 in.)	0.58	0.46	0.46	0.46	0.46	0.46
Annual Based on 1-in-10 Rainfall Year (27.5 in.)	0.68	0.54	0.54	0.54	0.54	0.54
Eastern Highlands County						
Acreage	**Acres**					
Irrigated Acres	1,645	1,776	1,854	1,933	2,011	2,090
Net Irrigation Requirement	**MGD**					
Annual Based on Average Rainfall Year (23.52 in.)	3.84	4.14	4.32	4.51	4.69	4.87
Annual Based on 1-in-10 Rainfall Year (28.0 in.)	4.57	4.93	5.15	5.37	5.59	5.81
Western Okeechobee County						
Acreage	**Acres**					
Irrigated Acres	815	912	1,009	1,107	1,204	1,302
Net Irrigation Requirement	**MGD**					
Annual Based on Average Rainfall Year (23.3 in.)	1.88	2.10	2.33	2.56	2.78	3.01
Annual Based on 1-in-10 Rainfall Year (29.1 in.)	2.35	2.63	2.91	3.19	3.48	3.76

Improved Pasture

Improved pasture is pasture that has the facilities in place to carry out irrigation. Unless there is evidence of active pasture irrigation within a specific county, the irrigation of that acreage is not included in the primary projection scenario analyzed in the District's regional water supply plans. Although this assumption may not be the case in a minority of instances, it is closer to actual production practices than irrigation requirement model or permit values.

The water supply planning assumption that improved pasture is not irrigated does not preclude ranchers from acquiring SFWMD consumptive use permits, or carrying out pasture irrigation; however, this irrigation activity is not part of the primary projection for irrigation demand in a mean or 1-in-10 year drought event.

Cattle Watering

Water required for cattle watering was assessed as a function of the quantity and type (beef or dairy) of cattle. Demand projections for cattle watering (**Table 14**) were based on the SFWMD allocation of 12 gallons/cow/day for beef cattle and 150 gallons/cow/day for dairy cattle. Demand was assessed at 9.6 MGD in Year 2000 and is projected to remain stable through Year 2025.

Table 14. Cattle Watering Demands in the Kissimmee Basin Planning Area.

County Area	Total Non-Dairy Cattle	Dairy Cows	Total Cattle & Calves	MGY	MGD
Southern Orange	1,700	0	1,700	7	0.02
Western Osceola	62,400	0	62,400	273	0.75
Eastern Polk	35,343	500	35,843	182	0.50
Eastern Highlands	88,800	7,000	101,369	772	2.11
Northern Glades	50,692	0	50,692	222	0.61
Western Okeechobee	86,870	30,600	147,050	2,056	5.63
Total	325,805	38,100	399,054	3,512	9.62

Aquaculture

Aquacultural operations withdraw water for circulation and replace evaporative losses. Replacement quantities, outlined in **Table 15**, were assessed for counties with currently permitted consumptive uses for aquaculture (fish farming). There are no existing consumptive use permits for aquaculture in southern Orange or northern Glades counties. Demands are projected to remain at a constant level through Year 2025.

Table 15. Aquaculture Demands in the Kissimmee Basin Planning Area.

County Area	MGY	MGD
Western Osceola	203	0.55
Eastern Polk	2	0.01
Eastern Highlands	114	0.31
Western Okeechobee	229	0.63
Total	548	1.50

Total Irrigated Acreage

Table 16 presents irrigated agricultural acreages for the KB Planning Area. **Table 17** shows the Average Irrigation Demands for Agricultural Demands in KB Planning Area.

Table 16. Irrigated Agricultural Acreage in the KB Planning Area.

Category	Southern Orange County	Western Osceola County	Eastern Polk County	Eastern Highlands County	Northern Glades County	Western Okeechobee County	Total KB	% of Total
2000								
Citrus	4,497	9,333	2,537	27,346	5,043	3,408	52,164	70.0%
Vegetables, Melons and Berries	0	2,432	588	3,645	1,248	4,977	12,890	17.3%
Field Crops (Sugarcane)	0	0	0	0	3,338	0	3,338	4.5%
Sod	0	500	1,000	900	300	250	2,950	4.0%
Greenhouse/ Nursery	452	248	0	1,645	0	815	3,160	4.2%
Total	4,949	12,513	4,125	33,536	9,929	9,450	74,502	100.0%
2025								
Citrus	974	6,899	2,041	26,559	4,984	5,078	46,535	64.4%
Vegetables, Melons and Berries	0	2,432	588	3,645	1,248	4,977	12,890	17.8%
Field Crops (Sugarcane)	0	0	0	1,000	4,438	0	5,438	7.5%
Sod	0	500	1,000	900	300	250	2,950	4.1%
Greenhouse/ Nursery	657	198	0	2,090	0	1,502	4,447	6.2%
Total	1,631	10,029	3,629	34,194	10,970	11,807	72,260	100.0%

Table 17. Average Irrigation Demands for Agricultural Demands in KB Planning Area.

Category	Southern Orange County	Western Osceola County	Eastern Polk County	Eastern Highlands County	Northern Glades County	Western Okeechobee County	Total KB
2000							
Citrus	4.34	7.19	2.63	30.42	7.50	3.84	55.92
Vegetables, Melons and Berries	0.00	3.62	0.84	5.33	2.10	9.45	21.34
Field Crops (Sugarcane)	0.00	0.00	0.00	10.02	1.98	0.00	12.00
Sod	0.00	1.53	2.98	2.79	1.02	0.76	9.08
Greenhouse/Nursery	0.93	0.58	0.00	3.84	0.00	1.88	7.23
Fruits & Nuts	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cattle Watering	0.02	0.75	0.50	2.11	0.61	5.63	9.62
Aquaculture	0.00	0.55	0.01	0.31	0.00	0.63	1.50
Total	5.27	12.92	6.45	52.40	12.60	15.93	116.70
2025							
Citrus	0.94	5.32	2.18	29.54	7.42	5.71	51.11
Vegetables, Melons and Berries	0.00	3.62	0.84	5.54	2.10	9.45	21.55
Field Crops (Sugarcane)	0.00	0.00	0.00	13.32	1.98	0.00	15.30
Sod	0.00	1.53	2.98	2.79	1.02	0.76	9.08
Greenhouse/Nursery	1.32	0.46	0.00	4.69	0.00	2.78	9.25
Fruits & Nuts	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cattle Watering	0.02	0.75	0.50	2.11	0.61	5.63	9.62
Aquaculture	0.00	0.55	0.01	0.31	0.00	0.63	1.50
Total	2.28	12.23	6.51	58.30	13.13	24.96	117.41

(4) Commercial / Industrial Self-Supply

This category includes self-supplied commercial and industrial water demands not supported by a public utility. Water used for commercial and industrial purposes supplied by utilities is included with other utility demands. The majority of the region's employees are found in the service and retail sales economic sectors, indicating that water demand by these sectors will generally grow along with the population. Demand for this category of water use was projected to grow at the rate of each county's population growth. Demands for commercial and industrial are not estimated to change between average and 1-in-10 year drought demand conditions. **Table 18** summarizes Kissimmee Basin Planning Area Commercial and Industrial demand projections; Year 2000 use was based on the SFWMD's water use permit records.

Table 18. Commercial and Industrial Self-Supply 1-in-10 Year Demand (MGD).

County Area	2000	2005	2010	2015	2020	2025
Southern Orange	6.33	7.92	9.51	11.10	12.69	14.28
Western Osceola	0.32	0.38	0.44	0.49	0.55	0.61
Eastern Polk	0.05	0.06	0.07	0.08	0.08	0.09
Eastern Highlands	3.15	3.43	3.71	3.99	4.28	4.56
Western Okeechobee	3.98	4.21	4.45	4.69	4.93	5.17
Total MGD	13.83	16.00	18.18	20.35	22.53	24.71

(5) Thermoelectric Power Generation Self-Supply

Thermoelectric power plants may withdraw large quantities of water for cooling purposes. The vast majority of this water is not consumed in the sense that the same water may pass through the plant repeatedly, sequentially circulating through a series of ponds. There will normally be some evaporative losses (mostly related to the cooling water being kept in ponds), which must be replaced from an external source beyond rainfall and runoff. The permitted supplemental withdrawal for thermoelectric power cooling (fresh water) was 0.5 MGD in Year 2000 or 0.3 percent of the overall urban water demand. This water was used the Kissimmee Utility Authority (KUA) operating in the region. Florida Power & Light has identified a coal-fired power plant for construction in Glades County, just outside the Kissimmee Basin Planning Area. This water demand is addressed in the Lower West Coast Water Supply Plan Update. The KUA expects moderate increases in use over time, but anticipates this additional use will be met by the Toho Water Authority (TWA). This increase is water use is identified in TWA's projected growth (Appendix E). The exact location of the projected power facilities has not been determined at this time.

(6) Recreational Self-Supply

The Recreational Self-Supply demand category includes self-supplied irrigation demands for large landscaped and recreational areas (as opposed to private homes), and for golf courses, typically identified through consumptive use permits. Golf course demands by county are projected separately and added to the other landscape and recreation demands. Golf course irrigation is the largest recreational type of water use. Non-golf course landscaping and recreational water use was assumed to increase in proportion to the county population, with Year 2000 used as the base year. Recreational irrigation requirement estimates for average and l-in-10 year drought events were made using the AFSIRS model. The irrigation requirements were calculated similarly to other irrigation requirements, using a representative irrigation system/rainfall station/soil type combination for each county. Recreational Self-Supply demand projections for landscape and golf acreage are shown in **Table 26**. Recreational demands supplied by public utilities are included in the Public Water Supply demands.

Landscape

Demand projections for this subcategory include irrigated acreage specifically identified for landscape and recreation in the District's consumptive use permitting database. This category excludes golf courses. Landscaped areas that are not identified in the water use permits are assumed included in the Public Water Supply for utilities. Landscaping acreage was projected to increase proportionally to the county population, with Year 2000 used as the base year. Within the Kissimmee Basin during Year 2000, there were 700 acres of landscape self-supplied demand in the greater than 100,000 GPD (0.1 MGD) category. **Table 19** outlines acreage projections for large-scale landscaping and recreation self-supplied usage.

Table 19. Landscape Self-Supply Acreage.

County	2000	2005	2010	2015	2020	2025
Southern Orange	613	766	919	1,075	1,226	1,385
Western Osceola	24	28	32	36	41	45
Eastern Polk	16	23	30	37	44	51
Eastern Highlands	7	8	8	9	10	10
Northern Glades	10	11	12	13	13	14
Western Okeechobee	30	32	34	35	37	39
Total Acres	2,700	868	3,045	3,220	3,391	3,569

Golf Courses

Historical irrigated golf course acreage data were gathered from the District's Consumptive Use Permitting database, the *Golf Course Directory* (National Golf Foundation 2001) and personal communication with staff from several of the golf courses listed. Irrigated golf course acreage projections were made by statistically correlating historical acreage to historical population, or to a time trend, or to both. Projections were made for total irrigated golf course acreage. Those courses supplied by reuse or potable utility systems were identified and accounted for in the projections.

In Year 2000, there were 53 golf courses in the Kissimmee Basin, of which 21 were self-supplied and 32 were irrigated with reclaimed water. The great majority of the golf courses (46) in the Kissimmee Basin are in southern Orange and western Osceola counties. There are no golf courses currently in northern Glades

County that are self-supplied, and none are projected. All projected courses are considered potentially self-supplied in this analysis; however, use of reclaimed water is encouraged.

Southern Orange County and Western Osceola County

Golf courses currently located in Orange County and Osceola County are shown in **Table 20** and **Table 21** , respectively. As in other counties, the growth in golf course acreage has occurred irregularly on a year-by-year basis.

Using historic golf course construction as a baseline, a statistical model was applied to project irrigated golf course acreage in both southern Orange and Osceola counties (portions located within the SFWMD). All golf courses currently in Osceola County are within the SFWMD. An equation using a damped trend exponential smoothing model was estimated to project irrigated golf course acreage in both of these counties.

Irrigation requirements for projected self-supplied golf courses in southern Orange County and western Osceola County are shown in **Table 22**. Water demands created by future golf course expansion were considered self-supplied.

Table 20. Golf Courses in Southern Orange County.

Name	Year Opened	Irrigated Acres	Self-Supplied Acres
Eaglewood GC	1958	332	332
Bay Hill[a]	1964	180	0
Greens Golf[a]	1968	35	0
Cypress Creek[a]	1970	120	0
LBV Oak Trail Golf Club[a]	1971	58	0
Orange Tree[a]	1973	94	0
McCoy Annex	1981	30	30
Boggy Creek	1982	27	27
Orange Lake	1982	238	238
Grand Cypress[a]	1983	477	0
Meadow Woods[a]	1985	105	0
Hunters Creek[a]	1986	180	0
Isleworth[a]	1986	179	0
Lake Nona[a]	1986	161	0
Marriott Orlando[a]	1986	95	0
Windemere[a]	1986	140	0
International[a]	1987	110	0
Metro West[a]	1987	109	0
Orangewood[a]	1987	138	0
Eastwood Golf Course	1989	120	120

Table 20. Golf Courses in Southern Orange County (Continued.)

Name	Year Opened	Irrigated Acres	Self-Supplied Acres
Bonnet Lakes	1991	145	145
Glenmuir	1993	512	512
Eagle Pines[a]	1995	70	0
The Palms	1995	120	120
Exec. Nine	1995	30	30
Faldo Golf Institute	1996	80	80
Keene's Point[a]	1999	263	0
Lake Hart GC[a]	2000	96	0
Total		4,244	1,634

a. Irrigated with reuse.

Table 21. Golf Courses in Osceola County.

Name	Year Opened	Irrigated Acres	Self-Supplied Acres
Kissimmee GC (Airport Inn)[a]	1965	100	0
Kissimmee GC[a]	1970	37	0
Buenaventura Lakes CC[a]	1975	65	0
Crystalbrook Golf Club	1973	18	18
Osceola Golf Club	1984	120	120
Kissimmee Oaks GC[a]	1985	158	0
Kissimmee Bay CC[a]	1990	85	0
Million Dollar Mulligan	1990	60	60
Falcon's Fire Golf Club (Saralago)[a]	1993	170	0
Celebration Golf Club[a]	1996	120	0
Remington Golf Club[a]	1996	102	0
The Palms (Tempus Palms, Mystic Dunes)[a]	1998	140	0
The Palms (Tempus Palms, Mystic Dunes)[a]	1999	24	0
Champions Gate Golf Resort[a]	2000	225	0
Total		1,424	198

a. Irrigated with reuse.

Table 22. Irrigation Requirements for Projected Self-Supply Golf Courses in Southern Orange County and Western Osceola County.

County/Acreage/Demand	2000	2005	2010	2015	2020	2025
Southern Orange County						
Acreage	**Acres**					
Irrigated Acreage	4,669	5,161	5,648	6,155	6,678	7,211
Self-Supply Irrigated Acreage	1,754	2,015	2,363	2,652	2,893	3,093
Net Irrigation Requirement	**MGD**					
During an Average Rainfall Year (17.9 inches)	3.12	3.58	4.20	4.71	5.14	5.49
During a 1-in-10 Rainfall Year (22.2 inches)	3.86	4.43	5.20	5.84	6.37	6.81
Western Osceola County						
Acreage	**Acres**					
Irrigated Acreage	1,424	1,851	2,333	2,812	3,290	3,765
Self-Supply Irrigated Acreage	198	625	1,107	1,586	2,064	2,539
Net Irrigation Requirement	**MGD**					
During an Average Rainfall Year (20.5 inches)	0.40	1.27	2.25	3.22	4.20	5.16
During a 1-in-10 Rainfall Year (23.4 inches)	0.46	1.45	2.57	3.68	4.79	5.89

Other Kissimmee Basin Counties

With the exception of Orange and Osceola counties, there are relatively few golf courses in the Kissimmee Basin. Those existing in Year 2000 are shown in **Table 22** through **25**. There are no golf courses in the Kissimmee Basin portion of Glades County. Trend establishment is not realistic due to the small number of existing courses in these counties. Based on existing information, there are no courses planned in Highlands and Okeechobee counties; and, therefore, no new acreage is projected. Development near the Orange-Polk County line since Year 2000 has shown very rapid growth including several new golf courses. In addition, future land use maps for northeast Polk County show a change from rural to residential development by Year 2020. For these reasons, it is anticipated that new growth in northeast portion of Polk County will grow rapidly and that two or three new golf course communities will be constructed as part of this growth.

Table 23. Golf Courses in Eastern Polk County.

Name	Year Opened	Irrigated Acres	Self-Supplied Acres
Indian Lake Estates Golf	1964	71	71
Grenelefe	1972	15	15
Poinciana	1972	120	120
Sun Air	1976	80	80
Total		286	286

Table 24. Golf Courses in Eastern Highlands County.

Name	Year Opened	Irrigated Acres	Self-Supplied Acres
Placid Lakes CC	1966	90	90
Spring Lake G&CC[a]	1980	160	0
Total		250	90

a. Irrigated with reuse.

Table 25. Golf Courses in Western Okeechobee County.

Name	Year Opened	Irrigated Acres	Self-Supplied Acres
Okeechobee G&CC	1966	31	31
Okeechobee KOA (Crystal Lakes)	1968	57	57
Total		88	88

Recreation

Table 26 presents Recreational Self-Supply demand projections in the Kissimmee Basin.

Table 26. Recreational Self-Supply Demand Projections in the Kissimmee Basin.

County/Acreage/Demand	2000	2005	2010	2015	2020	2025
Southern Orange						
Acreage	**Acres**					
Irrigated Golf Course Acres	4,669	5,161	5,648	6,155	6,678	7,211
Self-Supply Golf Course Acres	1,754	2,015	2,363	2,652	2,893	3,093
Self-Supply Landscape Acres	613	766	919	1,075	1,226	1,385
Irrigation Requirement	**MGD**					
Average	4.20	4.94	5.83	6.62	7.32	7.95
1-in-10 Year	5.21	6.12	7.23	8.21	9.07	9.86
Western Osceola						
Acreage	**Acres**					
Irrigated Golf Course Acres	1,424	1,851	2,333	2,812	3,290	3,765
Self-Supply Golf Course Acres	198	625	1,107	1,586	2,064	2,539
Self-Supply Landscape Acres	24	28	32	36	41	45
Irrigation Requirement	**MGD**					
Average	0.45	1.33	2.32	3.30	4.28	5.25
1-in-10 Year	0.52	1.52	2.64	3.76	4.89	6.00
Eastern Polk						
Acreage	**Acres**					
Irrigated Golf Course Acres	286	286	370	470	570	670
Self-Supply Golf Course Acres	286	286	370	470	570	670
Self-Supply Landscape Acres	16	23	30	37	44	51
Irrigation Requirement	**MGD**					
Average	0.61	0.61	0.81	1.02	1.23	1.44
1-in-10 Year	0.93	0.93	1.16	1.48	1.81	2.13
Eastern Highlands						
Acreage	**Acres**					
Irrigated Golf Course Acres	250	250	250	250	250	250
Self-Supply Golf Course Acres	90	90	90	90	90	90
Self-Supply Landscape Acres	7	8	8	9	10	10
Irrigation Requirement	**MGD**					
Average	0.20	0.20	0.20	0.21	0.21	0.21
1-in-10 Year	0.32	0.33	0.33	0.33	0.33	0.33

Table 26. Recreational Self-Supply Demand Projections in the Kissimmee Basin (Continued).

County/Acreage/Demand	2000	2005	2010	2015	2020	2025
Northern Glades						
Acreage	**Acres**					
Irrigated Golf Course Acres	0	0	0	0	0	0
Self-Supply Golf Course Acres	0	0	0	0	0	0
Self-Supply Landscape Acres	10	11	12	13	13	14
Irrigation Requirement	**MGD**					
Average Irrigation Requirement	0.02	0.03	0.03	0.03	0.03	0.03
1-in-10 Year Irrigation Requirement	0.04	0.04	0.04	0.05	0.05	0.05
Western Okeechobee						
Acreage	**Acres**					
Irrigated Golf Course Acres	88	88	88	88	88	88
Self-Supply Golf Course Acreage	88	88	88	88	88	88
Self-Supply Landscape Acreage	30	32	34	35	37	39
Irrigation Requirement	**MGD**					
Average	0.23	0.23	0.24	0.24	0.24	0.25
1-in-10 Year	0.27	0.27	0.28	0.28	0.28	0.29
Totals						
Acreage	**Acres**					
Total KB Recreational Acres (Llandscape + Golf Self-Supply)	3,116	3,972	5,053	6,091	7,076	8,024
Irrigation Requirement	**MGD**					
Total KB Recreational Self-Supply Average	5.71	7.34	9.43	11.41	15.13	15.13
Total KB Recreational Self-Supply 1-in-10 Year	7.29	9.21	11.68	14.11	16.43	18.66

Total Annual Water Demand

Table 27 shows estimated Year 2000 and projected Year 2025 demands for the KB Planning Area.

Table 27. SFWMD Overall Water Demands for Year 2000 and Year 2025 (MGD).

Water Use Category	Average Demands 2000 (MGD)	Average Projected Demands 2025 (MGD)	% Change Average Demands 2000-2025	1-in-10 Year Projected Demand 2025
Public Water Supply	113.50	235.27	107%	263.89
Domestic Self-Supply	11.30	13.84	23%	15.62
Commercial & Industrial Self-Supply	11.00	18.80	71%	24.71
Recreational Self-Supply	5.71	15.13	165%	18.66
Thermoelectric Power Generation Self-Supply	0.46	0.46	0%	0.46
Agricultural Self-Supply	116.70	117.41	> 1%	190.52
Total Water Demands	258.67	400.91	55%	513.86

Summary of 1-in-10 Year Water Demands

The demand estimates summarized thus far have been presented for average water use conditions. However, the water supply plan requirements call for a level of certainty in the plan under a 1-in-10 year drought condition. In most instances the 1-in-10 year drought event water demands are higher than in the average water use. For Public Water Supply and Domestic Self-Supply use, drought conditions are represented by a use that is 6 percent higher than the average demands. Estimated 1-in-10 year drought demands for Public Water Supply and Domestic Self-Supply is 248.3 MGD for Year 2025. Agricultural 1-in-10 year drought demands can be significantly higher than average conditions depending on soil and crop type. Agricultural 1-in-10 year drought demands for Year 2025 are 190.5 MGD, 61 percent higher than average conditions. Recreational use has similar differences between average drought demand estimates. Only commercial/industrial use and power generation (electric) are estimated to show little difference between average and 1-in-10 year drought conditions. Total water use under 1-in-10 year drought conditions is estimated at 340.7 MGD for the Year 2000 and 498.2 MGD for the Year 2025.

Changes from the 2000 KB Water Supply Plan

There were several changes made in the demand assessment and projection methodology from the 2000 KB Plan to the 2005–2006 KB Plan Update. These are summarized below:

Census blocks versus Census block groups. The population analysis conducted in this 2005–2006 KB Plan Update used census blocks, whereas block groups were used for the 2000 KB Plan. A Census block is the smallest Census geographic area, normally bounded by streets and other prominent physical features. A Census block has a higher resolution than a group of blocks (Census block group); therefore, use of blocks rather than block groups provides a higher level of precision.

A lower water use threshold for Public Water Supply utilities from 500,000 to 100,000 gallons per day. This had the effect of increasing the number of Public Water Supply utilities analyzed in the 2005–2006 KB Plan Update.

Supplemental irrigation needs determined using the AFSIRS Model versus a modified Blaney-Criddle Model. Both of these models estimate evapotranspiration (ET) in order to derive supplemental irrigation requirements for agricultural crops and outdoor irrigation. However, in south Florida, the Blaney-Criddle Model tends to overestimate ET, which is the driving component of supplemental irrigation. As a result, the Blaney-Criddle Model has the potential to overestimate supplemental irrigation requirements. To address this, the District staff began using the Agricultural Field Scale Irrigation Requirement Simulation (AFSIRS) model as the regional water supply plans were updated. The AFSIRS model yields supplemental irrigation requirements that better reflect historic use patterns, and are generally lower than the modified Blaney-Criddle Model on an annual basis.

Comparison with 2000 KB Plan Projected Water Demands

Projected Water Demands

Table 28 shows the estimated average water demands estimated in the 2000 KB Plan and those estimated for the 2005–2006 KB Plan Update. **Table 29** presents the 1-in-10 year estimated demands in the 2000 KB Plan and those estimated for this update.

Table 28. Estimated Average Total Water Demands in the 2000 Kissimmee Basin Plan and the 2005–2006 KB Plan Update.

Water Use Category	2000 KB Plan Average Demands for 2020 (MGD)	2005 KB Plan Average Demands for 2025 (MGD)	% Change 2000 KB Plan (2020) vs. 2005 KB Update (2025)
Public Water Supply	145.30	235.27	62%
Domestic Self-Supply and Small Public Supply Systems	11.80	13.84	17%
Commercial & Industrial Self-Supply	5.80	18.80	224%
Recreational Self-Supply	23.82	15.13	-36%
Thermoelectric Power Generation Self-Supply	0.46	0.46	0%
Agricultural Self-Supply	476.70	117.41	-75%
Total Water Use	663.88	400.91	-40%

Table 29. Estimated 1-in-10 Year Demands in the 2000 Kissimmee Basin Plan and the 2005–2006 KB Plan Update.

Water Use Category	2000 KB Plan 1-in-10 Year Demands for 2020 (MGD)	2005 KB Plan 1-in-10 Year Demands for 2025 (MGD)	% Change 2000 KB Plan (2020) vs. 2005 KB Update (2025)
Public Water Supply	154.02	248.27	61%
Domestic Self-Supply and Small Public Supply Systems	12.51	15.62	25%
Commercial & Industrial Self-Supply	5.80	24.71	326%
Recreational Self-Supply	27.39	18.66	-32%
Thermoelectric Power Generation Self-Supply	0.46	0.46	0%
Agricultural Self-Supply	566.00	190.52	-66%
Total Water Use	766.18	498.24	-35%

For Public Water Supply and Domestic Self-Supply, 1-in-10 year drought event demand projections are believed to be 6 percent greater than average demand projections.

The most significant differences between the 2000 KB Plan demand estimates and the demand estimates in this plan update occur for the following reasons:

- Agricultural acreage growth trends (particularly citrus in the south of the Kissimmee Basin) have leveled off. This was not the observed trend at the time of the 2000 KB Plan. For example, the projection for irrigated agricultural acreage in the 2000 KB Plan anticipated a significant increase in citrus acreage (the dominant crop in the region), whereas the 2005–2006 KB Plan Update anticipates a modest decline.

- At the time of the development of the 2000 KB Plan, there were several agricultural corporations in the region expressing significant expansion plans for crops that would require irrigation; however, these plans were not fully carried out.
- The irrigation model used in the 2000 KB Plan was a modified Blaney-Criddle Model, whereas the AFSIRS Model is used for the 2005–2006 KB Plan Update. Use of that version of the Blaney-Criddle Model generally results in a higher per acre irrigation than estimated by the AFSIRS model.

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E

Potable and Wastewater Treatment Facilities

This appendix was prepared in October 2005 and updated based on available information in November 2006, reflecting status as of this date in time.

POTABLE WATER TREATMENT FACILITIES

An inventory of potable water supply facilities for the Kissimmee Basin (KB) Planning Area was made for those facilities treating greater than 0.10 million gallons per day (MGD) on an annual average. This inventory included facilities in the South Florida Water Management District (SFWMD) portions of Glades, Highlands, Okeechobee, Orange, Osceola and Polk counties.

In 2000, 15 potable water service providers were located within the Kissimmee Basin Planning Area. These utility providers operate 47 existing water treatment facilities within the basin and show plans for two additional water plants. These water treatment facilities are located mostly in the urbanized areas throughout the KB Planning Area. Nine of these facilities are privately owned and the remaining 38 water plants are owned or operated by a governmental agency. All but two of the facilities use the Floridan Aquifer System (FAS) for raw water supply. Of the non-Floridan sources, one facility uses water from Lake Okeechobee and the other facility uses water from the Surficial Aquifer System (SAS). In 2000, the total treatment capacity of these facilities was 226.30 MGD with an average annual water use of 111.66 MGD. **Figures 1** and **2** show the locations of the service areas for these providers.

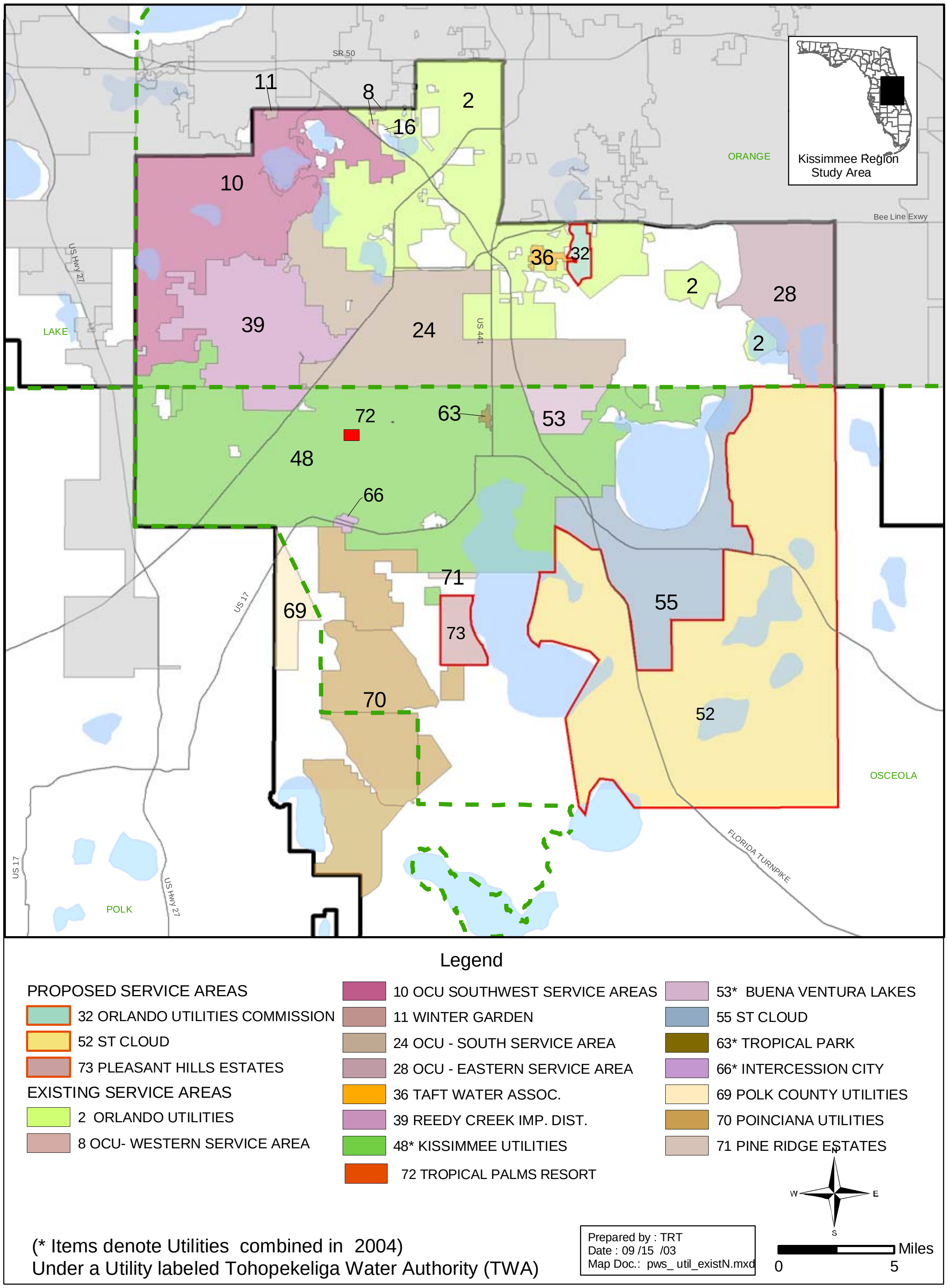

Figure 1. Potable Water Treatment Facility Service Areas in the Northern Kissimmee Basin, 2000–2025.

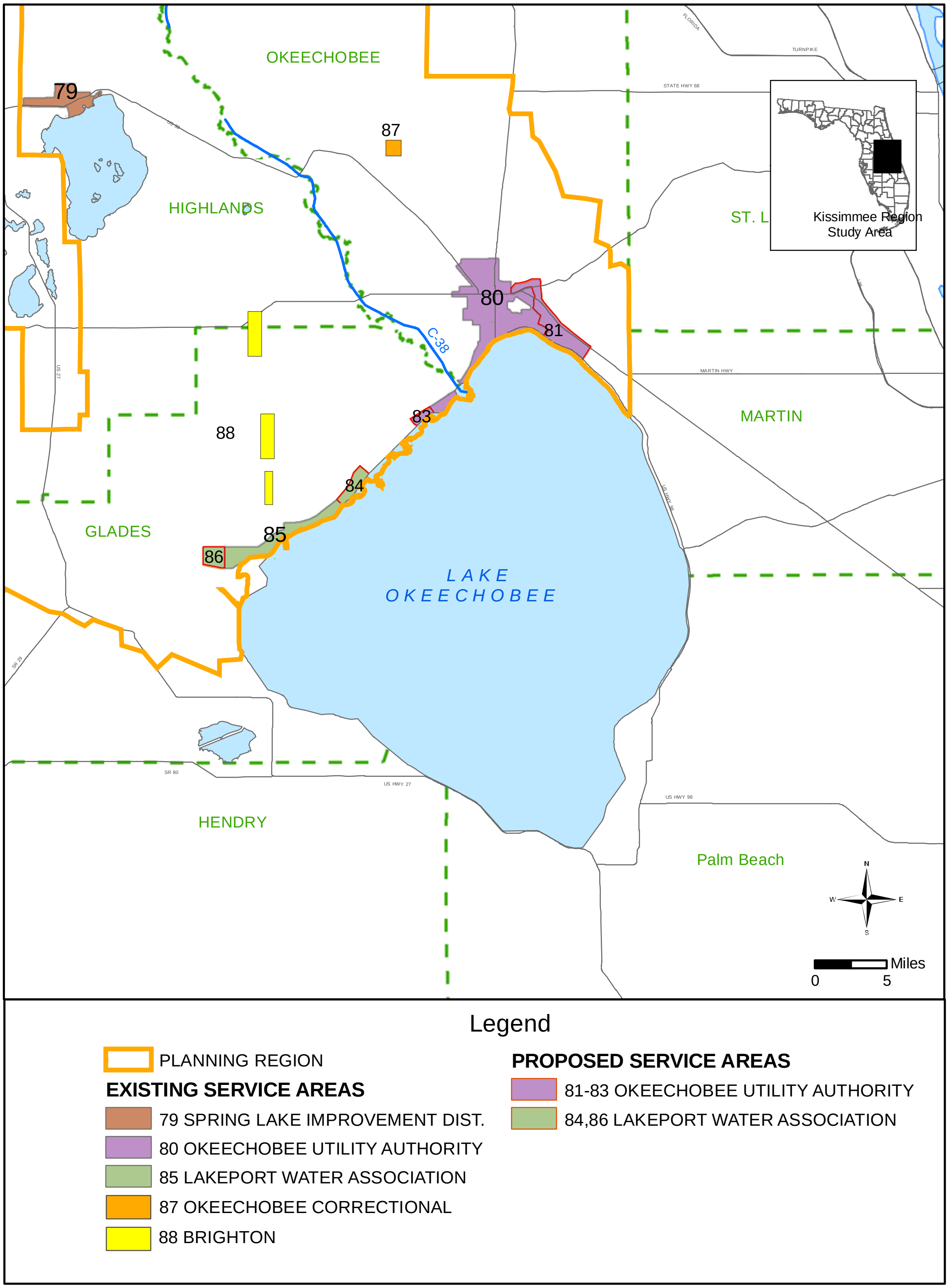

Figure 2. Potable Water Treatment Facility Service Areas in the Southern Kissimmee Basin, 2000–2025.

Table 1. Summary of the Regional Potable Water Treatment Facilities Located within the Kissimmee Basin Planning Area.

Facility	FDEP Rated Capacity (MGD)	2000 Average Daily Flow (MGD)	Method of Treatment				Raw Water Sources		
			Chlorination	Coagulation /Filtration	Aeration	Ozonation	Surface Water	SAS	FAS
Glades									
Brighton Public Water	*0.50	0.39	X		X				X
Highlands									
Spring Lake Imp. District	0.50	0.23	X						X
Okeechobee									
Okeechobee Utility Authority									
Groundwater Plant	1.00	0.49	X[a]	X	X[b]			X	
Surface Water Plant	3.20	1.85	X	X			X		
Okeechobee Correctional	0.32	0.12	X						X
Orange									
Orange County Utilities									
Cypress Walk	2.49	0.93	X		X				X
Hidden Springs	8.95	2.83	X		X				X
Hunters Creek	6.46	1.84	X		X				X
Meadow Woods	5.18	0.63	X		X				X
Orangewood	10.80	4.72	X						X
Southern Regional (permitted)		---							X
CR 535 WSF (under design)		---	X						X
Vistana	4.46	4.17	X						X
Orlando Utilities Commission									
Kirkman	15.00	9.13				X			X
Southeast	---	---				X			X
Sky Lake	15.00	13.10	X[c]						X
Southwest	40.00	20.65				X			X
Reedy Creek									
Pump Station A	17.30	5.06	X						X
Pump Station B	21.50	3.70	X						X
Pump Station C	12.60	4.77	X						X
Pump Station D	8.60	6.01	X						X

a. Chlorination and ammonia.
b. Includes filtration.
c. Chlorine/activated carbon process used to treat for hydrogen sulfide.
* Estimated.

Table 1. Summary of the Regional Potable Water Treatment Facilities Located within the Kissimmee Basin Planning Area (Continued).

Facility	FDEP Rated Capacity (MGD)	2000 Average Daily Flow (MGD)	Method of Treatment				Raw Water Sources		
			Chlorination	Coagulation /Filtration	Aeration	Ozonation	Surface Water	SAS	FAS
Pump Station 5 (closed)			X						X
Taft Water Assoc.	9.00	0.27	X						X
Osceola									
Florida Water Services									
Buenaventura Lakes	5.04	2.09	X		X				X
Tropical Park	0.29	0.11	X						
Pine Ridge Estates	0.49	0.14	X						X
Kissimmee									
Camelot East	*0.50	0.22			X				X
Camelot West	2.89	2.41			X				X
Fountain Park	1.04	.22			X				X
Indian Ridge	1.76	2.41			X				X
North Bermuda	16.15	9.62			X				X
Northwest	9.36	4.16			X[b]				X
Parkway	5.60	1.75			X				X
Ruby Street	2.16	0.66			X				X
Poinciana									
#1 (Industrial Park)	2.63	0.58			X				X
#2 (V-2 WTF)	2.54	1.13			X				X
St. Cloud									
#1	3.67	1.25			X				X
#2	4.81	1.80			X				X
#3 (Cane Brake)	0.50	0.03	X						X
O&S Water Co.	0.80	0.18 in 2005	X						X
Polk									
Oakhill Estates (Polk Utility)	2.16	0.45	X						X
Poinciana									
#3 (Core WTF)	1.58	0.99			X				X
#4 (Wilderness WTF)	0.29	0.10			X				X
#5 (V-7 WTF)	0.90	0.65			X				X
KB PWS Total	247.22	111.66							

a. Chlorination and ammonia.
b. Includes filtration.
c. Chlorine/activated carbon process used to treat for hydrogen sulfide.
* Estimated.

Glades County Potable Water Treatment Facilities

In 2000, there were two active public or private providers of domestic water treatment services in Glades County that exceeded 0.10 MGD of annual average water use. These utilities were operated by the Seminole Tribe of Florida and the Okeechobee Utility Authority. A summary of the Seminole Tribe's water service information follows. The Okeechobee Utility Authority is discussed in the Okeechobee County Potable Water Facilities section of this appendix.

Brighton Public Water System

Permits

SFWMD Permit Number: 22-00183-W

Current SFWMD Permit Expires: November 15, 2006 (under review)

The 2003 average daily pumpage from the Surficial Aquifer wells was 0.61 MGD with a maximum day of 0.98 MGD.

Existing Facilities

The Seminole Tribe of Florida operates a utility serving an estimated 2,000 residents in Glades County. The Tribe's water system services two areas in addition to the Tribe. These include the Lykes Brothers Incorporated property and the Town of Lakeport. The Town of Lakeport accepts the bulk sale of water from the Tribe's system and provides additional chlorination before distribution to its estimated 1,145 customers. Water is supplied by two wells located on Lykes Brothers property. The Tribe provides pre-chlorination and aeration as treatment. There is a 250,000 gallon aboveground storage tank located at the water treatment facility (WTF). Both wells withdraw from the Upper Floridan Aquifer System. **Table 2** provides details of wells construction. Water use in 2000 was approximately 0.39 MGD. Permitted allocations for the facilities are as follows:

Annual Allocation: 161 MGY (0.44 MGD)

Maximum Daily Allocation: 0.75 MGD

Table 2. Brighton Potable Water Supply Wells.

Well Number	Status	Active	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Year Drilled
1	Existing	Yes	Floridan	1,000	480	8	500	1973
2	Existing	Yes	Floridan	1,000	500	8	500	1973

Future Facilities

A recent permit for the Brighton supply system indicates only small growth in the system, estimated at about 40 customers per year though 2010. Past per capita rates are estimated at 193 GPD. Water use estimates for 2025 are 0.47 MGD. The construction of any new facilities is unknown at this time.

Highlands County Potable Water Facilities

In 2000, Spring Lake Improvement District operated the only utility providing domestic water treatment services in Highlands County and within the SFWMD that exceeded 0.10 MGD of withdrawals on an average annual basis.

Spring Lake Improvement District

Permits

SFWMD Permit Number: 28-00122-W

Current SFWMD Permit Expires: September 10, 2008

Existing Facilities

In 2000, the Spring Lake Improvement District operated a single water plant and three Floridan Aquifer wells to supply an estimated 1,720 residents. The service area for the Spring Lake facility is located on the north shore of Lake Istokpoga along U.S. 98 (**Figure 2**). The 2000 average daily pumping from the Spring Lake wells was approximately 0.23 MGD. The Spring Lake Improvement District potable facilities are not known to have interconnections with any other utilities. **Table 3** provides the construction details of the utility's wells. Permitted allocations for the facilities are as follows:

Annual Allocation: 117 MGY (0.32 MGD)

Maximum Daily Allocation: 0.62 MGD

Table 3. Spring Lake Improvement District Water Supply Wells.

Well Number	Status	Active	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Year Drilled
1	Existing	Yes	Floridan	900	300	8	300	1971
2	Existing	Yes	Floridan	1,150	350	10	500	1972
3	Existing	Yes	Floridan	1,000	350	10	500	1992

Future Facilities

The Spring Lake Improvement District services the Spring Lake subdivision. Growth in the service area is expected to be residential infill within the subdivision. The population served by the Spring Lake water plant is expected to increase to an estimated 2,492 residents by 2025 using approximately 0.31 MGD during average conditions.

Okeechobee County Potable Water Facilities

In 2000, there were two active public or private providers of domestic water treatment services in Okeechobee County that exceeded 0.10 MGD in average annual withdrawals. These utilities were operated by the Okeechobee Utility Authority and the Okeechobee Correctional Institution.

Okeechobee Utility Authority

Permits

SFWMD Permit Number: 47-00004-W

Current SFWMD Permit Expires: January 10, 2007

Existing Facilities

Okeechobee Utility Authority (OUA) operates a utility serving approximately 8,200 residential and commercial connections (an estimated 13,350 residents) in portions of Okeechobee and Glades counties. Approximately 14 percent of the utility customers are located in Glades County. Okeechobee Utility Authority operates two water treatment facilities – one surface water plant using water from Lake Okeechobee and one plant using seven existing Surficial Aquifer wells. The surface water plant is rated at 3.20 MGD and the groundwater plant is rated 1.00 MGD. The location of the utility service area is shown in **Figure 2**. Permitted allocations for the facilities are as follows:

Annual Allocation: 1,033 MGY (2.83 MGD)

Maximum Daily Allocation: 3.85 MGD

Table 4 presents details on the construction of individual wells. The water intake from Lake Okeechobee in located on the north shoreline near State Road 98. **Figure 2** shows the OUA service area. **Table 5** provides water use distribution for the 1998 to 2000 period. Water use for 2000 averaged 2.21 MGD.

Table 4. Okeechobee Utility Authority Potable Water Supply Wells.

Well Number	Status	Active	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Year Drilled
1	Existing	Yes	Surficial	155	88	10	300	1993
2	Existing	Yes	Surficial	165	98	10	400	1993
3	Existing	Yes	Surficial	155	108	10	300	1993
4	Existing	Yes	Surficial	175	108	10	250	1993
5	Existing	Yes	Surficial	175	108	10	300	1993
6	Existing	Yes	Surficial	175	108	10	300	1993
7	Existing	Yes	Surficial	175	108	10	300	1993

Table 5. Okeechobee Utility Authority Potable Supply Facilities Distribution of Withdrawals.

Facility Name	Existing Wells	Proposed Wells	Avg. 1998-2000 % of Total Annual Flow	Proposed % of 2025 Flows
Surface Water Plant	Lake Intake	Lake Intake	79%	100%
Groundwater Treatment Facility	1,2,3,4,5,6,7	1,2,3,4,5,6,7	21%	0%

Future Facilities

In 2005, the Okeechobee Utility Authority replaced its previous 3.20 MGD surface water treatment facility with a newer 6.00 MGD facility. Once the water plant is constructed, potable service will be supplied from surface water only. **Table 5** shows the distribution of future water production as a proposed percentage of 2025 Flows. Water use is projected to increase to 4.03 MGD by 2025 to serve an estimated 23,145 residents.

Okeechobee Correctional Institution

Permits

SFWMD Permit Number: 47-00421-W

Current SFWMD Permit Expires: January 15, 2015

Existing Facilities

The Florida Department of Corrections operates the Okeechobee Correctional Institution facility serving approximately 300 inmates and staff. The state operates one water treatment facility using two existing Floridan Aquifer wells. The water plant is rated at 0.32 MGD. **Figure 2** shows the location of the correctional facility. Permitted allocations for the facilities are as follows:

Annual Allocation: 1,033 MGY (2.83 MGD)

Maximum Daily Allocation: 3.85 MGD

Details on the construction of individual wells can be found in **Table 6**.

Table 6. Okeechobee Correctional Institution Water Supply Wells.

Well Number	Status	Active	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Year Drilled
1	Existing	Yes	Floridan	800	550	12	600	1994
2	Existing	Yes	Floridan	800	550	12	600	1994

Future Facilities

There are no known plans available for future facilities.

Orange County Potable Water Facilities

In 2000, there were a total of 17 active public or private entities in Orange County (countywide) providing domestic water treatment services exceeding 0.10 MGD. Among these service providers, four are located within the SFWMD portion of the county. These providers include Orange County Utilities, the Orlando Utilities Commission, the Reedy Creek Improvement District and the Taft Water Association. The City of Winter Garden also has a small portion of its service area within the SFWMD. In 2001, this area contained less than 1.03 square miles and there were no withdrawals from within SFWMD.

Winter Garden's facilities are not discussed in this section. The following is a summary of the remaining service providers located within the SFWMD portion of Orange County.

Orange County Utilities

Permits

SFWMD Permit Number: 48-00134-W (Southern) - expired 04/11/06 (under review)

48-01245-W (Horizons West) - expires 11/14/07 (under review)

48-00059-W (Hidden Springs) - expires 11/14/2022

SJRWMD Permit Number: 3317 (Eastern and Western Service Areas) - expires December 13, 2026

Existing Facilities

Orange County Utilities (OCU) is the second largest potable water provider in Orange County serving roughly 244,000 residents in 2000; approximately 48,000 residents are located within the SFWMD. Orange County Utilities operates 11 water treatment facilities, six of which are located in the SFWMD. Two additional water supply facilities are planned to be located in the SFWMD. The remaining five are located in the St. Johns River Water Management District (SJRWMD). Water is supplied to these treatment facilities by 38 wells completed in both the upper and lower zones of the FAS. **Figure 1** shows Orange County Utilities services areas subdivided into four service regions. Total water use for OCU for 2000 was 50.20 MGD with 15.12 MGD being pumped from SFWMD facilities. Permitted allocations for the facilities are as follows:

Annual Allocation:	7,264 MGY (19.90 MGD) SFWMD Current Total
	16,526 MGY (45.30 MGD) SJRWMD Current Total
Maximum Daily Allocation:	48.93 MGD SFWMD Total
	71.95 MGD SJRWMD Total

Table 7 provides details on the construction of individual wells. **Table 8** shows water use distribution for the 1998 to 2000 period.

Table 7. Orange County Utilities Potable Water Supply Wells.

Well	Status	Active	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Year Drilled
SFWMD Facilities								
Cypress Walk								
CW-1	Existing	Yes	Floridan	650	160	14	1,265	1982
CW-2	Existing	Yes	Floridan	500	171	14	1,250	1982
Hidden Springs								
HS-1	Existing	Yes	Floridan	492	185	12	1,000	N/A
HS-3	Existing	Yes	Floridan	1,401	1,250	16	3,000	N/A
HS-4	Existing	Yes	Floridan	1,400	1,250	24	3,000	N/A
HS-5	Monitoring	No	Floridan	1,410	1,050	16	3,000	N/A
Hunters Creek								
HC-1	Existing	Yes	Floridan	600	206	18	3,500	1985
HC-2	Existing	Yes	Floridan	600	201	18	3,500	1985
HC-3	Proposed	No	Floridan	1,700	1100	16	3,500	---
Meadow Woods								
MW-1	Existing	Yes	Floridan	500	185	16	1,800	1984
MW-2	Existing	Yes	Floridan	500	191	16	1,800	1984
SFWMD Facilities								
Orangewood								
OW-1	Existing	Yes	Floridan	600	190	16	2,500	1972
OW-2	Existing	Yes	Floridan	400	150	16	2,000	1979
OW-3	Existing	No	Floridan	1,380	1,110	16	2,100	1986
OW-4	Existing	Yes	Floridan		400			1994
Southern Regional								
SR-1	Proposed	No	Floridan	1,690	1,100	16	3,200	---
SR-2	Proposed	No	Floridan	1,690	1,100	16	3,200	---
SR-3	Proposed	No	Floridan	1,690	1,100	16	3,200	---
SR-4	Proposed	No	Floridan	1,690	1,100	16	3,200	---
SR-5	Proposed	No	Floridan	1,690	1,100	16	3,200	---
SR-6	Proposed	No	Floridan	1,690	1,100	16	3,200	---
SR-7	Proposed	No	Floridan	1,690	1,100	16	3,200	---
SR-8	Proposed	No	Floridan	1,690	1,100	16	3,200	---
Vistana								
V-3	Existing	Yes	Floridan	580	166	12	2,000	1972
V-4	Existing	Yes	Floridan	600	166	12	2,500	1985
V-5	Existing	Yes	Floridan	585	171	16	3,000	1978
CR 535 (Horizons)								
H-1	Proposed	No	Floridan	600	200	24	2,800	---
H-2	Proposed	No	Floridan	600	200	24	2,800	---
H-3	Proposed	No	Floridan	600	200	24	2,800	---
SJRWMD Facilities								
Bent Oaks								
BO-1	Out of Service & Monitoring	No	Floridan	790	N/A	24	N/A	N/A

Table 7. Orange County Utilities Potable Water Supply Wells (Continued).

Well	Status	Active	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Year Drilled
BO-2	Out of Service	No	Floridan	850	N/A	24	N/A	N/A
Bonneville								
BV-1	Existing	Yes	Floridan	550	N/A	12	N/A	N/A
BV-2	Existing	Yes	Floridan	650	N/A	16	N/A	N/A
SJRWMD Facilities								
Conway								
CN-1	Out of Service	No	Floridan	427	N/A	12	N/A	N/A
CN-2	Out of Service	No	Floridan	640	N/A	12	N/A	N/A
CN-3	Out of Service	No	Floridan	700	N/A	24	N/A	N/A
CN-4	Out of Service	No	Floridan	1,400	N/A	10	N/A	N/A
East Regional								
ER1-ER6	Existing	Yes	Floridan	600	N/A	24	3,500	1989–2001
ER7-ER14	Proposed	No	Floridan	600	200	24	3,500	N/A
Econ(SJR)								
EC-1	Existing	Yes	Floridan	669	N/A	24	N/A	N/A
EC-2	Existing	Yes	Floridan	650	N/A	24	N/A	N/A
EC-3	Existing	Yes	Floridan	700	N/A	24	N/A	N/A
EC-4	Existing	Yes	Floridan	669	N/A	24	N/A	N/A
Magnolia Woods								
MAW-1	Out of Service	No	Floridan	250	N/A	4	N/A	N/A
MAW-2	Out of Service	No	Floridan	430	N/A	8	N/A	N/A
MAW-3	Out of Service	No	Floridan	---	N/A	8	N/A	N/A
Oak Meadows								
OM-2	Existing	No	Floridan	715	N/A	12	N/A	N/A
OM-3	Existing	Yes	Floridan	1,100	N/A	18	N/A	N/A
OM-4	Existing	Yes	Floridan	1,260	N/A	18	N/A	N/A
OM-5	Proposed	No	Floridan	1,260	N/A	18	N/A	N/A

Table 7. Orange County Utilities Potable Water Supply Wells (Continued).

Well	Status	Active	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Year Drilled
SJRWMD Facilities								
Riverside								
RS-3	Out of Service	No	Floridan	364	N/A	10	N/A	N/A
RS-4	Out of Service	No	Floridan	1,231	N/A	16	N/A	N/A
West Regional								
WR1-WR8	Existing	Yes	Floridan	1,450	N/A	24	3,000	1989-1997
WR9-WR13	Proposed	Yes	Floridan	1,450	N/A	24	3,000	N/A
Lake Johns Shores	Existing	Yes	---	285	N/A	6	N/A	N/A

Table 8. Orange County Potable Supply Facilities Distribution of Withdrawals.

Facility Name	Existing Wells	Proposed Wells	Avg. 1998-2000 % of Total Annual Flow	Proposed % of 2025 Flows*
Cypress Walk (SF)	1,2		2.3%	2.0%
Hidden Springs (SF)	1,2,3,4		6.8%	3.0%
Hunters Creek (SF)	1,2	3	4.4%	6.0%
Meadow Woods (SF)	1,2		1.5%	3.0%
Orangewood (SF)	1,2		8.9%	3.0%
Vistana (SF)	3,4,5		7.5%	4.0%
Southern Regional (SF)	1	2,3,4,5,6,7,8	0.0%	15.0%
Horizons CR 535 (SF)	1,2,3		0.0%	3.0%
Bent Oaks (SJR)	1,2		0.8%	0.0%
Bonneville (SJR)	1,2		0.8%	0.0%
Conway (SJR)	1,2,3,4		0.4%	0.0%
Eastern Regional (SJR)	1,2,3,4,5,6	1,2,7,8,9,10, 11, 13,14	30.2%	28.0%
Econ (SJR)	1,2,3,4		8.2%	8.0%
Lake John Shores (SJR)	1	1	<0.0%	0.0%
Magnolia Woods (SJR)	1,2,3		<0.1%	0.0%
Oak Meadows (SJR)	2,3,4	5	8.1%	0.0%
Riverside (SJR)	1,2,3,4		1.8%	0.0%
West Regional (SJR)	1–8	9–13	16.9%	17.0%
Zellwood (SJR)	N/A	N/A	0.0%	0.0%

* Distribution of future withdrawals provided by OCU. Those facilities with 0% are out-of-service.

Future Facilities

Orange County has developed a plan for long-term modifications to their overall system. In the coming years, the county will continue to reduce the number of older, smaller water plants and shift production to central pumping and distribution centers. Approximately 14 water supply facilities are expected to provide the drinking water supply for OCU. The remaining portion of the demand is expected to be met with reclaimed water or other alternatives.

Orlando Utilities Commission

Permits

SFWMD Permit Number:	48-00064-W
SJRWMD Permit Number:	3159
Current SJRWMD/SFWMD Permit Expires:	April 11, 2023

In 2003, the SJRWMD was given authority through an inter-district Memorandum of Understanding to permit all of Orlando Utilities Commission's water use.

Orlando Utilities Commission (OUC) operates a utility that served an estimated total of 395,000 residents in 2000, 146,500 of which reside in the SFWMD. Orlando Utilities Commission operates eight active water treatment facilities within its service area. The utility operates a total of 43 existing or proposed wells in these wellfields. All of the water plants, wells and the service area are located in Orange County. Four of the water treatment facilities and 21 of the wells are in the SJRWMD. The remaining four treatment facilities and 22 wells are located in the SFWMD. In 2000, OUC's average daily use was 99.28 million gallons. **Figure 1** provides the location of the OUC service area. Permitted allocations for the facilities are as follows:

Annual Allocation (SJRWMD):	39,868 MGY (109.22 MGD) (Groundwater)
Maximum Daily Allocation:	(N/A) MGD

Table 9 presents details on the construction of individual wells. **Table 10** shows water use distribution for the 1998 to 2000 period.

Table 9. Orlando Utilities Commission Potable Water Supply Wells.

Well Number	Status	Active	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Year Drilled
SFWMD Facilities								
Dr. Phillips								
DP-1	Existing	No	Floridan	450	159	10	2,083	1961
DP-2	Existing	No	Floridan	483	457	12	2,083	1970
DP-3	Existing	No	Floridan	420	201	20	2,083	1974
DP-4	Existing	No	Floridan	816	560	24	3,470	1986
Kirkman								
K-1	Existing	Yes	Floridan	1,346	1,045	16	3,470	1969
K-2	Existing	Yes	Floridan	1,410	982	16	3,470	1976
K-3	Existing	Yes	Floridan	1,410	983	16	3,470	1988
Martin								
M-1	Existing	No	Floridan	381	275	12	3,470	1957
M-2	Existing	No	Floridan	409	228	28	700	1957
M-3	Existing	No	Floridan	700	310	24	4,166	1981
Sky Lake								
SL-1	Existing	Yes	Floridan	1,380	980	16	3,470	1988
SL-2	Existing	Yes	Floridan	1,390	960	16	3,470	1988
SL-3	Existing	Yes	Floridan					2003
SL-4	Proposed	No	Floridan					---
Southwest								
SW-1	Existing	Yes	Floridan	1,400	1,000	24	4,166	1995
SW-2	Existing	Yes	Floridan	1,400	1,000	24	4,166	1995
SW-3	Existing	Yes	Floridan	1,400	1,000	24	4,166	1995
SW-4	Existing	Yes	Floridan	1,400	1,000	24	4,166	1995
SW-5	Existing	Yes	Floridan	1,400	1,000	24	4,166	---
SW-6	Existing	Yes	Floridan	1,400	1,000	24	4,166	---
SW-7	Proposed	No	Floridan	1,400	1,000	24	4,166	---
SJRWMD Facilities								
Conway								
C-1	Existing	Yes	Floridan	1,338	1,060	16	---	1967
C-2	Existing	Yes	Floridan	1,450	1,057	16	---	1971
C-3	Existing	Yes	Floridan	1,350	1,063	16	---	1981
C-4	Existing	Yes	Floridan	1,462	1,060	24	---	1997
C-5	Existing	Yes	Floridan	1,465	1,054	24	---	1997

Table 9. Orlando Utilities Commission Potable Water Supply Wells (Continued).

Well Number	Status	Active	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Year Drilled
C-6	Proposed	No	Floridan	1,470	1,060	24	---	---
Navy								
N-1	Existing	Yes	Floridan	1,385	1,080	16	---	1975
N-2	Existing	Yes	Floridan	1,357	876	24	---	2001
Highland								
H-1	Existing	Yes	Floridan	1,159	956	16	---	1958
H-2	Existing	Yes	Floridan	1,445	947	16	---	1958
H-3	Existing	Yes	Floridan	1,406	1,047	16	---	1958
H-4	Existing	Yes	Floridan	1,349	1,022	16	---	1957
H-5	Existing	Yes	Floridan	1,220	1,025	16	---	1957
H-6	Existing	Yes	Floridan	1,500	1,099	16	---	1958
H-7	Existing	Yes	Floridan	1,415	932	16	---	1957
Pine Hills								
PH-1	Existing	Yes	Floridan	1,414	995	16	---	1957
PH-2	Existing	Yes	Floridan	1,404	1,038	16	---	1967
PH-3	Existing	Yes	Floridan	1,400	1,035	16	---	1972
PH-4	Existing	Yes	Floridan	1,340	995	16	---	1981
PH-5	Existing	Yes	Floridan	1,400	795	24	---	1993
PH-6	Proposed	No	Floridan	1,400	800	24	---	
Southeast								
SE-1	Existing	Yes	Floridan	1,450	1,050	16	---	1999
SE-2	Existing	Yes	Floridan	1,450	1,050	16	---	1999

Table 10. Orlando Utilities Commission Potable Supply Facilities Distribution of Withdrawals.

Facility Name	Existing Wells	Proposed Wells	Avg. 1999 % of Total Annual Flow	Proposed % of 2025 Flows*
Dr. Phillips (off-line)	1,2,3,4	N/A	0.0%	0.0%
Kirkman	1,2,3	1,2,3	9.2%	8.8%
Martin (off-line)	1,2,3	N/A	0.0%	0.0%
Sky Lake	1,2	1,2,3,4	13.2%	15.2%
Southwest	1,2,3,4,5,6	1,2,3,4,5,6,7	20.8%	24.4%
Conway	1,2,3,4,5	1,2,3,4,5,6	19.6%	17.1%
Navy	1,2	1,2	3.8%	5.5%
Highlands	1,2,3,4,5,6,7	1,2,3,4,5,6,7	19.7%	16.2%
Pine Hills	1,2,3,4,5	1,2,3,4,5,6	13.1%	11.8%
Southeast	1,2	1,2	0.3%	0.9%

* Distribution based on recently issues permit.

Future Facilities

In 2000, OUC completed conversion of its water treatment facilities to ozone treatment. Under the permit recently granted by the SJRWMD, OUC is focusing on groundwater withdrawals from its facilities having Lower Floridan Aquifer production wells.

Recent water quality trends in the OUC Southeast wellfield have limited the production from this water plant. Water demands in 2023 are projected by the utility to be 123.80 MGD with an estimated 14.60 MGD of reclaimed water being used from the City of Orlando to meet its total demand. The remaining 109.22 MGD of proposed use is from the Floridan Aquifer System, 52.80 MGD of which is expected from the SFWMD facilities. The distribution of the water withdrawals among the utilities' wells is shown in **Table 10**.

Reedy Creek Improvement District

Permits

SFWMD Permit Number: 48-00009-W

Current SFWMD Permit Expires: May 15, 2007 (under review)

Existing Facilities

Reedy Creek Improvement District (RCID) operates a utility serving an estimated 70 full-time residents, but also serves the varying needs of the Walt Disney World theme parks and support services. Reedy Creek Improvement District operates 12 Floridan Aquifer wells to deliver water for services. The RCID water distribution system is served by four existing RCID water treatment facilities (Pump Stations A, B, C, D). The newest, Pump Station D came on line in 1997. There are two distribution interconnects with other utilities – one 12-inch interconnect with the Toho Water Authority (TWA) and a second 12-inch interconnect with Orange County Utilities. **Figure 1** shows the location of the area serviced by RCID. A portion of the RCID service area is in Osceola County, and RCID provides potable water to two resorts and a sports complex that reside wholly or in part in Osceola County. The permitted allocations are as follows:

Annual Allocation:	8,552 MGY (23.43 MGD)
Maximum Daily Allocation:	35.61 MGD

Table 11 presents details on the construction of individual wells. The average daily pumping from these wells in 2000 was 19.70 MGD. **Table 12** shows the 2000 distribution of water production for the RCID wells. Examination of flow information from other years shows that 15.00 to 16.00 MGD is more typical of average water use. Reedy Creek Improvement District's entire service area lies within the SFWMD boundaries.

Table 11. Reedy Creek Improvement District Potable Water Supply Wells.

Well Number	Status	Active	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Year Drilled
Pump Station A								
8	Existing	Standby	Floridan	900	181	24	3,500	1969
9	Existing	Yes	Floridan	900	186	24	4,000	1969
10	Existing	Yes	Floridan	340	187	24	4,000	1969
Pump Station B								
2	Existing	Yes	Floridan	420	200	20	1,500	1980
2A	Existing	Yes	Floridan	500	157	18	3,500	1980
17	Existing	Yes	Floridan	890	153	24	3,500	1987
Pump Station D								
18*	Existing	Yes	Floridan	700	160	24	4,000	1993
19	Existing	Yes	Floridan	700	163	24	4,000	1993
21	Existing	Yes	Floridan	620	220	24	4,000	1996
Pump Station C								
5	Existing	Standby	Floridan	350	172	24	1,100	1969
6	Existing	Yes	Floridan	485	164	24	3,000	1969
16	Existing	Yes	Floridan	900	163	24	4,000	1973

* Well #18 can pump to either PS “B” or PS “D”.

Table 12. Reedy Creek Improvement District Potable Supply Facilities

Well Number	Avg. 1995-2000 % of Total Annual Flow	Proposed % of 2025 Flows*
2	2.4%	4.0%
2A	6.7%	9.0%
5	0.0%	0.0%
6	9.7%	9.0%
9	12.8%	11.0%
10	12.9%	11.0%
11	0.0%	0.0%
16	14.5%	12.0%
17	9.7%	11.0%
18	9.0%	11.0%
19	10.0%	11.0%
21	11.5%	10.0%

* Distribution based on recently issued permit.

Future Facilities

Reedy Creek Improvement District plans to continue its efforts in water conservation and expand its reuse system. In evaluating its current pumping and treatment facilities, RCID has indicated that it does not see an immediate need to increase the number or type of wells or to make substantial changes to its treatment system. Growth in RCID is predicted to be moderate in the coming years and RCID estimates its use will not exceed its current allocation of 23.40 MGD by 2025. The distribution of the withdrawals is not expected to change significantly from the current use. These plans may change in the future if the theme parks, resorts or support systems experience high economic growth that results in expansion.

Taft Water Association

Permits

SFWMD Permit Number: 48-00995-W

Current SFWMD Permit Expires: September 10, 2008

Existing Facilities

The Taft Water Association, Inc. operated a single water plant and two Floridan Aquifer wells to supply service to an estimated 2,500 residents in 2000. The utility served 940 connections in 2000 and has shown a growth rate of about 12 connections per year. The construction details of the utility's wells are shown in **Table 13**. The service area for the Taft Water Association is shown in **Figure 1**. Permitted allocations for the facilities are as follows:

Annual Allocation: 107 MGY (0.29 MGD)

Maximum Daily Allocation: 0.44 MGD

Table 13. Taft Water Association Water Supply Wells.

Well Number	Status	Active	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Intake Depth (NGVD)
1	Existing	Yes	Floridan	572	221	10	500	1964
2	Existing	Yes	Floridan	600	225	10	500	1975

The 2000 average daily pumping from the Taft wells was approximately 0.27 MGD. The Taft water facilities are not known to have interconnections with any other utilities.

Future Facilities

The Taft Water Association service area is surrounded on all sides by areas serviced by the Orlando Utilities Commission. Growth in new service connections are expected as infill within the current service area boundaries. Growth has been steady at about 12 connections each year. Beyond this, no plans are known about future facilities for the utility. The population served by the Taft water plant is expected to increase to an estimated 2,700 residents in 2025 using approximately 0.33 MGD during average conditions.

Osceola County Potable Water Facilities

In 2000, there were a total of five public or private entities providing domestic water treatment services in Osceola County exceeding 0.10 MGD. Among these service providers, all are located within the SFWMD portion of the county. One additional utility began operations in 2002. These providers include the City of Kissimmee, the City of St. Cloud, Florida Water Services, Tropical Palms Resort, O&S Water Company and Poinciana Utilities. There are a total of 17 WTFs in Osceola County providing potable service above the 0.10 MGD threshold.

City of Kissimmee

Permits

SFWMD Permit Number: 49-00103-W

Current SFWMD Permit Expires: July 11, 2007 (under review)

Existing Facilities

In 2000, the City of Kissimmee owned and operated the potable utility for the city and served an estimated 79,000 residents. In 2000, the city operated nine water treatment facilities and used 27 existing upper FAS wells for water production. The location of the city's service area is shown on **Figure 1**. The city's Camelot East, Camelot West and Fountain Park WTFs are interconnected. In addition, the city's North Bermuda, Ruby Street and Parkway systems are interconnected. Permitted allocations for the facilities are as follows:

Annual Allocation: 9,785 MGY (26.80 MGD)

Maximum Daily Allocation: 43.70 MGD

Details on the construction of individual wells can be found in **Table 14**. Water use for the 1998 to 2000 period was distributed in the manner shown in **Table 15**. Water use for 2000 averaged 21.87 MGD.

Table 14. City of Kissimmee Potable Water Supply Wells.

Well Number	Status	Active	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Year Drilled
Camelot East								
C-1	Existing	No	Floridan	410	185	10	762	1973
C-2	Existing	No	Floridan	405	197	10	1,000	1973
C-3	Proposed	No	Floridan	500	200	16	1,000	---
C-4	Proposed	No	Floridan	500	200	16	1,000	---
C-5	Proposed	No	Floridan	500	200	16	1,000	---
C-6	Proposed	No	Floridan	500	200	12	760	---
Camelot West								
CW-1	Existing	Yes	Floridan	385	201	16	2,000	1987
CW-2	Proposed	No	Floridan	500	201	16	2,000	---
Fountain At Oak Point								
FP-1	Existing	Yes	Floridan	445	179	10	750	1980
FP-2	Existing	Yes	Floridan	445	205	10	750	1980
Indian Ridge								
IR-1	Existing	Yes	Floridan	480	411	10	800	1988
IR-2	Existing	Yes	Floridan	820	245	10	800	1988
North Bermuda								
NB-1	Existing	Yes	Floridan	458	278	16	2,100	1969
NB-2	Existing	Yes	Floridan	1,200	281	16	2,100	1969
NB-3	Proposed	No	Floridan	1,200	280	16	2,300	---
NB-4	Proposed	No	Floridan	1,200	280	16	2,300	---
Northwest								
NW-1	Existing	Yes	Floridan	375	147	12	2,200	1971
NW-2	Existing	Yes	Floridan	376	195	12	2,200	1971
NW-3	Proposed	No	Floridan	500	200	16	2,000	---
NW-4	Proposed	No	Floridan	500	200	16	2,000	---
Parkway								
P-1	Existing	Yes	Floridan	414	290	12	1,000	1973
P-2	Existing	Yes	Floridan	430	290	12	1,000	1973
P-3	Proposed	No	Floridan	500	290	16	1,500	---
P-4	Proposed	No	Floridan	500	290	16	1,500	---
P-5	Proposed	No	Floridan	500	290	16	1,500	---
Ruby Street								
RS-3	Existing	Yes	Floridan	467	N/A	10	1,800	1965
RS-4	Existing	Yes	Floridan	410	194	14	2,100	1959

Table 15. City of Kissimmee Potable Supply Facilities Distribution of Withdrawals.

Facility Name	Existing Wells	Proposed Wells	Avg. 1998-2001 % of Total Annual Flow	Proposed % of 2025 Flows
Camelot West	CW-1 & 2	CW-1, 2 & 3	11%	11%
Southwest	none in 2000	C-1 & 2	0%	12%
Fountain At Oak Point	FP-1 & 2	FP-1 & 2	1%	0%
Indian Ridge/Sandhill	IR-1 & 2	IR-1, 2, & 3	11%	0%
Northwest	NW-1,2,3,4	NW-1,2,3,4	19%	13%
Morning Side	M-1 & 2	M-1, 2 & 3	1%	<1%
North Bermuda	NB-1, 2,3,4	NB-1, 2,3,4	44%	51%
Parkway/Partin	P-1,2 & 3	P-1,2,3,4,5	8%	11%
Ruby St./Lakeshore	R-1 & 2	R-1 & 2	3%	0%
Intercession City	---	IC-1, 2, 3,4,5	<1%	<1%
Hiden Glen	G-1, G-2	G-1, G-2	<1%	<1%

Future Facilities

The City of Kissimmee proposes to expand its facilities southward, away from those areas identified as potentially most impacted in the 2000 KB Water Supply Plan. This expansion includes the development of a new upper FAS wellfield in Intercession City near the Kissimmee Utility Authority (KUA) power plant. The city has also proposed closing or substantially cutting back on pumping from its Camelot East, Fountain and Ruby Street WTFs, and a shift in withdrawals southward. The city has plans to complete connection of all of its WTFs to provide redundancy and to allow pumping shifts as needed.

In 2003, the City of Kissimmee joined administratively with Osceola County government to create the Toho Water Authority (TWA). This new, legislatively approved authority will take on all of the city's potable and wastewater responsibilities. In 2003, the TWA also assumed operation of all the former Florida Water Services WTFs. Future growth in these new acquisitions is uncertain at this time.

Water use for the utility is projected to be approximately 75.00 MGD by 2025 (exclusive of the Florida Water Services facilities). Production of this water amount is currently projected to come from the existing and proposed wells in the distribution shown as a proposed percentage of 2025 Flows in **Table 15**.

City of St. Cloud Utilities

Permits

SFWMD Permit Number: 49-00084-W

Current SFWMD Permit Expires: June 12, 2008

Existing Facilities

St. Cloud Utilities is a city owned and operated utility serving and estimated 31,500 residents in 2000. The City of St. Cloud operates three existing water treatment facilities and uses four existing upper FAS wells for water production. **Figure 1** shows the location of the city's service area. Permitted allocations for the facilities are as follows:

Annual Allocation: 1,610 MGY (4.41 MGD)

Maximum Daily Allocation: 9.97 MGD

Table 16 provides details on the construction of individual wells. **Table 17** shows water use distribution for the 1998 to 2000 period on an average annual basis. Water use for 2000 averaged 3.28 MGD.

Table 16. St. Cloud Potable Water Supply Wells.

Well Number	Status	Active	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Year Drilled
WTF #1 (10th St. & Oregon)								
1	Existing	Yes	Floridan	491	405	16	2,300	1960
WTF #2 (10th St. & CT Ave.								
2	Existing	Yes	Floridan	692	382	16	2,600	1954
3	Existing	Yes	Floridan	676	376	16	2,400	1954
WTF #3 (Crane Brake)								
4	Existing	Yes	Floridan	395	149	8	500	1987
WTF #4 (C-31 Area)								
5	Existing	No	Floridan	500	300	16	2,400	Est 2004
6	Existing	No	Floridan	500	300	16	2,400	Est 2004
7	Proposed	No	Floridan	500	300	16	2,400	Est 2004
8	Proposed	No	Floridan	500	300	16	2,400	Est 2015

Table 17. St. Cloud Potable Supply Facilities Distribution of Withdrawals.

Facility Name	Existing Wells	Proposed Wells	Avg. 1998-2001 % of Total Annual Flow	Proposed % of 2025 Flows
WTF #1 (10th St. & Oregon)	SC#1	SC#1	38%	0%
WTF #2 (10th St. & CT Ave.	SC#2, 3	SC#2, 3	55%	36%
WTF #3 (Crane Brake)	SC#4	SC#4, 5	7%	0%
WTF #4 (C-31 Area)	---	SC# 6, 7	0%	64%

Future Facilities

The City of St. Cloud is in an area of rapid growth. The city is proposing to begin construction in 2005 on WTF #4 west of the Florida Turnpike near the C-31 Canal crossing. A total of four new upper FAS wells are proposed for the WTF #4 location. The use of four new wells and their flow allocation assumes that the existing water plant #1 and well will be decommissioned. The city is currently completing studies to validate the feasibility of this plan. Average water use for the utility is projected to be 15.50 MGD by 2025 with 6.30 MGD of demand being met with reclaimed water. Production of this water is currently projected to be distributed among the existing wells #2, #3 and #4 and the proposed wells as shown in **Table 17**. The city is proposing to establish a potable interconnection with the TWA to be used as an emergency backup.

Florida Water Services – Osceola

Permits

SFWMD Permit Number: 49-00002-W (Buenaventura Lakes)

49-00977-W (Fountains WTF)

49-00970-W (Intercession City)

49-00946-W (Pine Ridge Estates)

49-00290-W (Tropical Park)

49-00959-W (Bay Lake Estates)

49-00415-W (Lake Ajay)

Current SFWMD Permits Expire: June 2005 through 2021 – merged with City of Kissimmee (TWA) under permit 49-00103-W, which is under review at the time of this report.

Existing Facilities

In 2000, Florida Water Services operated seven water treatment facilities within Osceola County. All of these water plants operate independent of one another, typically serving a single subdivision or smaller community. A total of 15 wells are used for water service among these plants. Only the water plants at Buenaventura, Pine Ridge Estates and Tropical Park have daily pumping averages of greater than 0.10 MGD for 2000. The location of these three service areas is shown on **Figure 1**. Each of these larger water plants provides simple chlorination or aeration with chlorination as treatment.

Water use for 2000 follows: 2.12 MGD for the Buenaventura facility, 0.11 MGD for the Tropical Park facility and 0.14 MGD for the Pine Ridge Estates facility. Permitted allocations for those facilities exceeding the 0.10 MGD threshold are as follows:

Buenaventura Lakes

Annual Allocation: 1,158 MGY (3.17 MGD)

Maximum Daily Allocation: 4.00 MGD

Tropical Park

Annual Allocation: 37 MGY (0.10 MGD)

Maximum Daily Allocation: 0.23 MGD

Pine Ridge Estates

Annual Allocation: 52 MGY (0.14 MGD)

Maximum Daily Allocation: 0.37 MGD

Details on the construction of individual wells can be found in **Table 18**.

Table 18. Florida Water Services Potable Water Supply Wells.

Well Number	Status	Active	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Year Drilled
Larger FWS Facilities								
Buenaventura								
BV-1	Existing	Yes	Floridan	689	250	12	2,100	1975
BV-2	Existing	Yes	Floridan	749	251	16	2,500	1980
Tropical Park								
TP-1	Existing	Yes	Floridan	410	194	14	1,000	
TP-2	Existing	Yes	Floridan	467	194	10	1,000	
Pine Ridge Estates								
PR-1	Existing	Yes	Floridan	410		8	325	
PR-2	Existing	Yes	Floridan	408		6	125	
Smaller FWS Facilities								
Lake Ajay								
AJ-1	Existing	Yes	Floridan	500	370	8	290	1989
AJ-2	Capped	No	Floridan	470	373	6	220	1978
AJ-3	Existing	No	Floridan	425	288	4	120	1993
AJ-4	Existing	Yes	Floridan	275	225	4	100	1998
Bay Lake Estates								
BL-1	Existing	Yes	Floridan	410		8	325	1985
Intercession City								
I-1	Existing	Yes	Floridan	200	100	4	325	
I-2	Existing	Yes	Floridan	200	100	8	125	
Fountains								
F-1	Existing	Yes	Floridan	500	200	6	220	
F-2	Existing	Yes	Floridan	500	200	4	80	

Future Facilities

Each of the water service plants operated by Florida Water Services was purchased by the Toho Water Authority (TWA) in 2003. It is uncertain when the TWA intends to provide interconnection of these facilities with the larger TWA water system. The population served by the Buenaventura, Tropical Park and Pine Ridge Estates is expected to increase to an estimated 33,950 residents in 2025 using approximately 3.21 MGD during average conditions. The remaining water plants serve communities that are not expected to grow significantly over the next 20 years.

Poinciana Utilities

Permits

SFWMD Permit Number: 49-00069-W

Current SFWMD Permit Expires: May 15, 2008

Existing Facilities

Poinciana Utilities is operated by Florida Governmental Utilities (FGUA) and served approximately 14,840 residents in 2000. Poinciana Utilities operates five water treatment facilities and uses 11 existing upper FAS wells for water production. **Figure 1** shows the location of the service area. Permitted allocations for the facilities are as follows:

Annual Allocation: 2,125 MGY (5.82 MGD)

Maximum Daily Allocation: 8.73 MGD

Table 19 provides details on the construction of individual wells. **Table 20** presents water use distribution for the 1998 to 2000 period. Water production for all five plants for 2000 averaged 3.42 MGD.

Table 19. Poinciana Utilities Potable Water Supply Wells.

Well Number	Status	Active	Aquifer	Total Depth (ft)	Cased Depth (ft)	Well Diameter (in)	Pump Capacity (GPM)	Year Drilled
Industrial Park								
1-1A	Existing	Yes	Floridan	450	115	12	1,000	1980
1-2	Existing	Yes	Floridan	390	127	12	1,000	1972
V-2 WTF								
2-1	Existing	Yes	Floridan	500	146	12	1,000	1988
2-2	Existing	Yes	Floridan	500	148	12	1,000	1990
Core WTF #3								
3-1	Existing	Yes	Floridan	400	182	6	275	1972
3-2	Existing	Yes	Floridan	435	209	8	500	1974
3-3	Existing	Yes	Floridan	497	146	12	1,000	1983
Wilderness #4								
4-1	Existing	Yes	Floridan	402	160	12	400	1986
4-2	Existing	Yes	Floridan	479	160	12	1,000	1986
4-3, 4-5	Proposed	No	Floridan	500	160	12	1,000	N/A
V-7 WTF(#5)								
5-1	Existing	Yes	Floridan	502	225	12	1,000	1988
5-2	Existing	Yes	Floridan	425	150	12	1,000	1991
5-3, 5-5, 5-6, 5-7	Proposed	No	Floridan	425	150	12	1,000	N/A

Table 20. Poinciana Utilities Potable Supply Facilities Distribution of Withdrawals.

Facility Name	Existing Wells	Proposed Wells	Avg. 1998-2001 % of Total Annual Flow	Proposed % of 2025 Flows
Industrial Park (#1)	1-1A, 1-2	1-1A, 1-2	17%	17%
V-2 Water Plant (#2)	2-1, 2-2	2-1, 2-2	33%	33%
Core Plant (#3)	3-1,3-2,3-3	3-1,3-2,3-3	29%	29%
Wilderness Plant (#4)	4-1	4-1, 4-2, 4-3	3%	3%
V-7 WTF (#5)	5-1, 5-2, 5-3	5-1, 5-2, 5-3, 5-5, 5-6, 5-7	19%	19%

Future Facilities

Osceola County (now the Toho Water Authority) and Polk County Utilities have expressed interest in sharing responsibility for the operation of the FGUA utility. During this transition period, plans for utility expansion are uncertain. The utility's current permit allows for the construction of five new wells to be placed at the Wilderness (#4) and V-7 (#5) water treatment facilities. Water use for the utility is projected to be 8.03 MGD by 2025. **Table 20** shows the projected distribution of water production.

Tropical Palms Resort

Permits

SFWMD Permit Number:	49-01268-W
Current SFWMD permit expires	April 22, 2023

Existing Facilities

Tropical Palms Resort, Inc. is a private company providing water services exclusively to Tropical Palms Resort. Tropical Palms operated a single water treatment facility (WTF) using one 6-inch diameter well cased to 165 feet and having a total depth of 203 feet. Tropical Palms water use since 1998 has averaged 0.12 MGD serving resort landscaping and an estimated customer base of 1,532 residents. **Figure 1** shows the location of the service area. Permitted allocations for the facilities are as follows:

Annual Allocation:	45 MGY (0.12 MGD)
Maximum Daily Allocation:	0.24 MGD

Future Facilities

There is no new growth projected for the Tropical Palms Resort over the next 20 years. Water use is expected to remain level during that period.

O&S Water Company

Permits

SFWMD Permit Number:	49-01207-W
Current SFWMD permit expires	May 15, 2008

Existing Facilities

O&S Water Company is a privately held water utility that serves Pleasant Hill Lakes and Bella Lago subdivisions. O&S operates a single water treatment facility (WTF) using two 10-inch diameter wells cased to between 130 and 160 feet and having a total depth of 450 feet. O&S water use began in 2002 and has increased steadily to serve an estimated 1,800 in 2005. **Figure 1** shows the location of the service area. Permitted allocations for the facilities are as follows:

Annual Allocation: 155 MGY (0.42 MGD)

Maximum Daily Allocation: 0.64 MGD

Future Facilities

Residential growth is projected to grow through build-out in 2013 with an estimated 4,255 residents. Water use is expected to remain level after that point at 0.42 MGD.

Polk County Potable Water Facilities

In 2000, Polk County Utilities and Poinciana Utilities provided domestic water treatment services in Polk County exceeding 0.10 MGD and operating within the SFWMD. Each of these providers has one WTF located with the SFWMD portion of the county. The following discussion addresses only the Polk County Utilities as the Poinciana Utilities facility is discussed under the Osceola County section.

Polk County Utilities (Oak Hill Estates)

Permits

SFWMD Permit Number: 53-00126-W

Current SFWMD Permit Expires: December 15, 2005 (under review)

Existing Facilities

Polk County Utilities operates the Oakhill Estates WTF under an operation agreement with the development. The utility served 170 connections or an estimated 450 residents in 2000. The water utility at Oakhill Estates consists of a single water treatment facility serviced by a single well. The well is 12 inches in diameter, has a total depth of 750 feet and a cased depth of 350 feet. The well was drilled in 1993. The pumping capacity of the well is 950 GPM. Permitted allocations for the facilities are as follows:

Annual Allocation: 611 MGY (1.67 MGD)

Maximum Daily Allocation: 2.17 MGD

In 2000, the daily pumping from this well averaged approximately 0.45 MGD. Oakhill Estates has been connected with the Loma Linda water plant located within the Polk County Utilities System since April, 1994. Loma Linda has two wells at its WTF.

Future Facilities

In 2003, two existing and two new wells were added to the Oakhill Estates WTF facility by the Oakhill Estates organization. The new wells are proposed for public water supply. The two existing wells were re-permitted to remain as irrigation wells for the Oakhill Estates development. The two new wells contribute 0.60 MGD each for a total of 2.87 MGD in water capacity for the Oakhill WTF.

Oakhill Estates developers project a build-out of 6,427 units including residential, commercial and recreational uses by 2020. Growth in the system has been well below this projected use. An adjusted 2025 residential estimate based on census data indicates about 6,200 residents with a water use of nearly 2.00 MGD within the Oakhill WTF service area. The service area includes both the SFWMD and Southwest Florida Water Management District (SWFWMD). Actual water use is estimated to be below this developer driven estimate, and more in line with the 2004 Bureau of Economic and Business Research (BEBR) estimates. Water use estimates in this plan update will not match use for these wells as Polk County has recently proposed meeting a portion of its total demands for its northern service area using the Oak Hill WTF wells in an amount up to 5.00 MGD. The permit was not finalized at the time this report was prepared.

Future expansion proposes interconnecting the Loma Linda/Oakhill System with the Northeast Regional System, which has five water plants: Edgehill, Holiday Inn, Regal Inn, Van Fleet and Polo Davenport.

WASTEWATER TREATMENT FACILITIES

The reuse of highly treated wastewater has long been identified as a valued resource for irrigation, aquifer recharge and other beneficial uses which offset the demands on other water resources. The primary means of wastewater treatment is through wastewater treatment facilities and septic tanks. This section documents information on wastewater treatment facilities with FDEP-rated capacities of 0.10 MGD or greater that have been incorporated into the 2005 KB Water Supply Plan Update.

MOST BENEFICIAL USE

- Direct recharge to the aquifer through injection
- Direct replacement of use that would otherwise use the Floridan Aquifer
- Application of wastewater to areas of highest recharge to the Floridan
- Application of wastewater to areas of lower recharge or discharge to the Floridan
- Discharge to surface water bodies

LEAST BENEFICIAL USE

Figure 3. Relative Scale of Beneficial Reuse of Reclaimed Water.

In 2001, the KB Planning Area had 22 domestic wastewater treatment facilities that exceed the 0.10 MGD treatment threshold. Most are located in urbanized areas, where potential reuse demand is relatively high. Seventeen of the facilities are municipally/publicly owned, and all the facilities use the activated sludge treatment process or modification thereof. The reclaimed water/effluent disposal methods consist of discharge to surface waters, groundwater recharge, urban irrigation reuse (golf courses, residential lawns, medians, parks, etc.) and agricultural irrigation.

Those facilities located within the Kissimmee Basin Planning Area had a total rated capacity of 108.00 MGD in 2001. The 2001 average daily flow for these facilities was approximately 70.00 MGD. Wastewater flows from these facilities are projected to increase to approximately 105.20 MGD by 2025. Future wastewater generation estimates are based on a ratio or percentage of the projected potable water use by the same utility. In certain instances utility wastewater projections were deemed more reliable.

Some types of reuse are considered more beneficial than others. The 2000 KB Water Supply Plan (KB Plan) identified categories of higher and lower beneficial reuse. **Figure 3** was used in the 2000 KB Plan to present the ranking of wastewater reuse options into these categories in an attempt to identify reclaimed water that could be used in a more beneficial way. Direct reuse, rapid infiltration basins, percolation ponds in high or moderate recharge areas, and direct injection are generally more beneficial than surface water discharges and percolation ponds located in low recharge areas. **Table 21** provides a summary of wastewater reuse for facilities located within the Kissimmee Basin Planning Area.

Table 21. Summary of the Wastewater Treatment Facilities within the Kissimmee Basin Planning Area.

Facility	FDEP Rated Capacity (MGD)	2001 Average Daily Flow (MGD)	Disposal Method		2025 Projected Flow (MGD)*
			Lower Beneficial Discharge (MGD)	Higher Beneficial Reuse (MGD)	
Okeechobee County					
Okeechobee Utility Authority	1.10	0.65	0.30	0.35	3.00
Orange County					
Orange County Utilities					
Cypress Walk	0.69	0.38	0.00	0.38	0.41
South WRF	30.50	24.72	0.00	24.70	24.70
Southwest WRF(Proposed)	---	---	---	---	5.05
City of Orlando					
Water Conserv I	7.50	2.76	0.00	2.76	0.00
McLeod Road (Water Conserv II)	25.00	12.85	0.00	12.85	18.70
Reedy Creek	15.00	9.90	0.00	9.90	17.50
Osceola County					
Buenaventura Lakes (FWS)	1.80	1.64	0.07	1.56	2.45
Kissimmee					
Camelot	5.00	2.92	0.00	2.92	4.50
Parkway	1.50	1.04	0.00	1.04	1.50
Sandhill Road	5.00	2.59	0.00	2.59	5.00
South Bermuda	7.00	5.24	0.00	5.24	18.00
West Regional	1.50	1.25	0.00	1.25	- -
Harmony	0.12	0.04	0.04	0.00	1.20
Poinciana Utilities					
#1	0.35	0.25	0.25	0.00	0.53
#2	0.60	0.60	0.60	0.00	1.47
St. Cloud					
Lakeshore	2.40	1.38	0.78	0.60	0.00
Southside	0.80	0.32	0.00	0.32	4.00
Good Samaritan Retirement	0.20	0.10	0.00	0.10	0.00
Orlando Hyatt Hotel	0.30	0.17	0.17	0.00	0.00
Polk County					
Poinciana Utilities					
#3	0.35	0.22	0.22	0.00	0.50
#5	1.20	1.15	1.15	0.00	2.70
Oakhill Estates (Polk Utility)	0.20	0.10	0.10	0.00	0.20
Kissimmee Basin Total	108.11	70.27	3.68	66.56	111.41

Note: Plans identified by utilities.

Details of individual wastewater utility provider systems are given by county for those utilities within the SFWMD and those treating more than 0.10 MGD on an average annual basis. **Tables 22** through **31** provide a breakdown of the application of treated wastewater by individual wastewater treatment facility (WWTF). Within these tables three categories of wastewater reuse are described.

1. The category of Irrigation + Other is given to uses of reclaimed water for irrigation and uses that directly offset potable demands.
2. The category of Recharge is applied to water discharged to rapid infiltration basins or ponds located in high or moderate Floridan Aquifer recharge areas.
3. The category of Disposal is applied to surface water discharges, percolation ponds in low recharge areas and wetland support systems not directly part of a mitigation plan.

The categories of Irrigation + Other and Recharge are considered to represent higher beneficial uses of reclaimed water, for the purpose of this evaluation. Treated wastewater uses labeled as Disposal in **Table 21** are identified as having lower benefit. Not all wastewater designated as disposal is recoverable for higher beneficial reuse.

Okeechobee County Wastewater Facilities

There are two existing domestic wastewater treatment facilities located in Okeechobee County. These include the Okeechobee Correctional Institution and the wastewater treatment facility operated by the Okeechobee Utility Authority (OUA). (The Eckerds WWTF was taken off line in February 2002 and the flow was pumped to the OUA WWTF.) Between these two facilities, only the correctional institution and OUA exceed the 0.10 MGD threshold needed to provide reclaimed water. The correctional institution is currently providing only basic disinfection of treated water. This leaves OUA as the sole provider of public access reclaimed water in the county.

Okeechobee Utility Authority

Existing Facilities

The wastewater treatment facility for OUA consists of an existing a 1.10 MGD treatment plant with reclaimed water disposal via reuse by spray irrigation using an on-site spray field, irrigation of 761 acres of citrus owned by the Williamson Cattle Company and for limited public access landscape irrigation. The utility treated an average of 0.65 MGD in 2001 with an average of 0.35 MGD going to citrus irrigation. The wastewater service area for the OUA is shown in **Figure 5**. There are no known proposed new facilities planned at this time. **Table 22** shows the distribution of wastewater flows from the OUA WWTF.

Table 22. Okeechobee Utility Authority Wastewater Treatment Facility Flows for 2001.

WWTF	FDEP Rated Capacity	Flow	Irrigation + Other	Recharge	Disposal
Okeechobee Utility Authority WWTF	1.10	0.65	0.35	0.00	0.30
Total	1.10	0.65	0.35	0.00	0.30

Future Facilities

Projected wastewater flows are expected to increase in proportion to increases in potable water deliveries. Estimated wastewater flows are projected to increase to 3.00 MGD by 2025.

Orange County Wastewater Facilities

In 2001, there were a total of 11 public or private entities providing domestic wastewater treatment services exceeding 0.10 MGD located in Orange County as a whole. Among these service providers, only three providers are located within the SFWMD portion of the county. These providers include Orange County Utilities, the City of Orlando and the Reedy Creek Improvement District. The Toho Water Authority also provides wastewater services in Orange County, but does not operate a WWTF within the county. Combined, there are a total of 22 existing WWTFs in Orange County, five of which are located within the SFWMD.

Orange County Utilities

Existing Facilities

In 2001, Orange County Utilities (OCU) operated a total of five water reclamation facilities (WRF) within the county. Two of these facilities are located within the SFWMD. These facilities include the Cypress Walk and South (Sand Lake Road) WRFs, both of which are in OCU's South Service Area. In addition, OCU owns the Water Conserv II Distribution Facility in partnership with the City of Orlando. Water Conserv II is linked to OCU's South WRF that serves southern and central Orange County. The Water Conserv II facility distributes reclaimed water to the western portion of Orange County and east Lake County for agricultural uses, golf course irrigation and aquifer recharge through rapid infiltration basins (RIBs). Water Conserv II includes irrigation of approximately 3,250 acres of citrus with a permitted irrigation capacity of 51.93 MGD. The project has eight RIB sites covering more than 3,700 acres in Orange and Lake counties containing 150 cells. Water Conserv II RIBs have a total estimated capacity of 29.20 MGD.

Orange County Utilities provides reclaimed water for irrigation to 10 golf courses, numerous commercial sites, residences and roadway medians. Orange County Utilities has a volumetric reclaimed water rate for all new customers. Reclaimed water customers with long-term agreements are subject to the metered rates stipulated in their agreements. The county has 14 Westerly RIBs, as well as other uses within the South Service Area. Orange County Utility's permitted irrigation capacity for the South Service reuse area is 28.22 MGD. The Westerly Effluent Disposal System is located in Southwest Orange County, west of Shingle Creek and east of the intersection of Interstate 4 and State Road 535. **Table 23** summarizes OCU wastewater facilities. The county currently has the capability to augment its reclaimed water use with groundwater during peak demand periods.

In addition to the facilities operated within the SFWMD, OCU operates an additional three WRFs in 2001 located within the SJRWMD. Orange County Utility groups the plants into five service areas including the North, West, Southwest, South and East. The West and East service areas include portions of the SFWMD, but do not include any WRFs within SFWMD boundaries.

Table 23. Orange County Utility Wastewater Facilities for 2001.

WRF	FDEP Rated Capacity	Flow	Irrigation + Other	Recharge	Disposal
Cypress Walk WRF	0.69	0.38	0.38	0.00	0.00
Southern WRF (includes Water Conserv II)	30.50	24.70	17.17	7.15	0.00
Total	31.19	25.08	17.55	7.15	0.00

Note: All flows represent annual average daily flow in MGD unless otherwise noted.

Future Facilities

Orange County has significant plans for expansion of its reclaimed water treatment facilities and reclaimed water application projects. Orange County Utilities is focusing on wetland enhancement, aquifer recharge capabilities and expanding its reclaimed water systems to serve new customers. The larger new applications of reclaimed water will: serve the Horizons West corridor of growth; expand rapid infiltration basin and reclaimed water capacity at the Northwest WRF; increase supply to Curtis Stanton Energy Center from 8.00 MGD to 13.00 MGD; expand the reclaimed water system; and create new interconnects where appropriate. Orange County estimates that a total of 88.50 MGD of treated wastewater is expected to be generated by 2025. Approximately 52.00 MGD is available from WRFs located within the SFWMD portion of the county. Orange County anticipates augmenting its reclaimed supplies by contracting with the City of Orlando for interconnects with the Iron Bridge Wastewater Reclamation Facility (WWRF) as part of the proposed Eastern Regional Reclaimed System.

City of Orlando

Existing Facilities

In 2001, the City of Orlando owned and operated three WWRFs. These included the Water Conserv I, Water Conserv II (McLeod Road) and the Iron Bridge treatment facilities. The Water Conserv I and II treatment facilities are located within the SFWMD, while the Iron Bridge facility is located near the Seminole County line and within the SJRWMD. The city's McLeod Road WWRF is part of the Water Conserv II system shared with Orange County Utilities. Until 2000, the city also operated a Lake Nona WWRF. This facility has since been closed and the flows directed to the Water Conserv I and Iron Bridge WWRFs.

The city provides reclaimed water to multiple customers mainly through the Water Conserv I and II facilities. The Water Conserv I customer base is located primarily around the Orlando International Airport. Water Conserv I also services the Lake Nona and Boggy Creek golf clubs, car washes, a school and median irrigation, among other uses. The remaining treated water is directed to one of 19 RIBs with a total disposal capacity of 7.50 MGD. The Water Conserv II service areas include Universal Studios, the Metro West golf course and other landscaping areas, the Millennia Mall (2002) and several businesses in the areas for landscape irrigation. The remaining treated supplies are delivered to the Water Conserv II Distribution Center for agricultural uses, golf course irrigation and aquifer recharge through rapid infiltration basins. Water Conserv II includes irrigation of approximately 4,300 acres of citrus. The city's Water Conserv II facilities include 66 RIBs sites covering 2,000 acres. The city/county uses the Floridan Aquifer as a supplemental source averaging approximately 0.29 MGD. Reclaimed water is also supplied from the city's Iron Bridge WWRF, through bulk agreements with other providers. **Table 24** provides a summary of the City of Orlando WWTFs.

Table 24. City of Orlando Wastewater Facilities for 2001.

WWRF	FDEP Rated Capacity	Flow	Irrigation + Other	Recharge	Disposal
Water Conserv I	7.50	2.76	1.97	0.79	0.00
Water Conserv II	25.00	12.85	4.25	8.60	0.00
Total	32.50	32.50	6.22	9.39	0.00

Note: All flows represent annual average daily flow in MGD unless otherwise noted.

Future Facilities

The City or Orlando has plans to abandon its Water Conserv I WWRF after 2005 to make way for airport expansion. Water previously treated at this facility will be directed to the Iron Bridge WWRF for treatment and then pumped back to the Water Conserv I service areas to maintain the current reuse delivery contracts. The existing Water Conserv I system storage tanks and pumps are expected to remain. The largest changes to the city will come from other utilities seeking reclaimed water from the Iron Bridge facility to supplement their reclaimed supply. The city has been approached by Orlando Utilities Commission to assist in the delivery of reclaimed water to Baldwin Park and other developments. A possible connection from the Iron Bridge and Orange County Eastern WRF is also under discussion. Seminole County has also approached the city for additional bulk agreements for Iron Bridge treated wastewater. The city estimates that 66.00 MGD of treated wastewater will be produced by 2025 with an estimated 70 percent being treated by the Iron Bridge/Water Conserv I system. The remaining 30 percent, or roughly 18.70 MGD, will be treated at the Water Conserv II WWRF located off McLeod Road.

Reedy Creek Improvement District Wastewater Facilities

Existing Facilities

The Reedy Creek Improvement District (RCID) currently owns a single wastewater collection and treatment facility that services the Walt Disney World complex and a limited surrounding area. By contract, Reedy Creek Energy Services operates this facility on behalf of the RCID. In 2001, the treatment facility had a permitted capacity of 15.00 MGD. In 2001, the daily average flow was 9.90 MGD. Reuse of the treated effluent is provided via rapid infiltration basins located on about 1,000 acres located northwest of the plant. Water is reused for public access irrigation of five golf courses, a 100+/- acre tree farm, landscaping in and around the parks and for innovative uses, such as sidewalk cleaning, vehicle washing, cooling tower makeup and fire suppression. In 2001, the daily average discharge to the RCID rapid infiltration basins was 4.00 MGD, while 5.90 MGD was provided for public access irrigation. **Table 25** provides a summary of the RCID WWTFs.

Table 25. Reedy Creek Improvement District Wastewater Facilities for 2001.

WWRF	FDEP Rated Capacity	Flow	Irrigation + Other	Recharge	Disposal
RCID WWRF	15.00	9.90	5.90	4.00	0.00
Total	15.00	9.90	5.90	4.00	0.00

Note: All flows represent annual average daily flow in MGD unless otherwise noted.

Future Facilities

Reedy Creek Improvement District has indicated that they have plans to expand their current WWTF from 15.00 to 20.00 MGD and to continue to improve upon the areas where reclaimed water is used. They anticipate the percentage of reclaimed water for RIB recharge and for potable water replacement will remain at a roughly 60/40 split as observed in the past. Reedy Creek Improvement District is estimated to treat a total of 17.50 MGD of wastewater by 2025.

Osceola and Polk County Wastewater Facilities

Twelve existing domestic wastewater treatment facilities with flows greater than 0.10 MGD were located within the Osceola County during 2001. **Figure 4** shows the service areas for these facilities. In addition, one new facility (constructed in 2001) came on-line for the Harmony development, and is rated at 0.12 MGD. Among the larger providers in 2001 are the City of Kissimmee, City of St. Cloud, Poinciana Utilities and Buenaventura Lakes operated in 2001 by Florida Water Services. All of these providers are located within the SFWMD.

In Polk County, there were two existing domestic wastewater providers larger than 0.10 MGD for 2001 located with the SFWMD. These providers include Polk County, which operates the facility on behalf of Oakhill Estates and Poinciana Utilities, which operates two of its four wastewater facilities in the county. There is currently no reuse provided from the Oak Ridge or Poinciana #3 and #5 WWTFs.

Buenaventura Lakes Wastewater Facility

Existing Facilities

The permitted capacity of the single domestic wastewater treatment facility servicing the Buenaventura subdivision is 1.80 MGD. In 2001, this facility was owned and operated by Florida Water Services. The WWRF provided reclaimed water for the irrigation of the Buenaventura 86-acre golf course and internal uses to the plant and grounds. In 2001, this reuse was estimated to average 0.11 and 0.38 MGD respectively. The remaining discharge from the plant is sent to one of four existing RIBs, which discharge to an adjacent canal via seepage to Bass Slough and Lake Tohopekaliga. These four RIBs have a permitted capacity of 1.33 MGD and a seepage length of 520 linear feet each. A 169-acre non-jurisdictional wetland is part of the treatment system and is estimated to use 0.07 MGD. Average wastewater flow in 2001 was 1.64 MGD. **Table 26** provides a summary of the Buenaventura Lakes WWTFs.

Table 26. Buenaventura Lakes Wastewater Facilities for 2001.

WWRF	FDEP Rated Capacity	Flow	Irrigation + Other	Recharge	Disposal
Buenaventura WWRF	1.80	1.64	0.12	1.45	0.07
Total	1.80	1.64	0.12	1.45	0.07

Note: All flows represent annual average daily flow in MGD unless otherwise noted.

Future Facilities

In 2003, the City of Kissimmee administratively joined with Osceola County government to create the Toho Water Authority (TWA). This new, legislatively approved Authority took on all of the city's potable and wastewater responsibilities. In addition, the new Authority has taken on the responsibilities of the operation of the Buenaventura Utilities from the Florida Water Services. Future growth in the utility is uncertain at this time. Flows generated for this service are expected to increase to 2.45 MGD by 2025. Since the TWA purchased this system, the Authority is considering taking this treatment facility off-line and diverting flows to the Bermuda WRF.

City Of Kissimmee Wastewater Facilities

Existing Facilities

In 2001, the City of Kissimmee owned and operated five domestic wastewater reclamation facilities with a total treatment capacity of 20.00 MGD. The city's reuse customer base is extensive, serving several golf courses, cemeteries, landscape irrigation for medians, schools, businesses and residential areas. The city provides reclaimed water to Florida Power & Light and the Kissimmee Utility Authority (KUA) for cooling towers and pollution control. The reclaimed water supplements these utilities' groundwater use and the power company often recirculates more water back to the reuse system than it provides. **Figure 4** shows the 2001 wastewater services areas for the city. **Table 27** summarizes the city's existing facilities.

The City of Kissimmee operates three wastewater disposal areas including the Pine Island spray field and the Champions Gate (Imperial) RIB sites. The Pine Island spray field has a capacity of 1.60 MGD and consists of 300 acres, located south of the Camelot plant. The city has indicated that this facility is infrequently used. Champions Gate is a large residential development with a golf course. As part of the development, the city obtained rights to provide landscape irrigation and to construct 16 RIBs as part of the golf course and housing development. In addition, the city has a 160-acre site located north of Champions Gate, where they have constructed 14 rapid infiltration basins. The combined capacity of Champions Gate and the 160-acre site is an estimated 14.70 MGD.

Table 27. City of Kissimmee Wastewater Facilities for 2001.

WWRF	FDEP Rated Capacity	Flow	Irrigation + Other	Recharge	Disposal
South Bermuda	7.00	5.24	0.92	4.32	0.00
Camelot	5.00	2.92	2.34	0.58	0.00
Parkway	1.50	1.04	0.71	0.33	0.00
Sandhill	5.00	2.59	1.91	0.68	0.00
West Regional	1.50	1.25	0.08	1.17	0.00
Harmony	0.12	0.04	0.00	0.00	0.04
Total	20.12	13.08	5.96	7.08	0.04

Note: All flows represent annual average daily flow in MGD unless otherwise noted.

Future Facilities

In 2002, the City of Kissimmee purchased the Harmony WWRF located in eastern Osceola County. This is a new WWRF with a 0.12 MGD capacity placed into service to serve the Harmony development. Flows were less than 0.04 MGD in 2001, but treated effluent will be directed towards the Harmony Golf Course when flows increase. In 2003, the city connected median irrigation for portions of John Young Parkway and is looking to develop additional reuse opportunities in this corridor. The city is working with the SFWMD to review the potential of removing water from Shingle Creek and East Lake Tohopekaliga to supplement the reclaimed supplies and to provide Floridan Aquifer recharge in the form of RIB discharges. Estimated total wastewater and supplemental flows are estimated at 25.20 MGD for 2025 for the facilities listed in **Table 27**.

In 2003, the City of Kissimmee joined administratively with Osceola County government to create the Toho Water Authority. This new, legislatively approved authority took on all of the city's potable and wastewater responsibilities. In addition, the Authority has taken on the responsibilities of the operation of the Buenaventura Utilities from the Florida Water Services. The TWA is reviewing opportunities to join with Poinciana Utilities in the future. Currently the city has an agreement to receive up to 3.00 MGD of flow from Poinciana Utilities for treated wastewater.

Poinciana Utilities Wastewater Facilities

Existing Facilities

In 2001, the Poinciana Utilities operated four domestic wastewater reclamation facilities with a total treatment capacity of 2.50 MGD. Total treated flow from these plants was 2.20 MGD. Two of the utility's WWTF are located in Osceola County, while plants #3 and #5 are located in Polk County. Wastewater Treatment Facilities #1 and #2 provide reclaimed water for irrigation. Wastewater Treatment Facility #3 and #5 provide no reclaimed water for reuse. Poinciana WWTF #2, #3 and # 5 are interconnected.

All of the wastewater treatment facilities use activated sludge treatment. Wastewater Treatment Facility #1 uses disposal via 5 acres of percolation ponds. Wastewater Treatment Facility #2 disposes of treated water via restricted public access irrigation of a 270-acre sod farm. Wastewater Treatment Facility #3 discharges to a 115-acre treatment wetland with an emergency overflow to the M-7 Canal to London Creek to Lake Hatchineha. Wastewater Treatment Facility #5, located in Polk County, disposes of treated water via 8.75 acres of percolation ponds. These ponds are located in an area that offers poor recharge capabilities to the Floridan Aquifer.

Figure 4 shows the 2001 wastewater service areas for the utility. **Table 28** summarizes the Poinciana's existing facilities.

Table 28. Poinciana Utilities Wastewater Facilities for 2001.

WWRF	FDEP Rated Capacity	Flow	Irrigation + Other	Recharge	Disposal
WWTF #1	0.35	0.25	0.00	0.00	0.25
WWTF #2	0.60	0.60	0.60	0.00	0.00
WWTF #3	0.35	0.22	0.00	0.00	0.22
WWTF #5	1.20	1.15	0.00	0.00	1.15
Total	2.50	2.22	0.60	0.00	1.62

Note: All flows represent annual average daily flow in MGD unless otherwise noted.

Future Facilities

Poinciana Utilities recently signed a contract to supply the City of Kissimmee (TWA) with up to 3.00 MGD of treated wastewater for the city to supplement its reclaimed water supply. In 2004, the supply was averaging an estimated 0.50 MGD. In 2001, Poinciana Utilities was managed by Florida Governmental Utility Authority (FGUA). Both the TWA and Polk County have expressed an interest in operating portions of the utility in the future. Anticipated flow for the four WWTF operated by Poinciana is 5.26 MGD by 2025.

City of St. Cloud Wastewater Facilities

Existing Facilities

The City of St. Cloud operates two wastewater treatment facilities. These include the Lakeshore WWTF and the Southside WWTF. The Lakeshore WWTF was the city's first wastewater treatment facility, using an activated sludge treatment process with high- level disinfection. The capacity of the plant is 2.40 MGD. Treated flow in the WWTF averaged 1.38 MGD in 2001. The Southside WWTF is the city's newest facility having been activated in 1999 with a capacity of 0.80 MGD. Treated water flow in 2001 averaged 0.32 MGD. **Figure 4** shows the location of the city wastewater service area.

In 2001, treated wastewater from the Lakeshore facility was disposed of via reuse for residential irrigation (0.60 MGD) and spray fields. The Southside WWTF disposed of treated wastewater through golf course irrigation (0.32 MGD), reuse, and an adjacent spray field. **Table 29** shows the distribution of discharges for 2001.

Table 29. St. Cloud Utilities Wastewater Facilities for 2001.

WWRF	FDEP Rated Capacity	Flow	Irrigation + Other	Recharge	Disposal
Lakeshore	2.40	1.38	0.60	0.00	0.78
Southside	0.80	0.32	0.32	0.00	0.00
Total	3.20	1.70	0.92	0.00	0.78

Note: All flows represent annual average daily flow in MGD unless otherwise noted.

Future Facilities

The City of St. Cloud has made significant strides in improving its wastewater and reuse facilities within its service area and has plans for additional expansion. In 1997, the city upgraded the treatment capacity at its Southside WWTF, and at the same time added 1.30 MGD in aboveground wastewater storage tanks. The city has also interconnected its Lakeshore and Southside WWTFs, and added new residential customers to its system. In 2002, the city completed construction of a retaining wall in an existing surface water holding pond to create a 70 million gallon storage area for highly treated effluent to address previous reuse peak flow issues. In 2003, the city implemented a block rate cost structure for its reuse customers to improve efficient use of the reclaimed water supply. Projected 2025 wastewater flow is estimated at 4.00 MGD.

The City of St. Cloud is currently evaluating a major expansion of the Southside WWTF in conjunction with diverting all flows that currently go to its Lakeshore plant to the Southside WWRF for treatment. The Lakeshore facility would retain storage facilities for reclaimed water and a possible surface water storage area from East Lake Toho. The Southside WWTF expansion is intended to replace the Lake Shore WWTF capacity, plus provide for substantial growth of the utility.

Other Wastewater Facilities - Osceola

Existing Facilities

In addition to the larger wastewater treatment facilities operated by the governmental agencies, there are smaller privately held treatment facilities that exceed the 0.10 MGD threshold and are located in Osceola County. Among these are the Good Samaritan Retirement Village, Siesta Lago MHP and the Orlando Hyatt Hotel. The Siesta Lago MHP discontinued operation in August 2002 after connection with the City of Kissimmee regional system.

The permitted capacity of the single domestic waste treatment facility servicing the Good Samaritan Retirement Village is 0.20 MGD. In 2001, the treated wastewater flow averaged 0.10 MGD, distributed among the village's golf course and other public access areas (99 residential units). The Orlando Hyatt Hotel operates a WWTF with a capacity of 0.30 MGD. The average treated wastewater flow in 2001 was 0.17 MGD, all of which was directed to the hotel's spray field for disposal. **Table 30** shows the distribution of wastewater discharges from each WWTF.

Table 30. Privately Held Wastewater Facilities for 2001.

WWRF	FDEP Rated Capacity	Flow	Irrigation + Other	Recharge	Disposal
Good Samaritan Retirement	0.20	0.10	0.10	0.00	0.00
Orlando Hyatt Hotel	0.30	0.17	0.00	0.00	0.17
Total	0.50	0.27	0.10	0.00	0.17

Note: All flows represent annual average daily flow in MGD unless otherwise noted.

Future Facilities

Both of these facilities are expected to be incorporated into the Toho Water Authority (TWA) and will be taken off-line in the future and flows diverted to other facilities.

Oakhill Estates Wastewater Facility

Existing Facilities

The Oakhill Estates owns a single WWTF having a capacity of 0.20 MGD and a 2001 flow of 0.12 MGD. Polk County operates the WWTF of behalf of Oakhill Estates. The facility offers basic disinfection treatment levels. Discharge from the WWTF is directed towards percolation ponds. No public access reuse is listed for the facility for 2001. **Table 31** provides the wastewater disposal summary for the utility for 2001.

Table 31. Privately Held Wastewater Facilities for 2001.

WWRF	FDEP Rated Capacity	Flow	Irrigation + Other	Recharge	Disposal
Oakhill Estates	0.20	0.12	0.00	0.00	0.12
Total	0.20	0.12	0.00	0.00	0.12

Note: All flows represent annual average daily flow in MGD unless otherwise noted.

Future Facilities

Developers for Oakhill Estates project growth in what would be the ultimate service area from 472 units to 5,210 by 2020. Actual growth has been substantially less than this and on the order of 100 units per year. The Oakhill WWTF is scheduled to be removed from service in the future. The wastewater flow will be redirected to the Northeast Regional WWTF, which is within the jurisdiction of the SWFWMD.

South Florida Water Management District has sponsored Polk County Utilities to install a reuse transmission line from the intersection of County Road 54 and US Highway 17 and 92, to approximately 4,500 linear feet south. This reuse transmission line will service three single-family residential developments with reclaimed water from the Northeast Regional WWTF. The projected service area for this project has a combined area of 191.43 acres and 445 single-family units. Rapid new growth in the northeast portion of the county is expected to place great demands on reclaimed water, and drive the subsequent construction of new lines to service these areas.

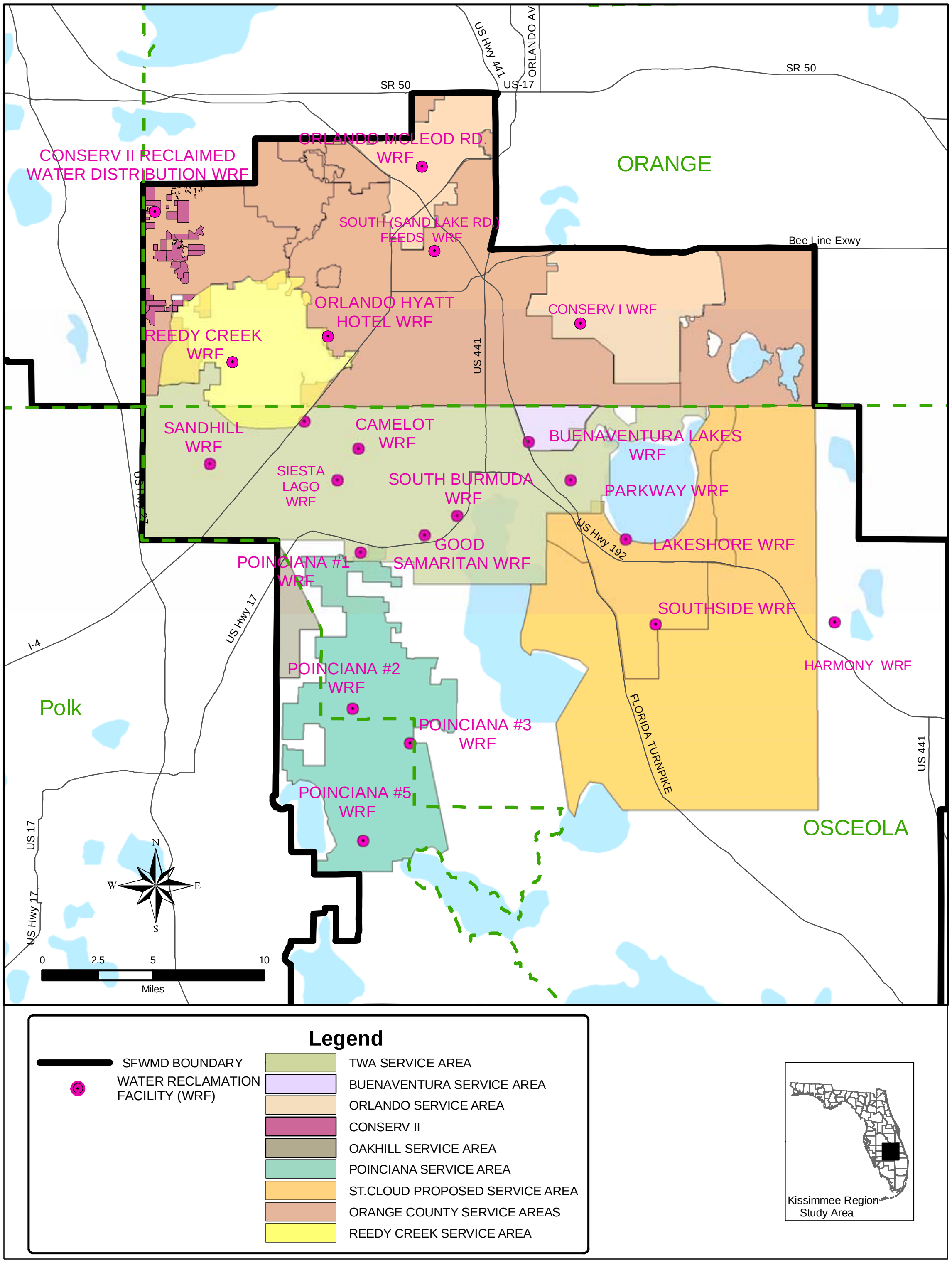

Figure 4. Wastewater Treatment Facility Service Areas in the Northern Kissimmee Basin, 2000-2025.

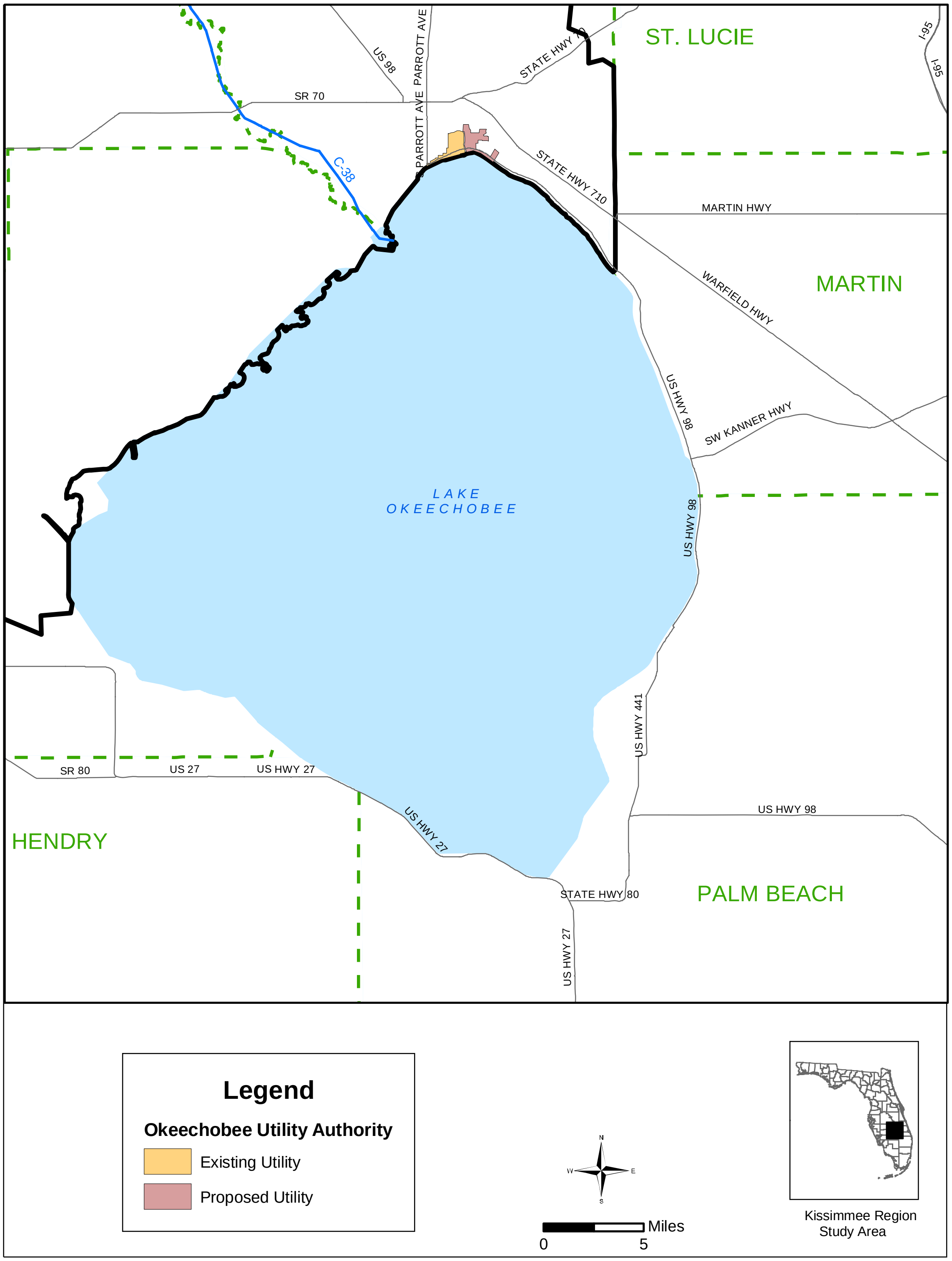

Figure 5. Wastewater Treatment Facility Service Areas in the Southern Kissimmee Basin, 2000-2025

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Bureau of Economic and Business Research (BEBR). 2004. *Projections of Florida Population by County 2004–2030*. BEBR, University of Florida, Gainesville, FL.

Florida Department of Environmental Protection. 2003. *Florida Department of Environmental Protection Reuse Inventory*. Tallahassee, FL. vari. pag.

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Alternative Water Supply Conceptual Design and Cost Estimation

> Note: Unit cost estimates used in this evaluation are subject to change. Land costs, in particular in the region of the project location, have risen sharply over the last few years and may greatly increase the estimated project cost. Any use of the financial portions of this memo should consider how these unit costs have changed, and how they may affect the final project cost total.

TECHNICAL MEMORANDUM:

Alternative Water Supply Projects Cost Estimation - Stormwater Reuse with Impoundments

This memorandum provides a summary of the conceptual design and planning level cost estimates for a potable water supply project using surface water runoff from the Kissimmee Chain of Lakes, specifically Lake Tohopekaliga (Lake Toho), as a source. The project includes sizing of an aboveground impoundment, inflow and outflow pump stations and seepage control facilities, as well as providing planning level costs estimates associated with diversion, storage and subsequent treatment of water using one of the stormwater treatment technologies. An ultrafiltration treatment technology, developed by ZENON Environmental Inc., which uses the ZeeWeed ultrafilter membrane (UF membrane), was selected as the water treatment technology for the project.

Derived from a study on stormwater availability in the Upper Kissimmee Basin (*A Preliminary Evaluation of Available Surface Water in East Lake Tohopekaliga and Lake Tohopekaliga*, Cai 2005), **Figure 1** shows 32-year average monthly volumes of water available for diversion from Lake Toho. As can be seen from the figure, there is an almost ten-fold difference in Lake Toho water availability between the months of May (4,440 acre-feet) and June (471 acre-feet).

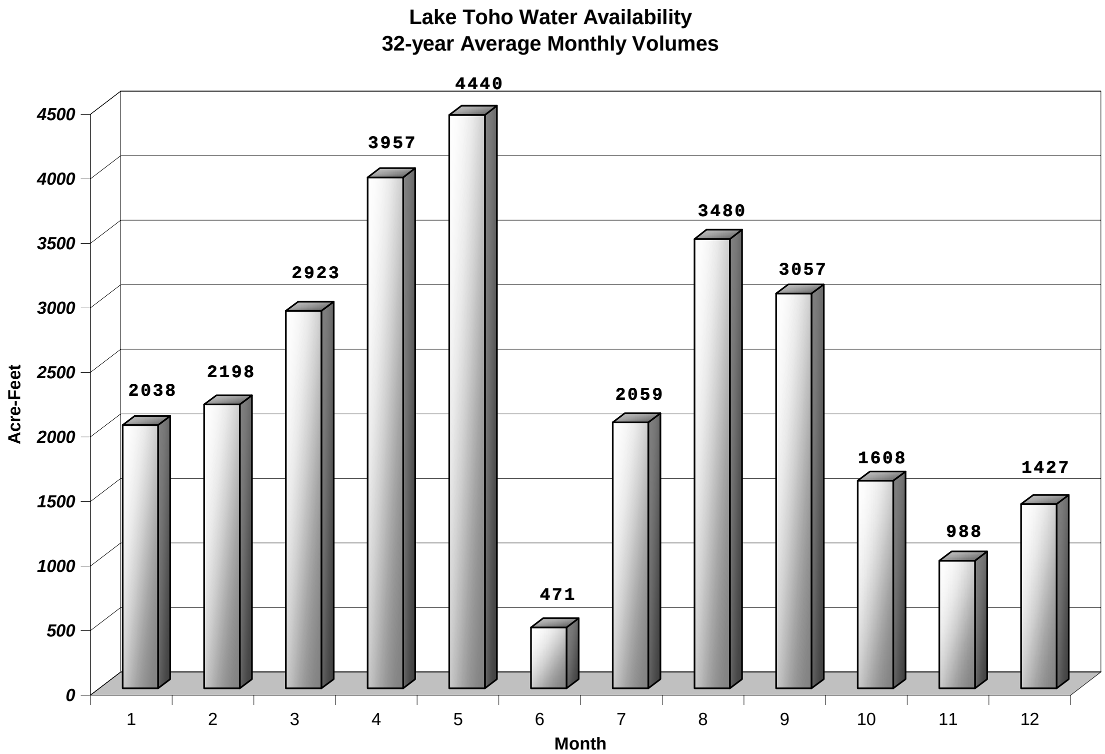

Figure 1. Lake Toho Water Availability.

In order to even out temporal variations of Lake Toho water availability and provide a reliable source of inflow to a water treatment plant, the project includes an aboveground impoundment to divert and store Lake Toho water when it is at, above, or within a certain range below its regulation schedule, and to release water for treatment when water from Lake Toho is not available. In order to size the impoundment, a water budget model was developed to simulate inflow, rainfall, seepage, evapotranspiration and water treatment plant demand (10, 15 and 25 MGD) on a daily basis from the impoundment for the 32-year (1970–2001) period of record.

The simulation results were summarized by plotting the demand level met against the impoundment size (200, 500, 1,000, 1,500, 2,000 and 3,000 acres), with each curve on the graph representing a different impoundment maximum depth (4, 6 and 8 feet). The plots of spillovers (amount of water available, but not captured in the impoundment due to it being full) as a function of the impoundment size were also provided. The simulation results showed that the seepage losses from the impoundment had to be controlled in order to achieve reliability for the water treatment facility in the 90 to 95 percent range, even for a 10-MGD level of demand.

A second set of simulations consisted of model runs with a seepage recycling rate of 70 percent. The results of the impoundment performance, with 70 percent of seepage recycled back to the impoundment, showed much improved demand levels met for all impoundment sizes and depths. The seepage perimeter canal and the seepage recycling pump station are, therefore, included in the proposed impoundment conceptual design.

Using the results from each model run, the demand level met for every combination of the impoundment size and depth, and the water treatment plant demand (plant capacity) were calculated. For example, for the plant capacity of 10 MGD, the range of the demands met is between 7.87 MGD (for a 200-acre 4-foot deep impoundment) and 9.85 MGD (for a 3,000-acre 8-foot deep impoundment), or 76 percent to 98 percent of time, respectively. For a plant capacity of 15 MGD, the range of the demands met is between 11.09 MGD and 14.54 MGD, or 71 to 97 percent of time, respectively. Finally, for a 25-MGD water treatment plant, the range of demands met is between 16.76 MGD and 21.90 MGD, or between 62 and 86 percent of time, respectively.

Figure 2 through **Figure 4** show the demand levels met, by volume, as a function of the impoundment size for the 10-, 15- and 25-MGD capacity water treatment plants. **Figure 5** through **Figure 7** show the same relationship with the demand level met expressed as percent of time.

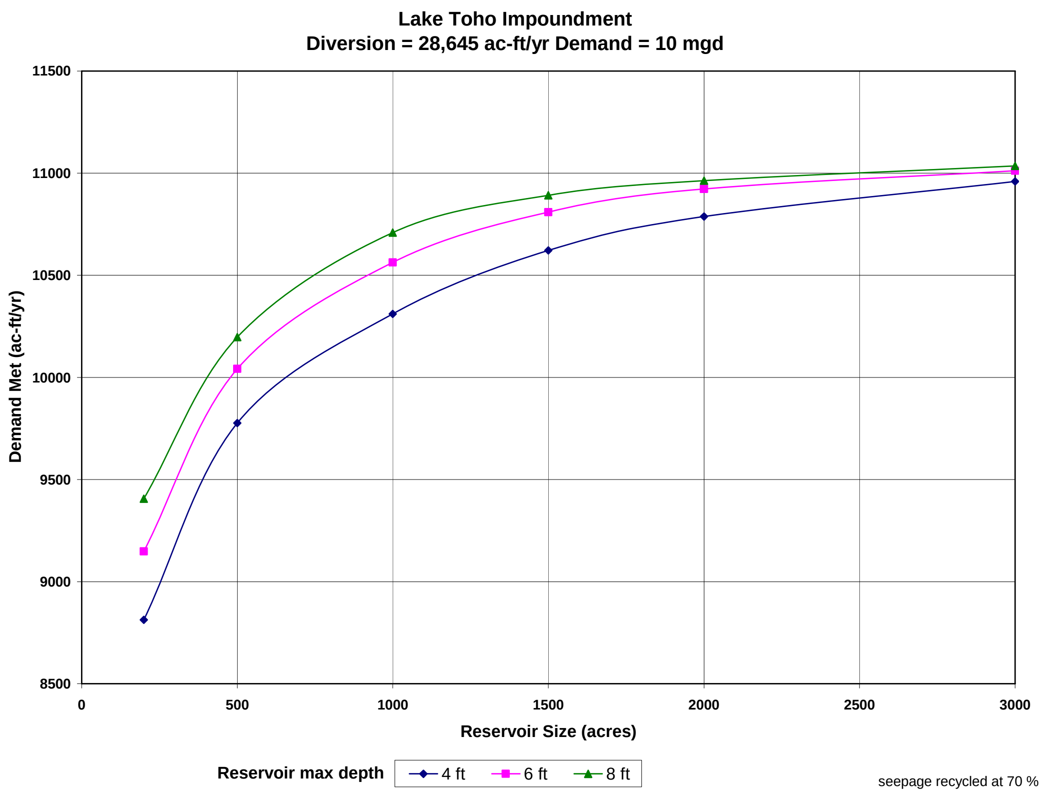

Figure 2. Demand Level Met (by volume) for a 10-MGD Capacity Treatment Plant.

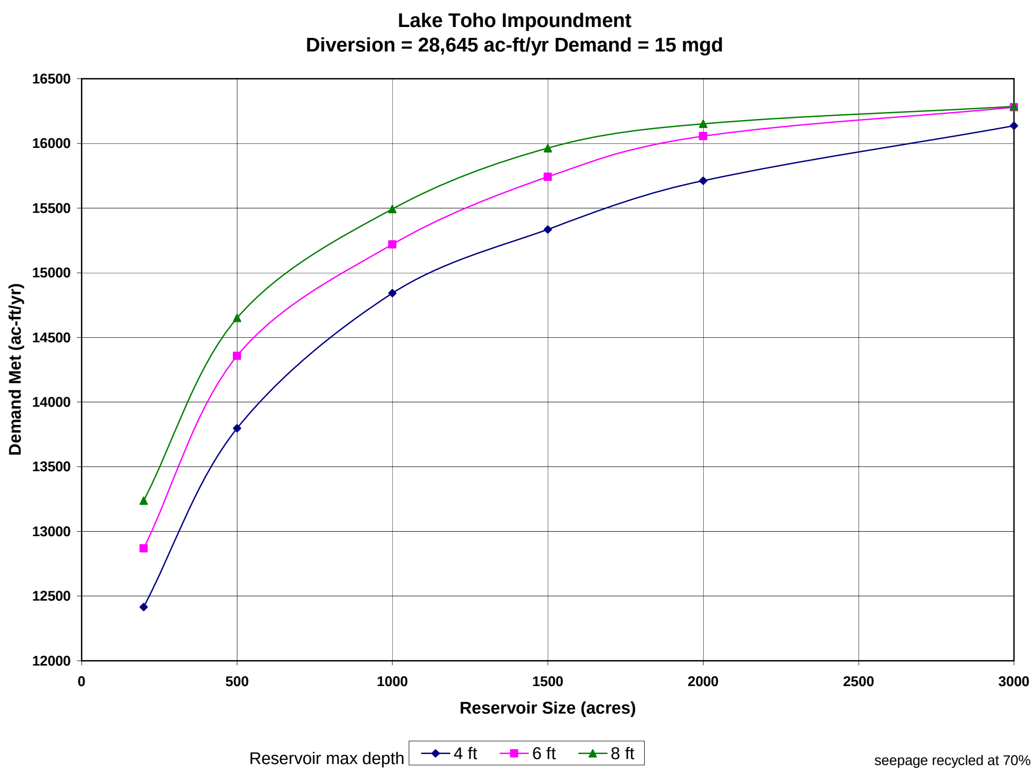

Figure 3. Demand Level Met (by volume) for a 15-MGD Capacity Treatment Plant.

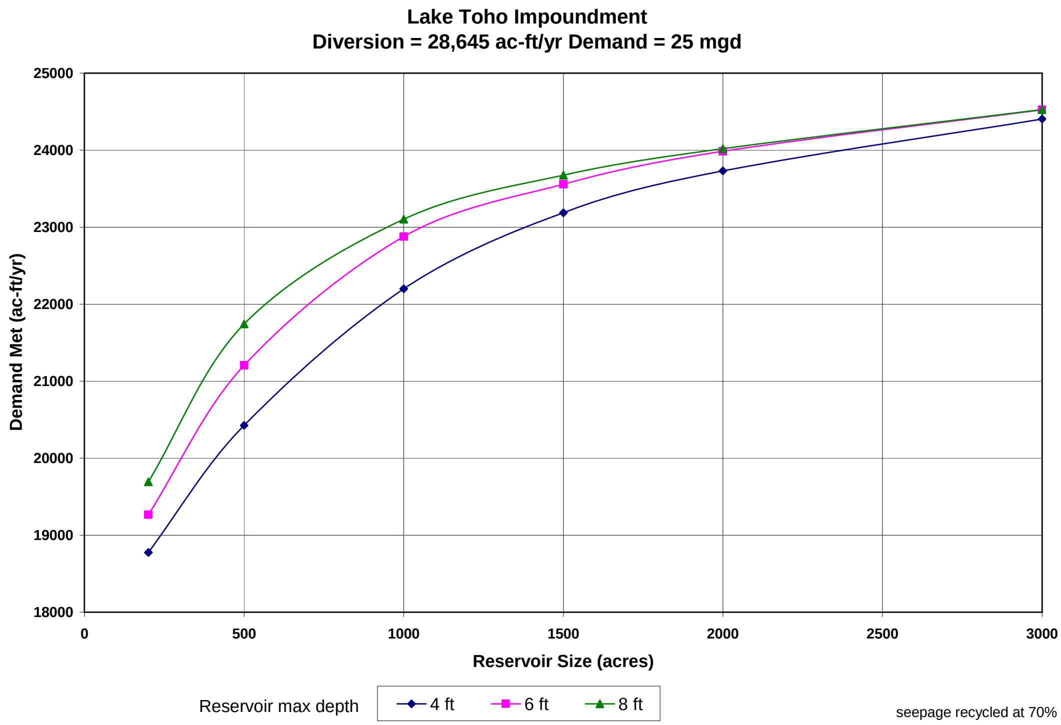

Figure 4. Demand Level Met (by volume) for a 25-MGD Capacity Treatment Plant.

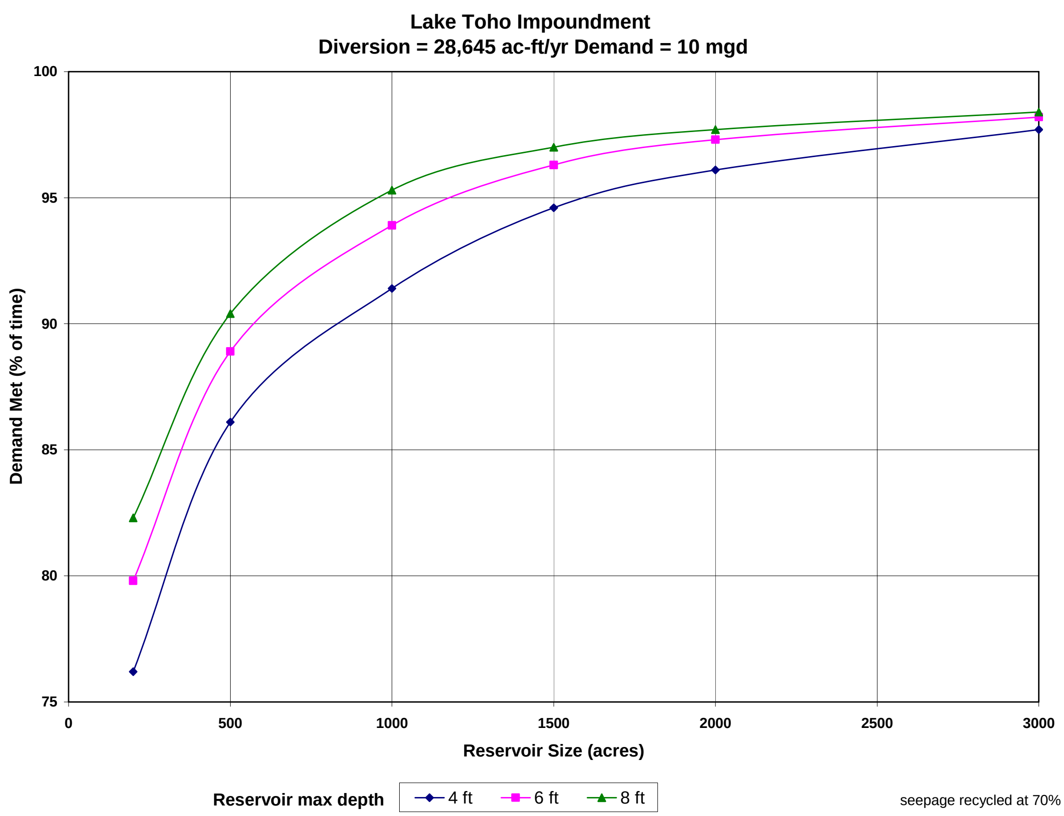

Figure 5. Demand Level Met (percent of time) for a 10-MGD Capacity Treatment Plant.

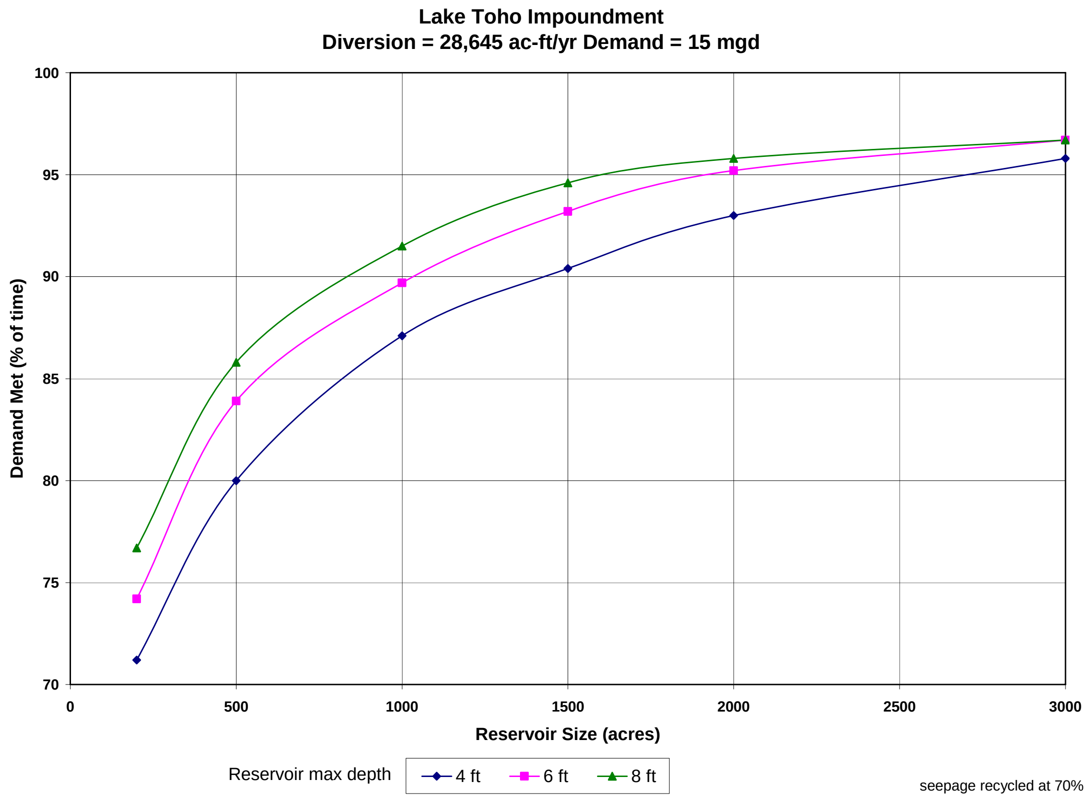

Figure 6. Demand Level Met (percent of time) for a 15-MGD Capacity Treatment Plant.

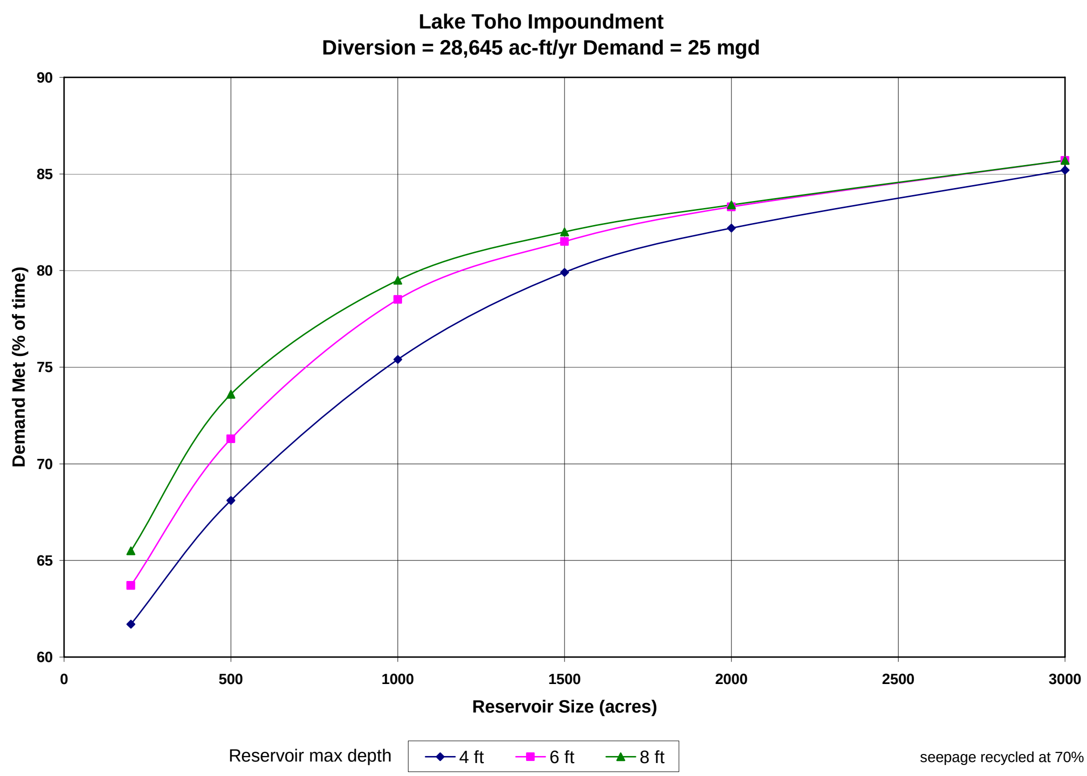

Figure 7. Demand Level Met (percent of time) for a 25-MGD Capacity Treatment Plant.

Next, for every pair of impoundment size and depth and its corresponding water treatment plant capacity (equaled to the demand level met), cost curves for planning level total project cost and cost per 1,000 gallons of treated water were developed. Due to the project's conceptual level design, the actual estimates of the cost cannot be determined until detailed design plans are prepared.

For cost estimation purposes, the impoundment is assumed to be a square shape, and its levee height is determined as follows: for a 4-foot deep impoundment, the levee height is 7.5 feet, for a 6-foot deep impoundment, the levee height is 11 feet and for an 8-foot deep impoundment, it is 17 feet. The seepage return pump is sized based on the impoundment seepage rate when it is half full. The impoundment inflow and outflow pump stations are sized according to the maximum available flow from Lake Toho over the period of record and the demand level met for each alternative, respectively. The cost estimates for seepage control facilities (except for seepage control pumps) are incorporated in the cost of levee construction. The land costs for the impoundment are based on the recent sales of agricultural land in the general area, which run between $2,000 and $6,000 per acre for the period between 2002 and 2005. The cost of $5,000 per acre is used in the cost analysis. Capital cost estimates provided by the *Project Cost Estimate, Peer Review of Microfiltration Supplemental Technology Demonstration Project* (Conlon and Regalado 2001) were used to estimate the cost for the ultrafiltration based water treatment plant with ZENON UF membranes.

Figure 8 through **Figure 10** show the planning level total cost to design and build the impoundment and water treatment plant facilities as a function of the impoundment size and depth, and the treatment plant capacity. **Figure 11** through **Figure 13** show the unit costs (cost per 1,000 gallons of treated water) for different impoundment sizes and water treatment plant capacities.

Figure 8. Planning Level Costs for a 10-MGD Water Treatment Plant/Impoundment.

Figure 9. Planning Level Costs for a 15-MGD Water Treatment Plant/Impoundment.

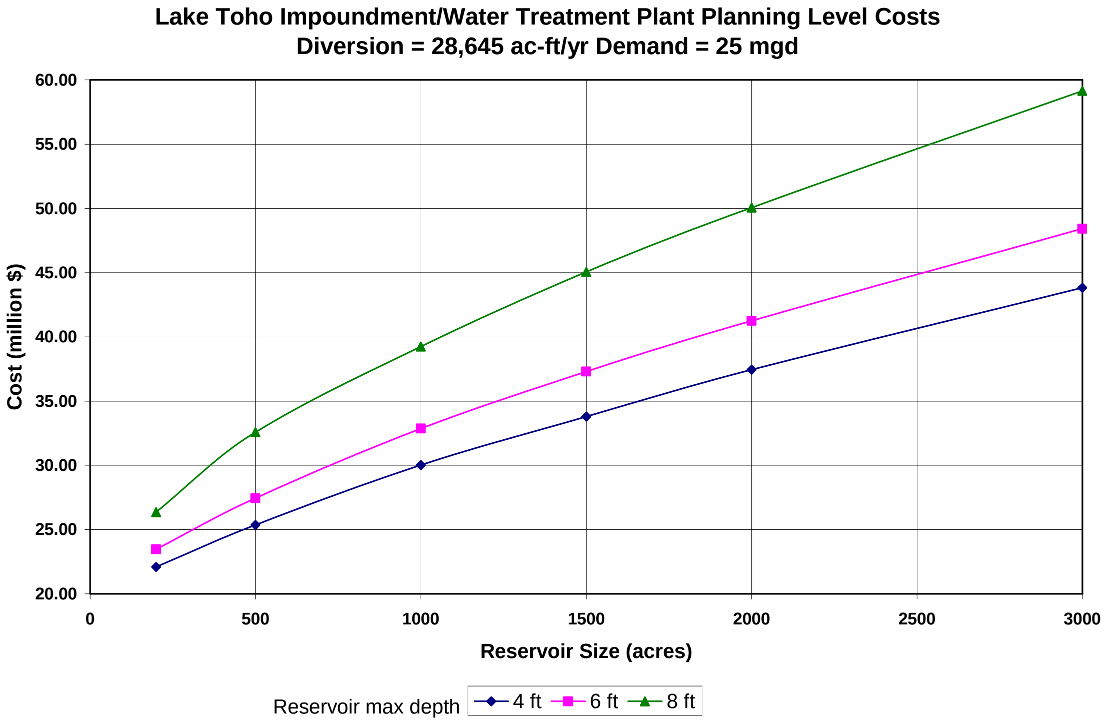

Figure 10. Planning Level Costs for a 25-MGD Water Treatment Plant/Impoundment.

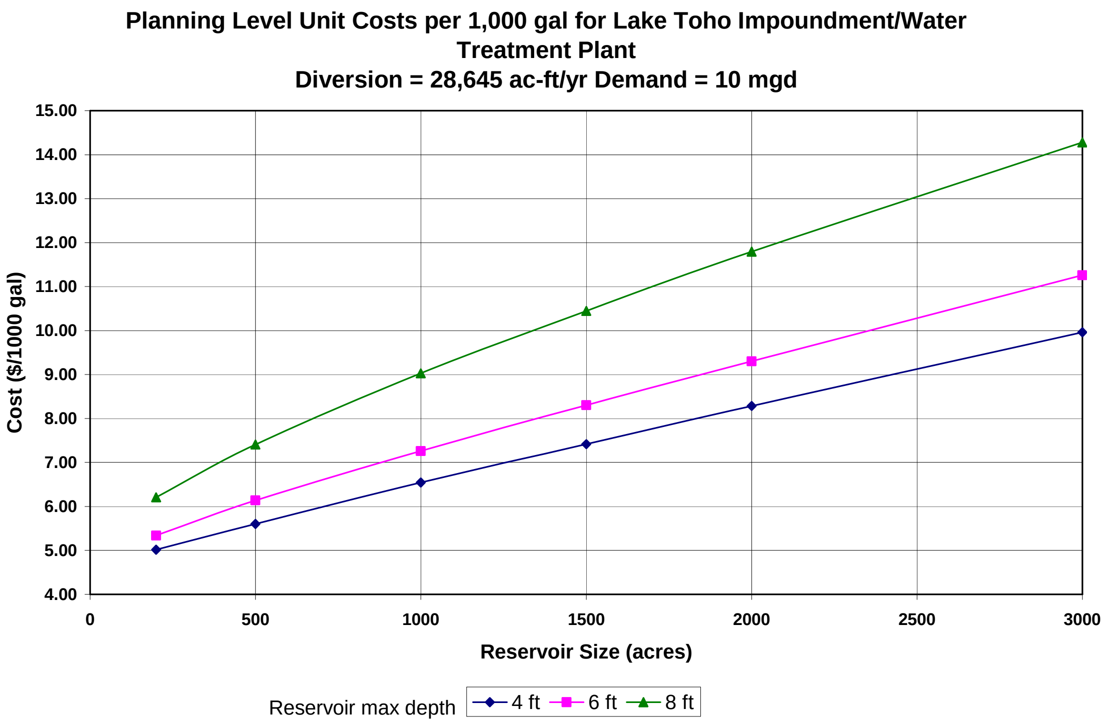

Figure 11. Planning Level Unit Costs per 1,000 gallons for a 10-MGD Water Treatment Plant/Impoundment.

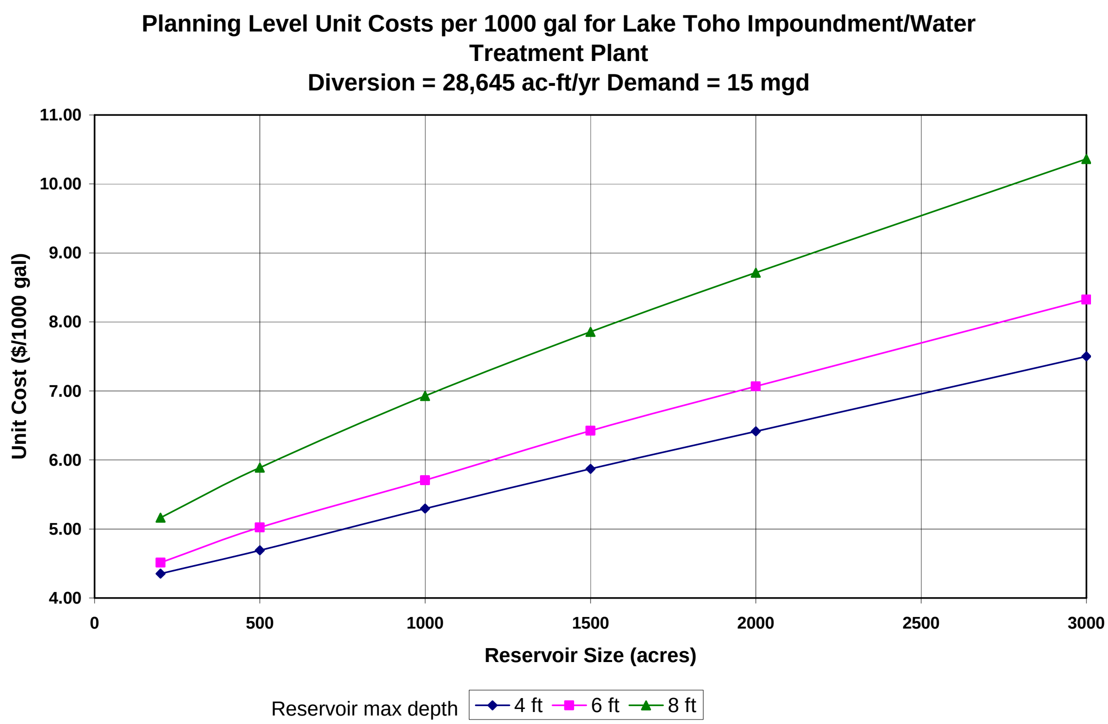

Figure 12. Planning Level Unit Costs per 1,000 gallons for a 15-MGD Water Treatment Plant/Impoundment.

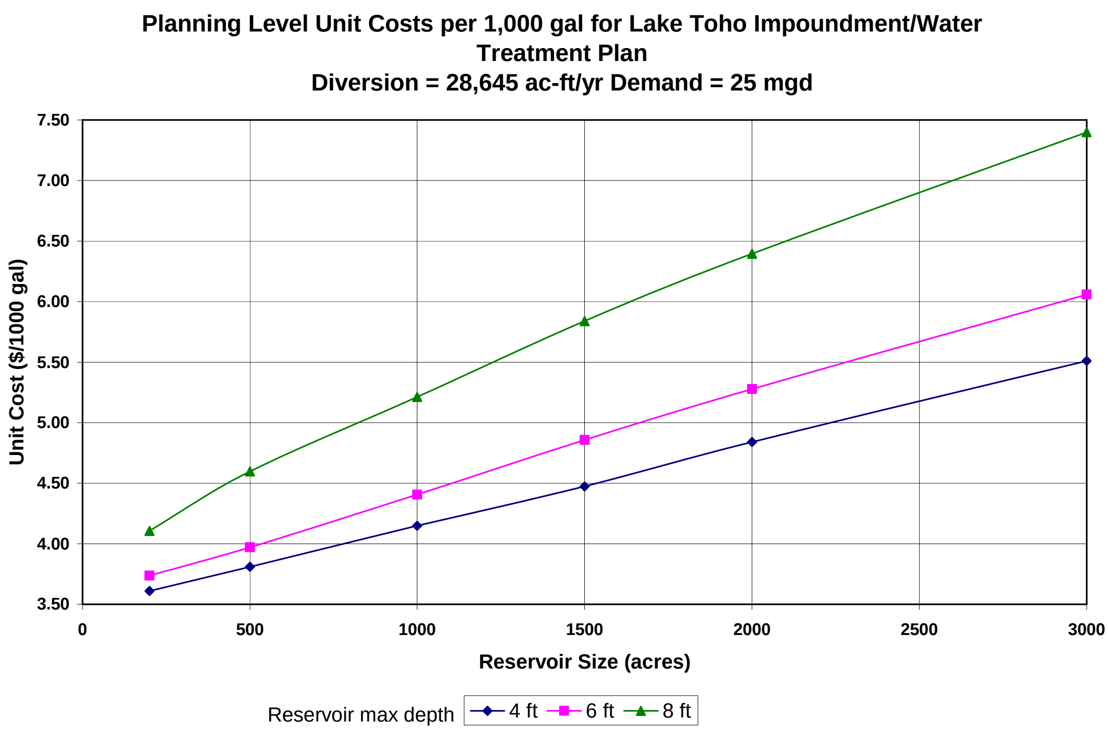

Figure 13. Planning Level Unit Costs per 1,000 gallons for a 25-MGD Water Treatment Plant/Impoundment.

In order to decide, for a given treatment plant capacity, which combination of the impoundment size and depth provides the most cost-efficient alternative, the unit costs should be compared first. As an example, for a 10-MGD plant, a 500-acre 8-foot deep, 1,000-acre 6-foot deep and 1,500-acre 4-foot deep impoundments all provide about the same cost-efficiency (see **Figure 11**). Next, the demand level met for the selected alternatives should be examined. In the previous example, a 500-acre impoundment provides the required inflow to the water treatment plant 90 percent of time, whereas the other two alternatives provide the required flow 94 percent of time (see **Figure 5**).

Table 1 provides summary planning level cost estimates, for the alternatives that were selected as most cost-efficient for each water treatment plant capacity. It should be noted that for each plant capacity a 1,000-acre 6-foot deep or a 1,500-acre 4-foot deep impoundments provide the same cost-efficiency level, e.g. the cost per 1,000 gallons of treated water is practically identical (see the cost curves, **Figure 11** through **Figure 13**). **Table 1** provides costs for a 1,000-acre 6-foot deep impoundment option.

Table 1. Planning Level Cost Estimates for an Impoundment / Water Treatment Plant Alternative[a].

System Component	Demand Level 10 MGD Reliability 93.9 %	Demand Level 15 MGD Reliability 89.7 %	Demand Level 25 MGD Reliability 78.5 %
Inflow Pump Station[b]	$1,010,000	$1,010,000	$1,010,000
Outflow Pump Station	$323,000	$423,000	$578,000
Seepage Control Pump	$500,000	$434,000	$350,000
Levees	$4,270,000	$4,270,000	$4,270,000
Water Treatment Plant Capital Cost	$4,780,000	$6,210,000	$8,150,000
Effluent Pump Station	$323,000	$423,000	$578,000
Water Treatment Plant Installation and Construction, 50% of Capital Costs[c]	$2,551,500	$3,316,500	$4,364,000
Project Implementation, 20% of Capital Costs (impoundment and water treatment plant)	$2,241,200	$2,554,000	$2,987,200
Subtotal Construction Costs	$15,998,700	$18,640,500	$22,287,200
Contingency at 25%	$3,999,700	$4,660,100	$5,571,800
Land	$5,000,000	$5,000,000	$5,000,000
Total Cost	$24,998,400	$28,300,600	$32,859,000
Cost per 1,000 gal.	$7.26	$5.71	$4.41
Annual O&M at 2–3% of Construction Costs	$353,500	$369,200	$403,900

Note: Unit cost estimates used in this evaluation are subject to change. Land costs, in particular in the region of the project location, have risen sharply over the last few years and may greatly increase the estimated project cost. Any use of the financial portions of this memo should consider how these unit costs have changed, and how they may impact the final project cost total.

a. Based on Lake Toho available diversion volume of 28,645 acre-feet per year.
b. A second pump station will be required depending on the distance from the Lake to the impoundment.
c. A 10% allowance is included for the canal construction connecting the Lake and the impoundment, and a possible additional pump (see b).

Due to economies of scale, the cost per 1,000 gallons of treated water (**Table 1**) decreases with the increase of the demand level. The cost is $7.26 per 1,000 gallons of treated water for the demand level of 10 MGD and only $4.41 per 1,000 gallons for the demand level of 25 MGD. However, it should be emphasized that for the demand level of 10 MGD, the demand is met 94 percent of time, whereas for the demand level of 25 MGD it is met only 79 percent of time. As a comparison, without the proposed impoundment, Lake Toho would be able to meet the water treatment plant demand only 66 percent of time for a 10-MGD plant capacity and a mere 53 percent of time for a 25-MGD plant capacity (Cai 2005). On average, there is a 26 percent increase in the ability of the surface water treatment plant to meet the demand with the inclusion of an impoundment option.

In order to improve the impoundment performance and the water treatment plant reliability for the demand levels of 15 and 25 MGD and possibly higher, a revised Lake Toho water withdrawal scenario that takes into account not only the Lake's regulation schedule, but also its historical water levels was developed (Cai 2005). The new time series provided a 34 percent increase in water available for diversion into the impoundment.

Figure 14 through **Figure 16** show the demand level met, by volume, as a function of the impoundment size for the 15-, 25- and 30-MGD capacity water treatment plants using the new time series of available water. **Figure 17** through **Figure 19** show the same relationship with the demand level met expressed as percent of time. The results of the impoundment performance show a 2 to 5 percent increase in the demand volume met for the 15-MGD level of demand (**Figure 3** and **Figure 14**), and a much improved impoundment performance for the 25-MGD level of demand (**Figure 4** and **Figure 15**). There is, on average, a 12 percent increase in water treatment plant reliability using the new Lake Toho available water time series for the demand level of 25 MGD (see **Figure 7** and **Figure 18**). In addition, the new time series of available water allows meeting the 30-MGD level of demand within a range of 25.00 MGD and 30.80 MGD, or between 73.8 and 91.6 percent of time, respectively (**Figure 16** and **Figure 19**). The smaller number corresponds to a 200-acre 4-foot deep impoundment and the bigger number corresponds to a 3,000-acre 8-foot deep impoundment.

Figure 20 through **Figure 22** show planning level total cost for the impoundment/water treatment plant as a function of the impoundment size and depth and the treatment plant capacity using new available water time series for impoundment sizing. **Figure 23** through **Figure 25** show the unit costs (cost per 1,000 gallons of treated water) for different impoundment sizes and water treatment plant capacities.

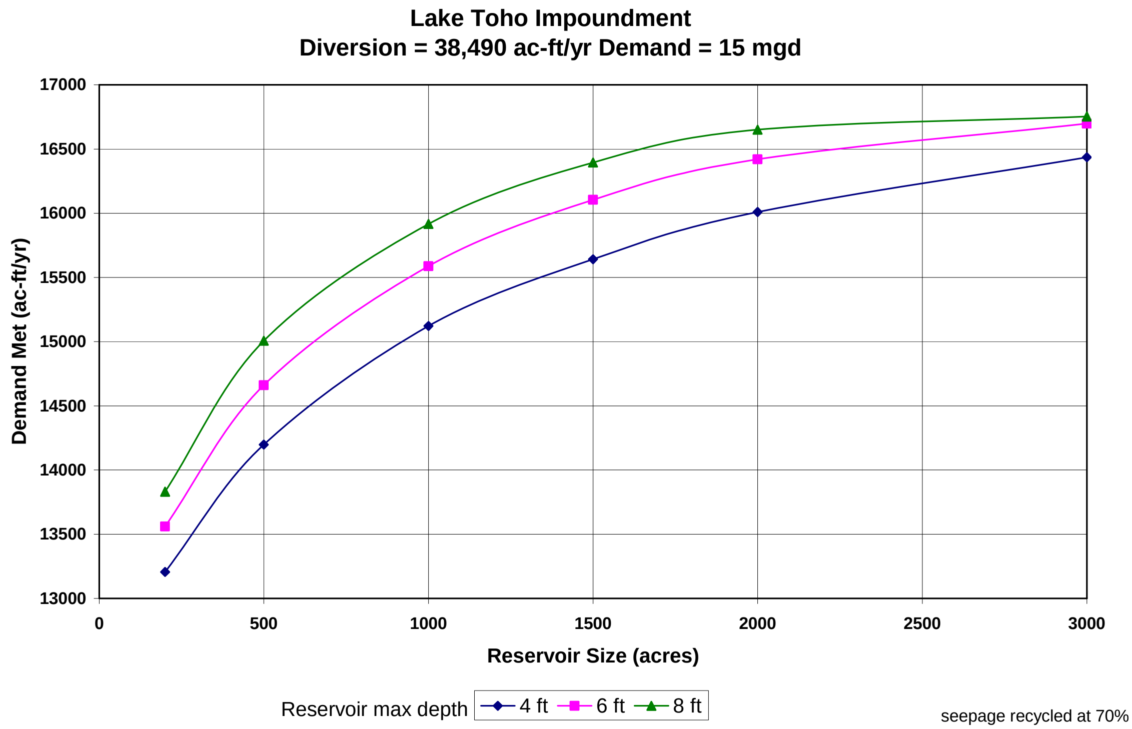

Figure 14. Demand Level Met (by volume) for a 15-MGD Capacity Treatment Plant.

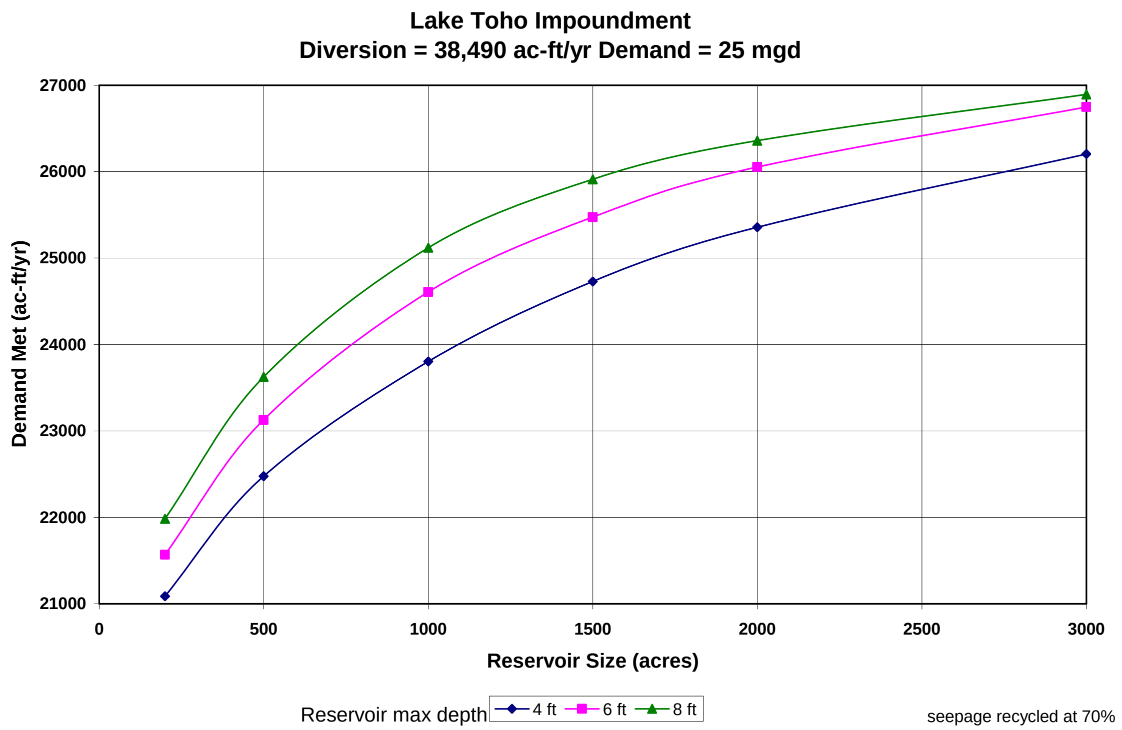

Figure 15. Demand Level Met (by volume) for a 25-MGD Capacity Treatment Plant.

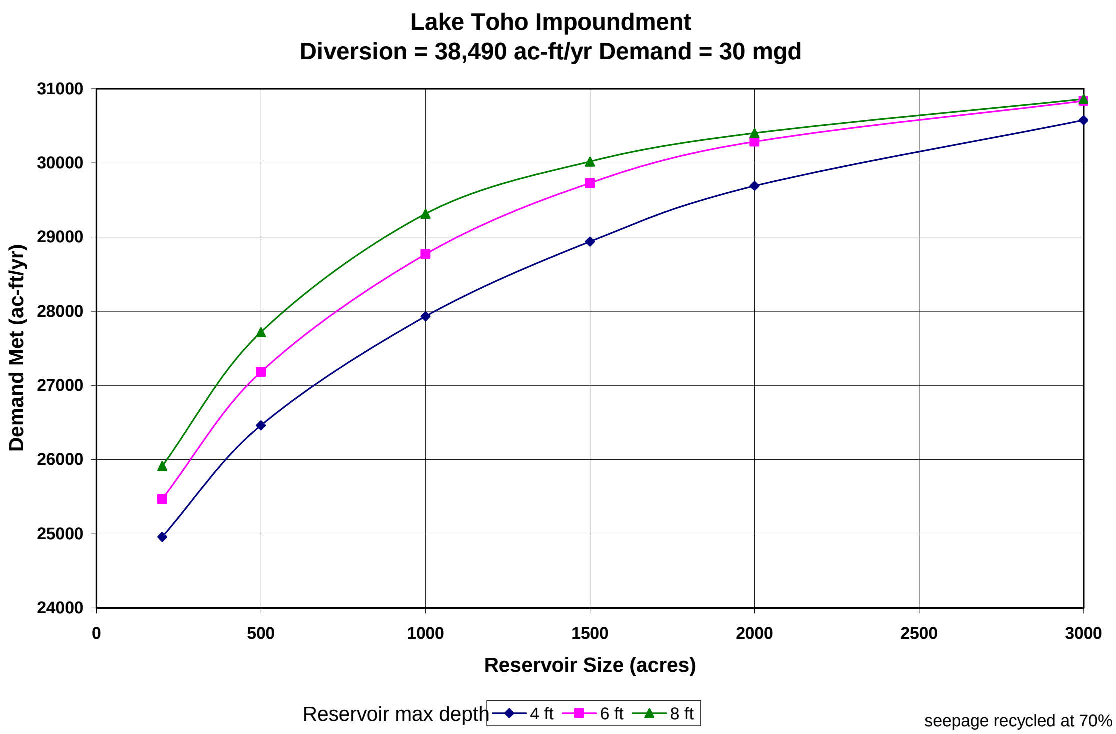

Figure 16. Demand Level Met (by volume) for a 30-MGD Capacity Treatment Plant.

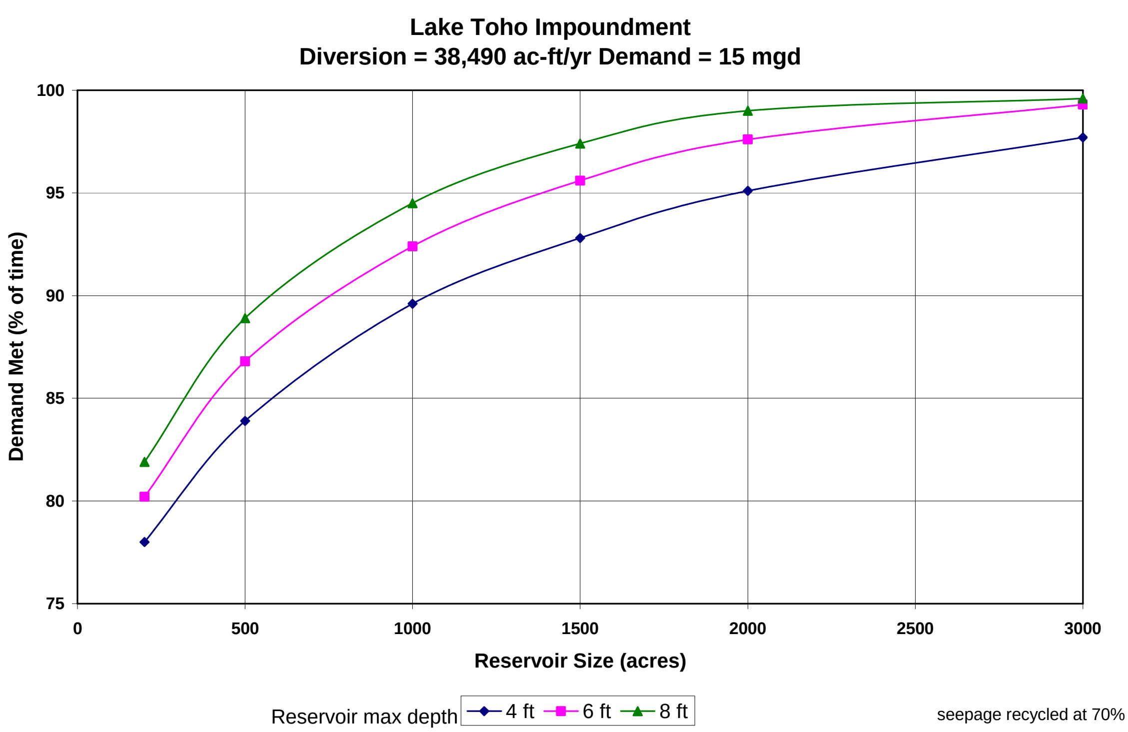

Figure 17. Demand Level Met (percent of time) for a 15-MGD Capacity Treatment Plant.

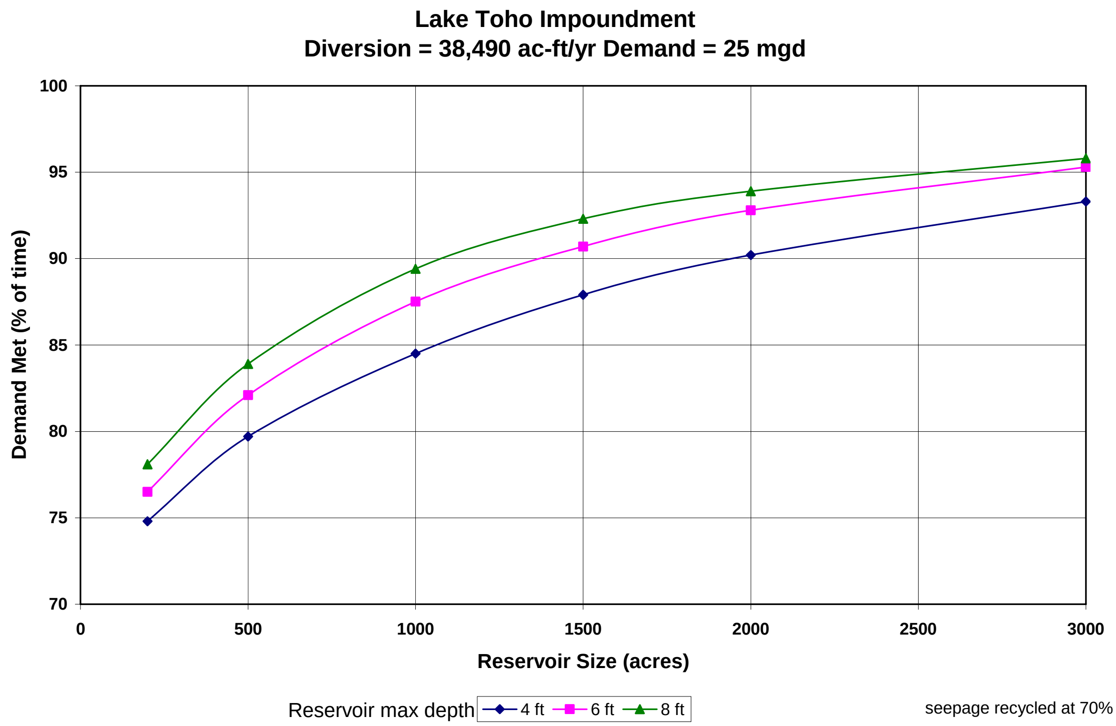

Figure 18. Demand Level Met (percent of time) for a 25-MGD Capacity Treatment Plant.

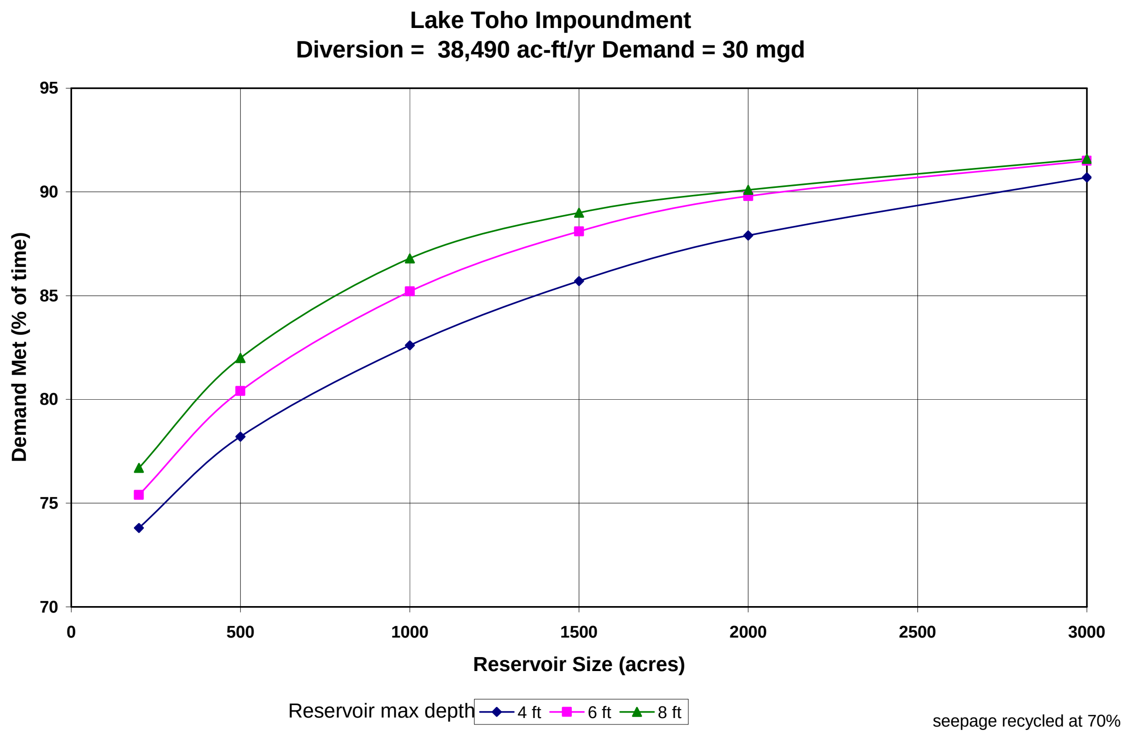

Figure 19. Demand Level Met (percent of time) for a 30-MGD Capacity Treatment Plant.

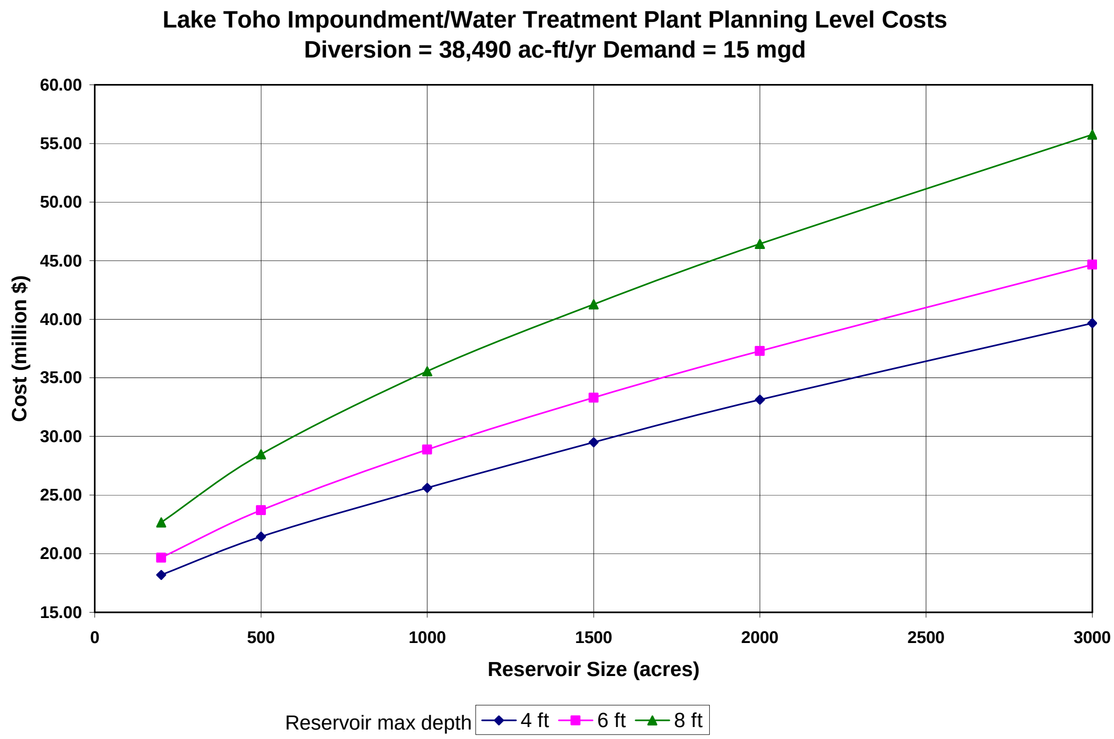

Figure 20. Planning Level Costs for a 15-MGD Water Treatment Plant/Impoundment.

Figure 21. Planning Level Costs for a 25-MGD Water Treatment Plant/Impoundment.

Figure 22. Planning Level Costs for a 30-MGD Water Treatment Plant/Impoundment.

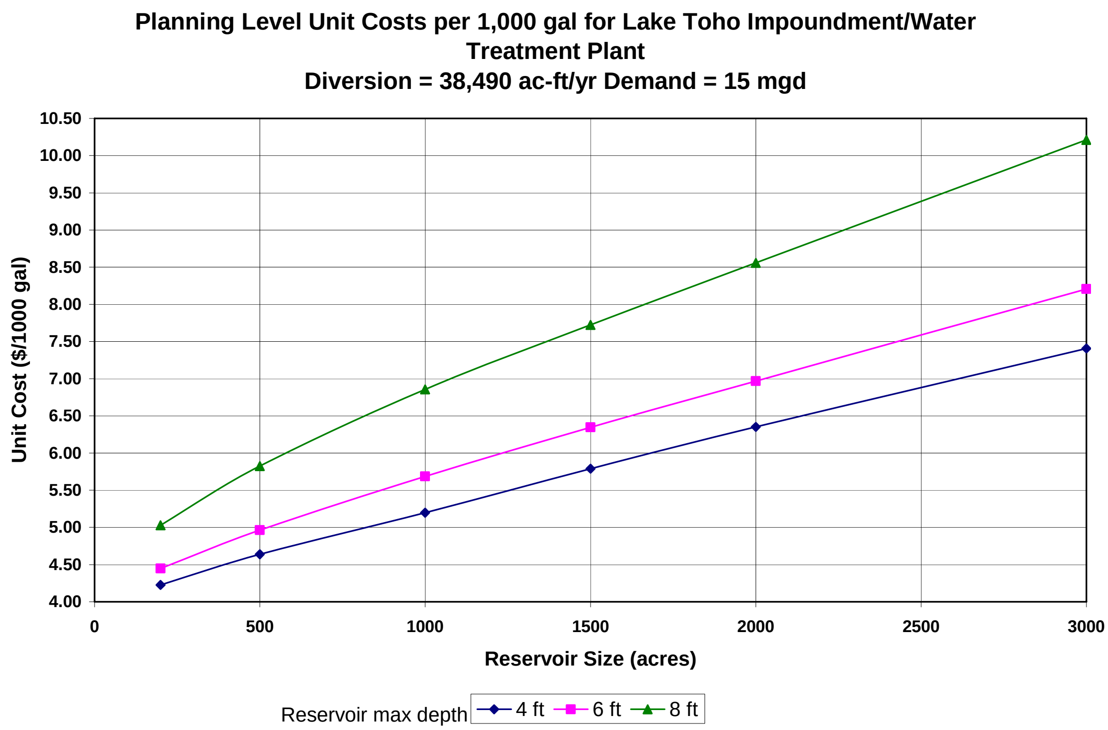

Figure 23. Planning Level Unit Costs per 1,000 gallons for a 15-MGD Water Treatment Plant/Impoundment.

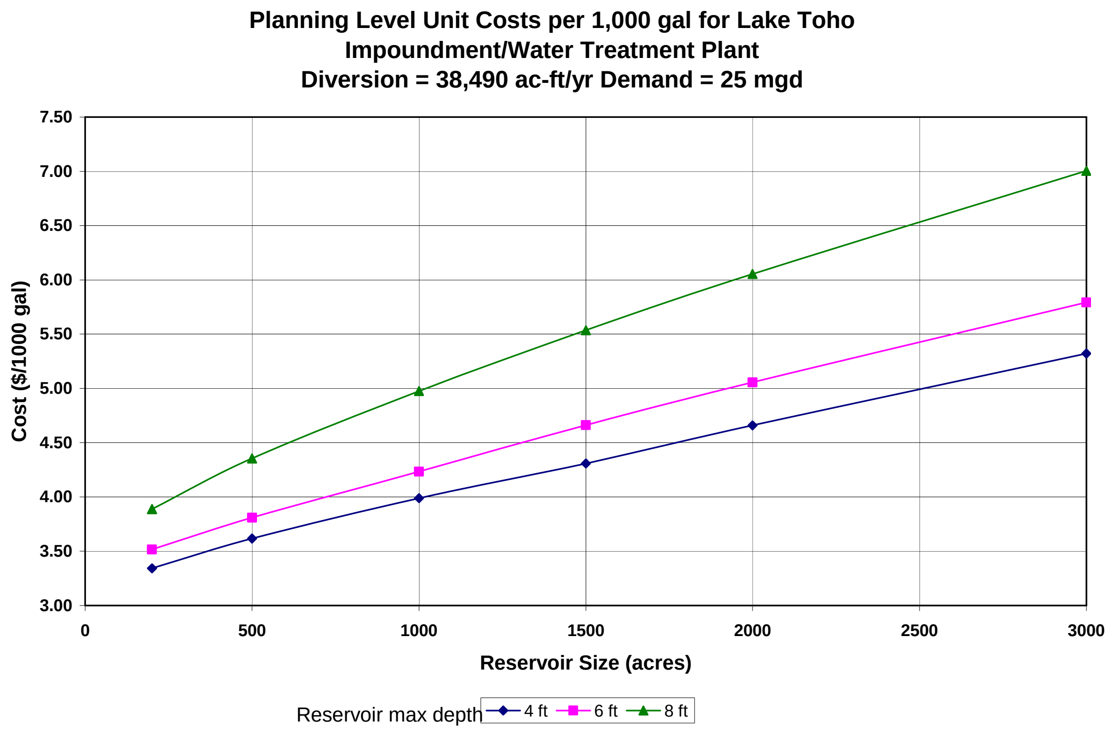

Figure 24. Planning Level Unit Costs per 1,000 gallons for a 25-MGD Water Treatment Plant/Impoundment.

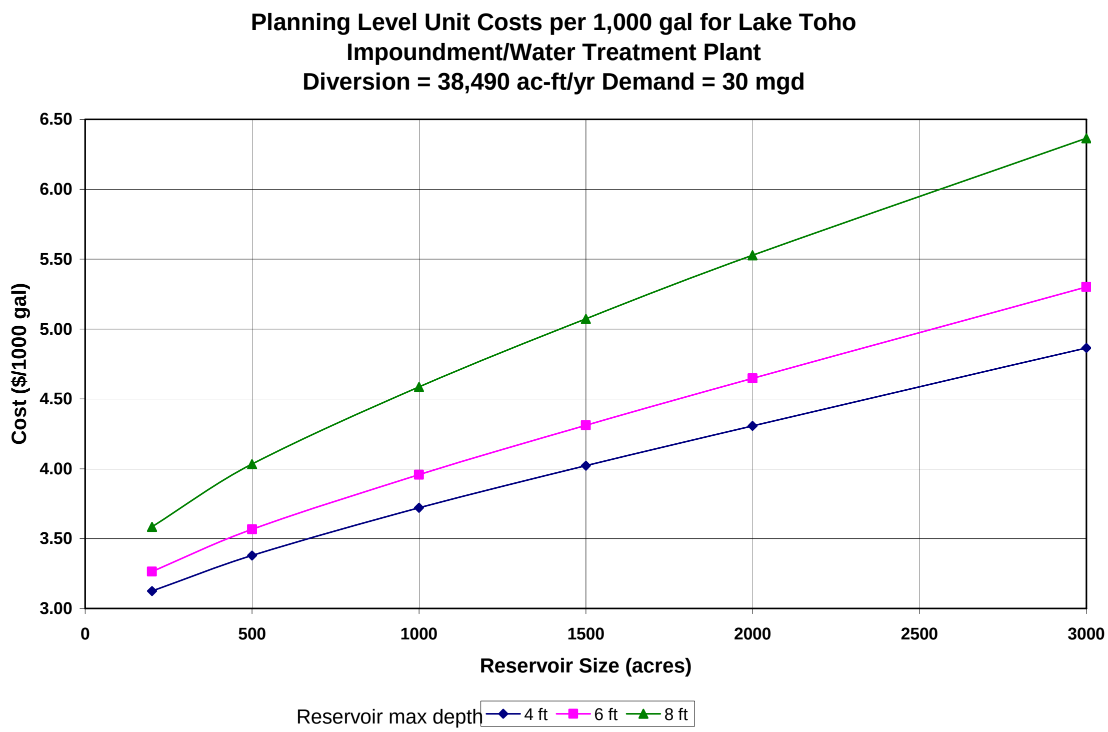

Figure 25. Planning Level Unit Costs per 1,000 gallons for a 30-MGD Water Treatment Plant/Impoundment.

Table 2 provides summary planning level cost estimates for the alternatives that were selected as most cost-efficient: 1,500-acre 6-foot deep impoundments for all three treatment plant capacities.

Table 2. Planning Level Cost Estimates for an Impoundment/Water Treatment Plant Alternative[a].

System Component	Demand Level 15 MGD Reliability 95.6%	Demand Level 25 MGD Reliability 90.7%	Demand Level 30 MGD Reliability 88.1%
Inflow Pump Station[b]	$1,010,000	$1,010,000	$1,010,000
Outflow Pump Station	$423,000	$578,000	$650,000
Seepage Control Pump	$610,000	$540,000	$490,000
Levees	$5,230,000	$5,230,000	$5,230,000
Water Treatment Plant Capital Cost	$6,590,000	$8,910,000	$10,270,000
Effluent Pump Station	$423,000	$578,000	$650,000
Water Treatment Plant Installation and Construction, 50% of Capital Costs[c]	$3,510,000	$4,740,000	$5,460,000
Project Implementation, 20% of Capital Costs (Impoundment and water treatment plant)	$2,860,000	$3,370,000	$3,660,000
Subtotal Construction Costs	$20,650,000	$24,950,000	$27,420,000
Contingency at 25%	$5,160,000	$6,240,000	$6,850,000
Land	$7,500,000	$7,500,000	$7,500,000
Total Cost	$33,310,000	$38,690,000	$41,770,000
Cost per 1,000 gal.	$6.35	$4.66	$4.31
Annual O&M at 2-3% of Construction Costs	$408,300	$451,600	$487,100

a. Based on Lake Toho available diversion volume of 38,490 acre-feet per year.
b. A second pump station will be required depending on the distance from the Lake to the impoundment.
c. A 10% allowance is included for the canal construction connecting the Lake and the impoundment, and a possible additional pump (see b).

TECHNICAL MEMORANDUM

Reservoir Sizing in the Upper Kissimmee River Basin

One of the possible alternatives in meeting the growing potable water demand of the area's population is the use of basin stormwater runoff. This work summarizes results of sizing an aboveground impoundment to divert and store the surface water from Lake Tohopekaliga (Lake Toho) when it is above or within the allowable range below its regulation schedule, and subsequent use of the stored water as a source influent to a water treatment plant. A water budget simulation model was developed and run on a daily basis to size an impoundment based on a 32-year period of record of available diversion from Lake Toho.

The following describes the hydrologic variables and assumptions used in the model simulation.

- Rainfall data used in the model come from the rainfall dataset used in running the Upper Kissimmee Chain of Lakes Routing Model (UKISS Model) corresponding to the Lake Toho subbasin.
- Evapotranspiration data used in the model are a pan evapotranspiration for an open water land use recently updated for the central Florida region by District staff.
- Seepage rate loss from the impoundment is assumed to be two cubic feet per second (cfs) per mile of the impoundment levee per one foot of head difference between the impoundment and the seepage perimeter canal, selected based on the hydrogeologic characteristics of the basin and literature research. Seepage is assumed to be recycled at a 70 percent rate by the seepage pumps installed in the seepage perimeter canal.
- Time series of daily flows available for diversion into the impoundment was calculated by comparing the Lake stage with its regulation schedule. For the detailed water availability methodology refer to the technical memorandum entitled, *A Preliminary Evaluation of Available Surface Water in East Lake Toho and Lake Toho* (Cai 2005). Two scenarios with the average annual volume of Lake Toho water available for diversion of 28,645 acre-feet and 38,490 acre-feet were analyzed.
- The demand time series (daily releases from the impoundment) varied between 10 MGD and 25 MGD for the available diversion of 28,645 acre-feet per year and between 15 MGD and 30 MGD for the available diversion of 38,490 acre-feet per year.

Several model runs using different impoundment sizes and demand levels were simulated to evaluate the performance of the impoundment. A summary of all runs is provided. The summary shows impoundment size and the maximum water depth; amount of water available, but not diverted into the impoundment due to it being full (spillover); demands met; average impoundment depth; percent of time the impoundment is 90, 75 and 50 percent full; and, seepage losses for the 32-year simulation period (**Table 3** through **Table 8**). Six different impoundment sizes (200, 500, 1,000, 1,500, 2,000 and 3,000 acres) and three different maximum impoundment depths (4, 6 and 8 feet) were simulated.

Table 3. Summary Reservoir Performance (Diversion = 28,645 acre-feet per year). Demand = 10 MGD, Seepage rate = 2 cfs/mi/ft of head (70% recycled).

Reservoir Depth, ft	Reservoir Area, acres	Spillover ac-ft/yr	Demand Met			Avg Res Stage, ft	Res @ 90% Capacity, % of time	Res @ 75% Capacity, % of time	Res @ 50% Capacity, % of time	Seepage @ Avg Stage, cfs
			ac-ft/yr	mgd	% of time					
4	200	17,943	8,813	7.87	76.2%	2.47	55.7%	58.3%	63.5%	11.07
4	500	15,564	9,777	8.73	86.1%	2.67	53.0%	58.6%	68.1%	18.90
4	1,000	13,137	10,311	9.21	91.4%	2.85	51.0%	59.8%	74.2%	28.50
4	1,500	11,237	10,621	9.48	94.6%	2.91	49.2%	60.5%	76.9%	35.62
4	2,000	9,694	10,787	9.63	96.1%	2.94	47.7%	61.2%	77.6%	41.57
4	3,000	7,208	10,959	9.78	97.7%	2.96	44.2%	61.9%	78.3%	51.27
6	200	16,514	9,148	8.17	79.8%	3.80	54.1%	57.9%	64.5%	17.02
6	500	13,440	10,042	8.97	88.9%	4.11	50.4%	57.7%	70.0%	29.10
6	1,000	10,272	10,563	9.43	93.9%	4.28	46.9%	58.2%	75.7%	42.80
6	1,500	7,962	10,809	9.65	96.3%	4.32	43.6%	57.6%	76.6%	52.88
6	2,000	6,166	10,923	9.75	97.3%	4.33	40.0%	57.5%	76.8%	61.23
6	3,000	3,677	11,012	9.83	98.2%	4.22	32.9%	51.9%	77.6%	73.09
8	200	15,158	9,406	8.40	82.3%	5.14	52.8%	57.2%	65.0%	23.03
8	500	11,470	10,197	9.10	90.4%	5.50	47.9%	56.7%	71.0%	38.94
8	1,000	7,673	10,709	9.56	95.3%	5.62	42.4%	54.8%	74.9%	56.20
8	1,500	5,138	10,891	9.72	97.0%	5.59	35.9%	53.0%	75.2%	68.42
8	2,000	3,384	10,963	9.79	97.7%	5.46	30.4%	48.4%	75.4%	77.20
8	3,000	1,354	11,035	9.85	98.4%	5.05	19.0%	37.6%	70.3%	87.47

Table 4. Summary Reservoir Performance (Diversion = 28,645 acre-feet per year).
Demand = 15 MGD, Seepage rate = 2 cfs/mi/ft of head (70% recycled).

Reservoir Depth, ft	Reservoir Area, acres	Spillover ac-ft/yr	Demand Met			Avg Res Stage, ft	Res @ 90% Capacity, % of time	Res @ 75% Capacity, % of time	Res @ 50% Capacity, % of time	Seepage @ Avg Stage, cfs
			ac-ft/yr	mgd	% of time					
4	200	14,577	12,416	11.09	71.2%	2.22	51.2%	54.4%	58.1%	9.95
4	500	12,057	13,798	12.32	80.0%	2.37	47.5%	52.4%	60.0%	16.78
4	1,000	9,468	14,842	13.25	87.1%	2.50	43.3%	50.9%	63.5%	25.00
4	1,500	7,674	15,334	13.69	90.4%	2.56	40.3%	49.8%	67.3%	31.33
4	2,000	6,233	15,712	14.03	93.0%	2.58	37.3%	49.2%	68.0%	36.48
4	3,000	4,097	16,137	14.41	95.8%	2.56	31.4%	45.9%	68.2%	44.34
6	200	13,148	12,869	11.49	74.2%	3.40	49.7%	53.4%	58.4%	15.23
6	500	9,880	14,357	12.82	83.9%	3.60	44.1%	50.1%	60.6%	25.49
6	1,000	6,804	15,220	13.59	89.7%	3.74	38.1%	47.7%	65.1%	37.40
6	1,500	4,698	15,742	14.06	93.2%	3.72	31.7%	44.7%	65.3%	45.53
6	2,000	3,232	16,057	14.34	95.2%	3.64	26.8%	40.5%	64.5%	51.47
6	3,000	1,556	16,280	14.54	96.7%	3.42	18.6%	32.1%	60.5%	59.23
8	200	11,807	13,237	11.82	76.7%	4.59	47.9%	52.0%	58.6%	20.56
8	500	7,995	14,651	13.08	85.8%	4.81	40.7%	48.3%	60.6%	34.05
8	1,000	4,521	15,493	13.83	91.5%	4.83	31.0%	43.1%	63.5%	48.30
8	1,500	2,456	15,963	14.25	94.6%	4.64	23.3%	36.6%	60.9%	56.79
8	2,000	1,359	16,152	14.42	95.8%	4.36	16.9%	29.4%	56.3%	61.65
8	3,000	411	16,286	14.54	96.7%	3.85	10.8%	18.0%	45.5%	66.68

Table 5. Summary Reservoir Performance (Diversion = 28,645 acre-feet per year). Demand = 25 MGD, Seepage rate = 2 cfs/mi/ft of head (70% recycled).

Reservoir Depth, ft	Reservoir Area, acres	Spillover ac-ft/yr	Demand Met			Avg Res Stage, ft	Res @ 90% Capacity, % of time	Res @ 75% Capacity, % of time	Res @ 50% Capacity, % of time	Seepage @ Avg Stage, cfs
			ac-ft/yr	mgd	% of time					
4	200	8,587	18,774	16.76	61.7%	1.82	34.8%	45.6%	50.3%	8.15
4	500	6,199	20,426	18.24	68.1%	1.89	33.7%	40.8%	49.4%	13.38
4	1,000	3,753	22,199	19.82	75.4%	1.82	25.8%	34.2%	46.0%	18.20
4	1,500	2,331	23,186	20.70	79.9%	1.74	19.8%	28.5%	42.8%	21.30
4	2,000	1,568	23,731	21.19	82.2%	1.64	15.8%	23.6%	38.3%	23.19
4	3,000	749	24,405	21.79	85.2%	1.45	11.6%	17.3%	30.9%	25.11
6	200	7,301	19,265	17.20	63.7%	2.79	35.9%	44.1%	49.9%	12.50
6	500	4,269	21,205	18.93	71.3%	2.76	28.4%	36.7%	47.1%	19.54
6	1,000	1,787	22,878	20.43	78.5%	2.50	17.4%	27.0%	40.5%	25.00
6	1,500	834	23,556	21.03	81.5%	2.24	11.8%	18.8%	33.8%	27.42
6	2,000	369	23,985	21.42	83.3%	2.02	8.4%	15.0%	27.9%	28.56
6	3,000	92	24,523	21.90	85.7%	1.68	4.8%	9.7%	20.2%	29.10
8	200	6,122	19,692	17.58	65.5%	3.70	33.6%	41.1%	49.1%	16.58
8	500	2,772	21,742	19.41	73.6%	3.49	23.1%	31.1%	44.3%	24.71
8	1,000	734	23,103	20.63	79.5%	2.95	10.9%	18.4%	33.8%	29.50
8	1,500	148	23,674	21.14	82.0%	2.50	5.7%	11.6%	25.4%	30.60
8	2,000	5	24,018	21.44	83.4%	2.16	3.2%	7.2%	19.4%	30.54
8	3,000	0	24,527	21.90	85.7%	1.71	0.0%	2.4%	12.6%	29.62

Table 6. Summary Reservoir Performance (Diversion = 38,490 acre-feet per year). Demand = 15 MGD, Seepage rate = 2 cfs/mi/ft of head (70% recycled).

Reservoir Depth, ft	Reservoir Area, acres	Spillover ac-ft/yr	Demand Met			Avg Res Stage, ft	Res @ 90% Capacity, % of time	Res @ 75% Capacity, % of time	Res @ 50% Capacity, % of time	Seepage @ Avg Stage, cfs
			ac-ft/yr	mgd	% of time					
4	200	23,196	13,205	11.79	78.0%	2.72	66.1%	68.6%	72.0%	12.19
4	500	20,768	14,197	12.68	83.9%	2.90	64.8%	68.8%	74.4%	20.53
4	1,000	17,984	15,121	13.50	89.6%	3.01	62.7%	69.4%	76.9%	30.10
4	1,500	15,813	15,642	13.97	92.8%	3.05	60.9%	68.4%	78.3%	37.33
4	2,000	13,940	16,009	14.29	95.1%	3.07	58.8%	67.9%	78.8%	43.41
4	3,000	10,771	16,436	14.68	97.7%	3.09	55.8%	66.2%	80.1%	53.52
6	200	21,636	13,560	12.11	80.2%	4.19	65.6%	68.4%	72.5%	18.77
6	500	18,325	14,661	13.09	86.8%	4.43	63.3%	68.9%	75.6%	31.36
6	1,000	14,691	15,587	13.92	92.4%	4.54	59.6%	67.9%	77.5%	45.40
6	1,500	11,953	16,104	14.38	95.6%	4.57	56.4%	66.5%	78.4%	55.94
6	2,000	9,704	16,421	14.66	97.6%	4.57	53.4%	65.1%	79.2%	64.62
6	3,000	6,284	16,698	14.91	99.3%	4.55	48.9%	62.2%	79.1%	78.81
8	200	20,155	13,831	12.35	81.9%	5.68	64.7%	68.2%	73.1%	25.45
8	500	16,001	15,007	13.40	88.9%	5.94	61.2%	68.0%	76.0%	42.06
8	1,000	11,624	15,916	14.21	94.5%	6.02	55.8%	65.6%	77.3%	60.20
8	1,500	8,454	16,395	14.64	97.4%	6.00	51.1%	62.9%	78.1%	73.44
8	2,000	6,053	16,651	14.87	99.0%	5.95	47.0%	60.5%	77.5%	84.13
8	3,000	2,754	16,754	14.96	99.6%	5.8	36.8%	55.7%	77.4%	100.46

Table 7. Summary Reservoir Performance (Diversion = 38,490 acre-feet per year). Demand = 25 MGD, Seepage rate = 2 cfs/mi/ft of head (70% recycled).

Reservoir Depth, ft	Reservoir Area, acres	Spillover ac-ft/yr	Demand Met			Avg Res Stage, ft	Res @ 90% Capacity, % of time	Res @ 75% Capacity, % of time	Res @ 50% Capacity, % of time	Seepage @ Avg Stage, cfs
			ac-ft/yr	mgd	% of time					
4	200	15,505	21,086	18.83	74.8%	2.50	63.0%	65.9%	68.7%	11.20
4	500	12,853	22,475	20.07	79.7%	2.67	59.4%	63.7%	69.4%	18.90
4	1,000	10,124	23,805	21.25	84.5%	2.70	53.0%	60.2%	70.5%	27.00
4	1,500	8,073	24,729	22.08	87.9%	2.68	48.4%	57.0%	69.1%	32.80
4	2,000	6,420	25,358	22.64	90.2%	2.65	44.1%	55.6%	68.0%	37.47
4	3,000	3,981	26,205	23.40	93.3%	2.58	38.2%	50.5%	66.2%	44.69
6	200	13,902	21,567	19.26	76.5%	3.88	61.2%	64.9%	68.7%	17.38
6	500	10,441	23,128	20.65	82.1%	4.02	54.7%	61.5%	69.7%	28.46
6	1,000	6,986	24,609	21.97	87.5%	3.96	46.6%	56.1%	68.1%	39.60
6	1,500	4,630	25,475	22.75	90.7%	3.87	39.3%	52.8%	66.2%	47.37
6	2,000	2,943	26,055	23.26	92.8%	3.76	33.6%	47.5%	65.1%	53.17
6	3,000	1,067	26,750	23.88	95.3%	3.44	21.0%	37.6%	60.8%	59.58
8	200	12,374	21,983	19.63	78.1%	5.24	59.4%	63.8%	68.8%	23.48
8	500	8,291	23,625	21.09	83.9%	5.30	50.6%	57.4%	69.2%	37.52
8	1,000	4,323	25,121	22.43	89.4%	5.12	39.1%	51.7%	65.9%	51.20
8	1,500	2,031	25,911	23.13	92.3%	4.85	28.9%	43.9%	63.8%	59.36
8	2,000	838	26,360	23.54	93.9%	4.50	19.3%	34.9%	59.5%	63.63
8	3,000	109	26,894	24.01	95.8%	3.77	6.3%	19.5%	48.9%	65.30

Table 8. Summary Reservoir Performance (Diversion = 38,490 acre-feet per year). Demand = 30 MGD, Seepage rate = 2 cfs/mi/ft of head (70% recycled).

Reservoir Depth, ft	Reservoir Area, acres	Spillover ac-ft/yr	Demand Met			Avg Res Stage, ft	Res @ 90% Capacity, % of time	Res @ 75% Capacity, % of time	Res @ 50% Capacity, % of time	Seepage @ Avg Stage, cfs
			ac-ft/yr	mgd	% of time					
4	200	11,740	24,958	22.28	73.8%	2.38	59.4%	62.8%	66.8%	10.66
4	500	9,090	26,462	23.63	78.2%	2.51	54.3%	58.2%	65.7%	17.77
4	1,000	6,457	27,931	24.94	82.6%	2.49	47.3%	53.6%	63.7%	24.90
4	1,500	4,599	28,938	25.84	85.7%	2.44	39.6%	49.9%	63.1%	29.87
4	2,000	3,196	29,688	26.51	87.9%	2.35	33.3%	44.4%	61.2%	33.23
4	3,000	1,457	30,575	27.30	90.7%	2.20	24.2%	36.9%	57.4%	38.10
6	200	10,169	25,469	22.74	75.4%	3.68	56.8%	60.9%	65.5%	16.49
6	500	6,792	27,180	24.27	80.4%	3.73	48.6%	54.8%	63.6%	26.41
6	1,000	3,613	28,770	25.69	85.2%	3.58	36.9%	48.4%	62.1%	35.80
6	1,500	1,776	29,727	26.54	88.1%	3.34	26.6%	39.0%	58.9%	40.88
6	2,000	785	30,286	27.04	89.8%	3.08	18.7%	31.7%	52.7%	43.55
6	3,000	206	30,837	27.53	91.5%	2.60	8.6%	18.5%	42.2%	45.03
8	200	8,694	25,913	23.14	76.7%	4.94	54.4%	58.8%	64.9%	22.13
8	500	4,783	27,719	24.75	82.0%	4.86	43.3%	51.1%	62.2%	34.41
8	1,000	1,551	29,314	26.17	86.8%	4.40	26.2%	37.6%	58.0%	44.00
8	1,500	396	30,016	26.80	89.0%	3.84	13.3%	26.4%	48.4%	47.00
8	2,000	75	30,401	27.14	90.1%	3.35	6.4%	15.6%	40.1%	47.37
8	3,000	0	30,860	27.55	91.6%	2.67	0.0%	5.20%	24.4%	46.24

One of the best indicators of impoundment performance is the volume of spillover, e.g. the amount of water available, but not pumped into the impoundment when at capacity (As a rule, the smaller the impoundment's size and depth, the bigger the spillover). **Figure 26** through **Figure 28** show, for the diversion volume of 28,645 acre-feet/year, the average annual spillover as a function of the impoundment size for the demand level of 10, 15 and 25 MGD, respectively. Each line on the graphs represents an impoundment performance curve with a different maximum impoundment depth.

Figure 29 through **Figure 31** show, for the diversion volume of 28,645 acre-feet/year, the average impoundment depth as a function of the impoundment size for the demand level of 10, 15 and 25 MGD, respectively. For a given impoundment maximum depth, there is a pronounced drop in the impoundment average water levels with the increase of the impoundment size (due to increase in seepage losses) and the demand level.

Figure 32 through **Figure 34**, and **Figure 35** through **Figure 37** show the frequency of the impoundment at 90 percent and 75 percent capacity, respectively, for the demand level of 10, 15 and 25 MGD, and the diversion volume of 28,645 acre-feet/year. With the exception of a 4-foot deep impoundment for the demand level of 10 MGD, all performance curves show a lower frequency of impoundment being 90 and 75 percent full with the increase of the impoundment size.

Figure 38 through **Figure 49** describe impoundment performance for the demand level of 15, 25 and 30 MGD and the Lake Toho average annual volume available for the diversion of 38,490 acre-feet.

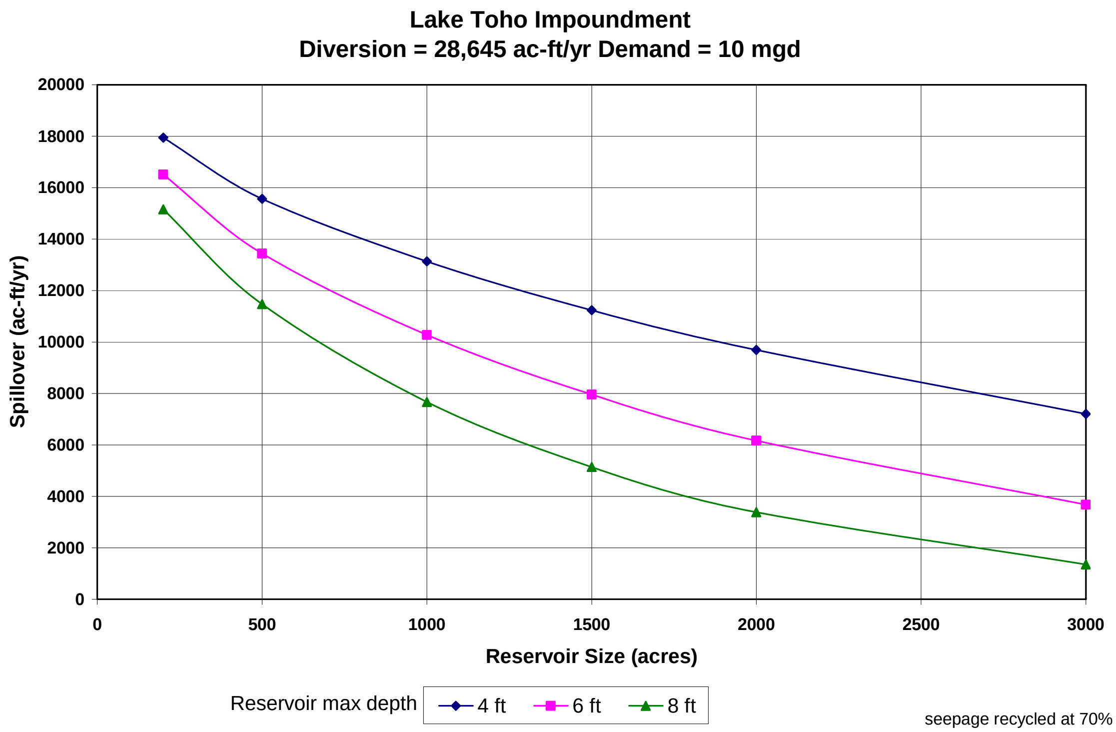

Figure 26. Lake Toho Impoundment Annual Average Spillover for the 10-MGD Demand Level.

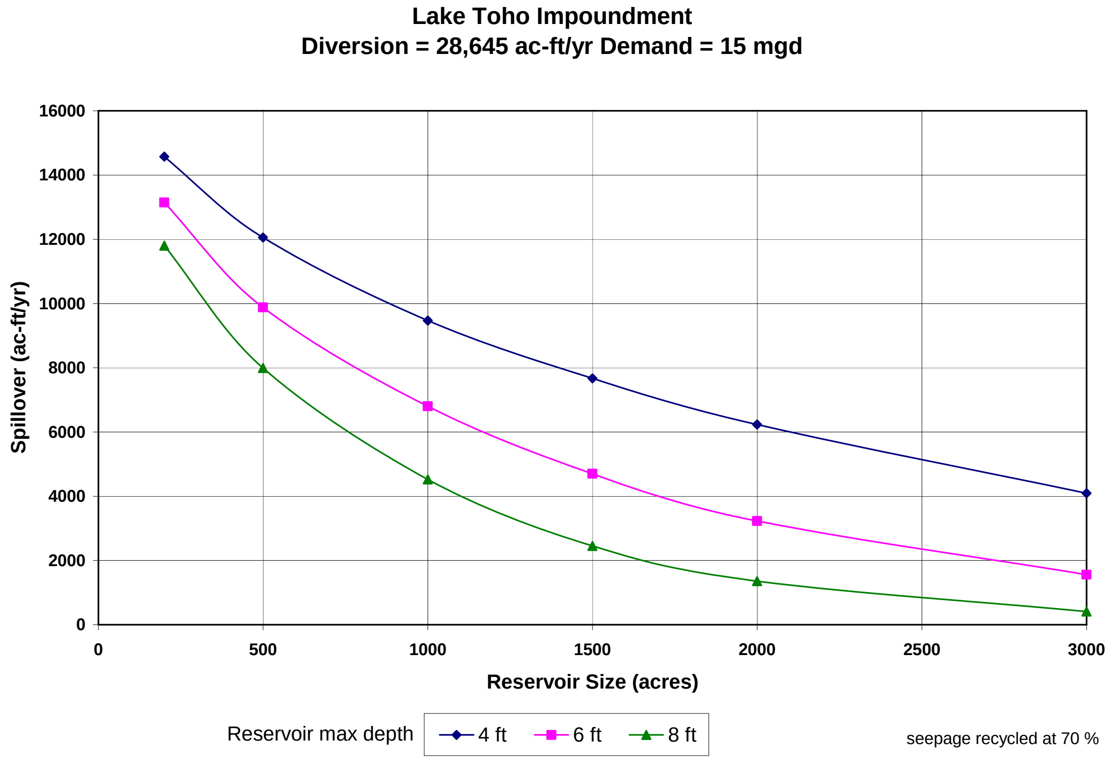

Figure 27. Lake Toho Impoundment Annual Average Spillover for the 15-MGD Demand Level.

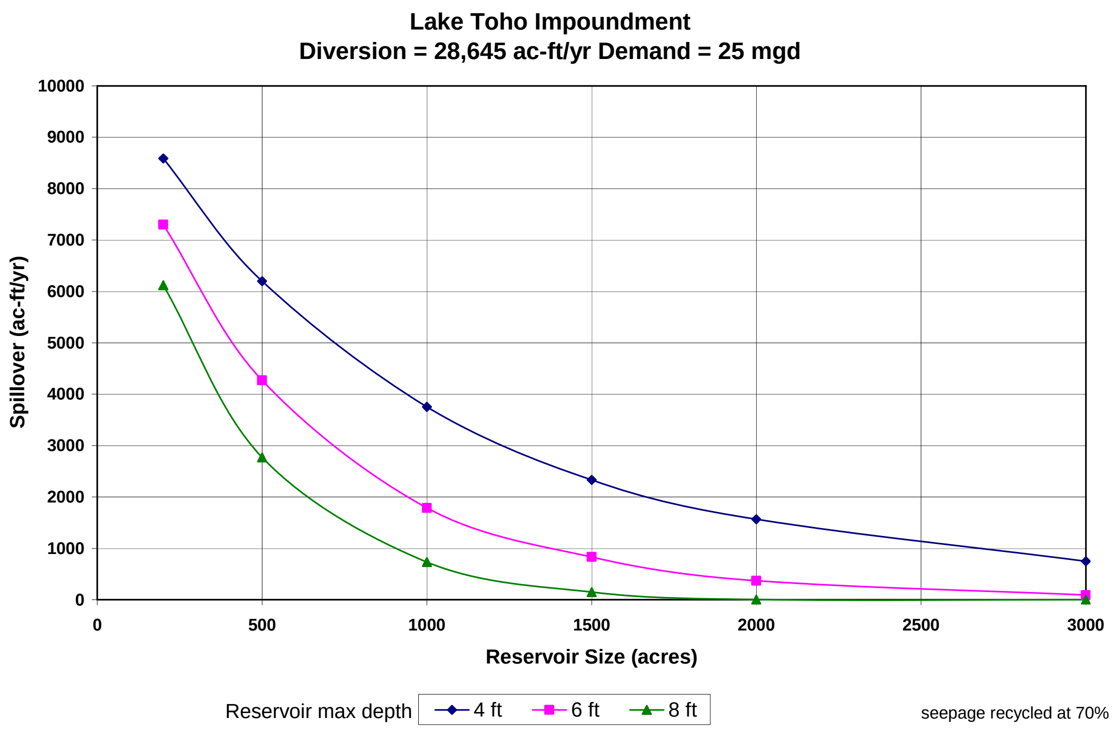

Figure 28. Lake Toho Impoundment Annual Average Spillover for the 25-MGD Demand Level.

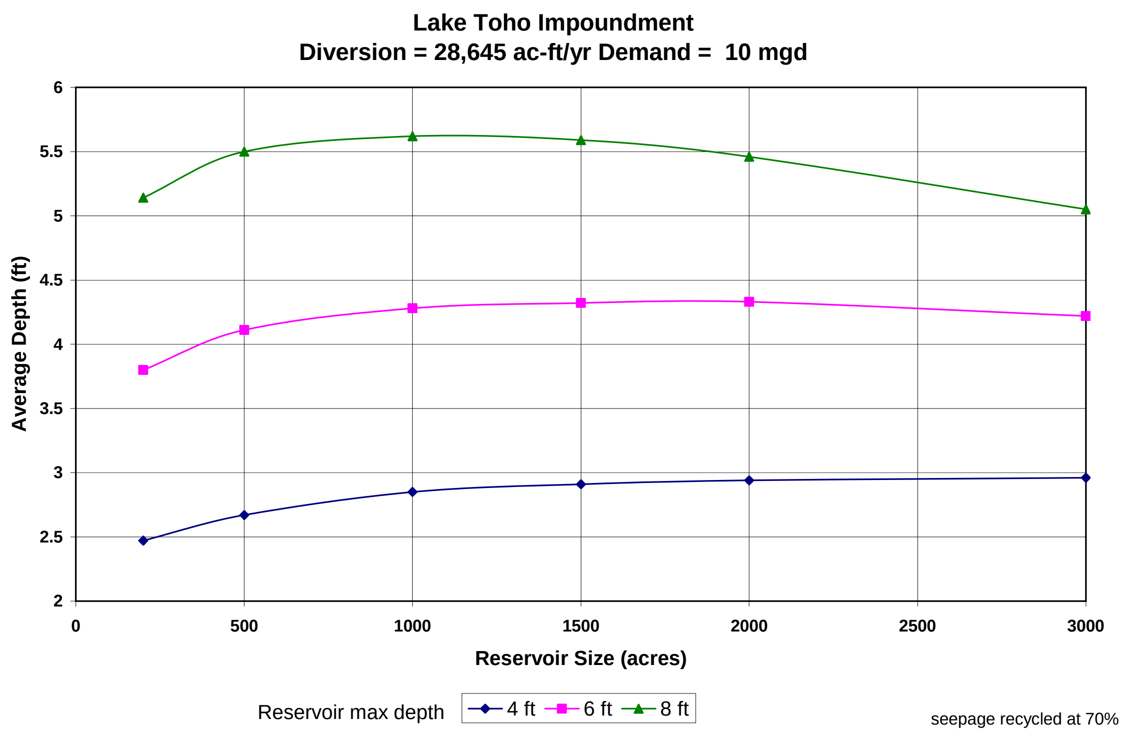

Figure 29. Lake Toho Impoundment Annual Average Water Levels for the 10-MGD Demand Level.

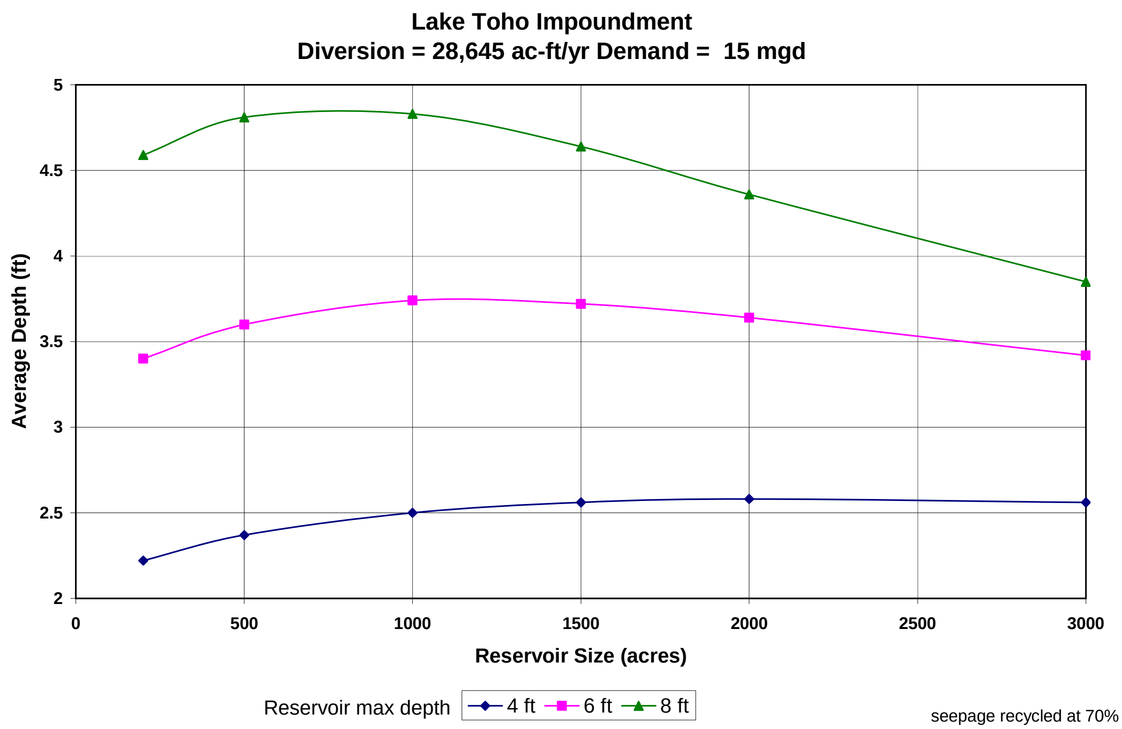

Figure 30. Lake Toho Impoundment Annual Average Water Levels for the 15-MGD Demand Level.

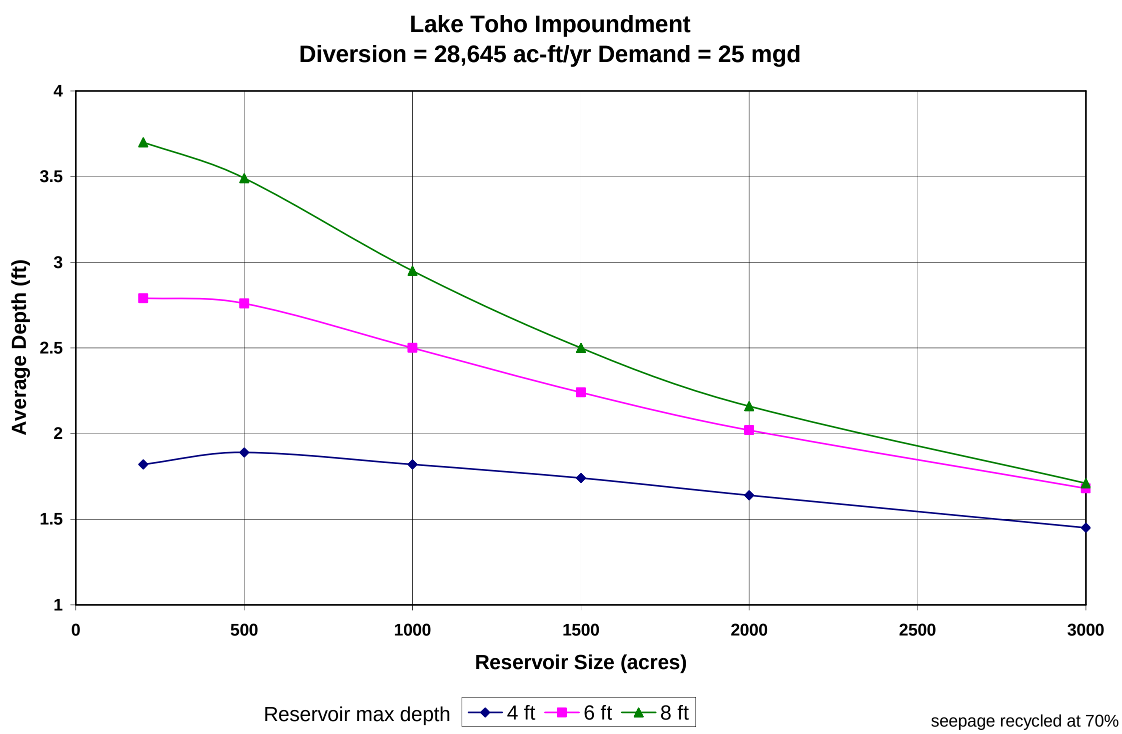

Figure 31. Lake Toho Impoundment Annual Average Water Levels for the 25-MGD Demand Level.

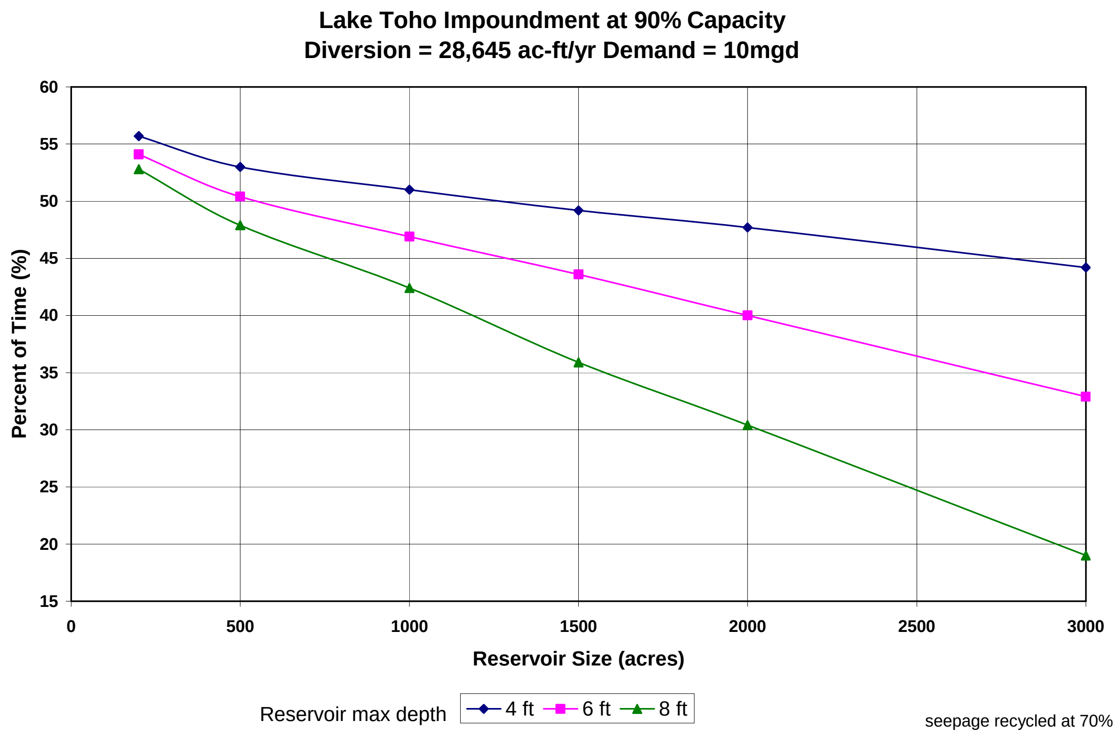

Figure 32. Percent of Time Impoundment at 90 Percent Capacity for the 10-MGD Demand Level.

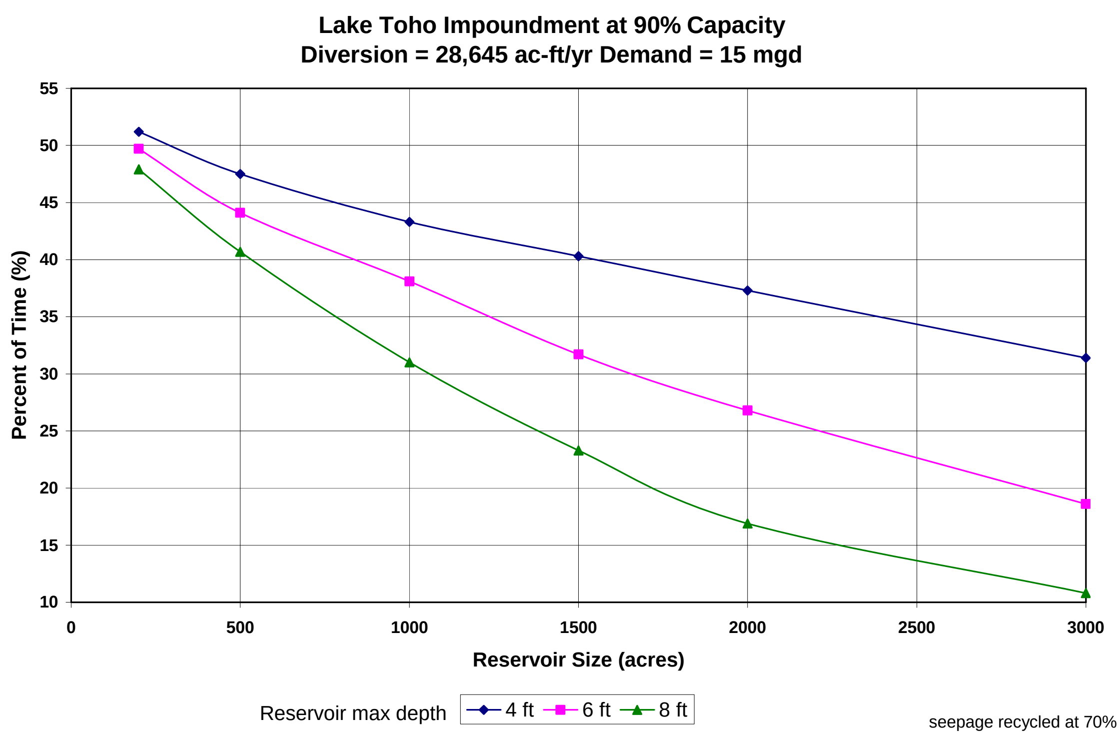

Figure 33. Percent of Time Impoundment at 90 Percent Capacity for the 15-MGD Demand Level.

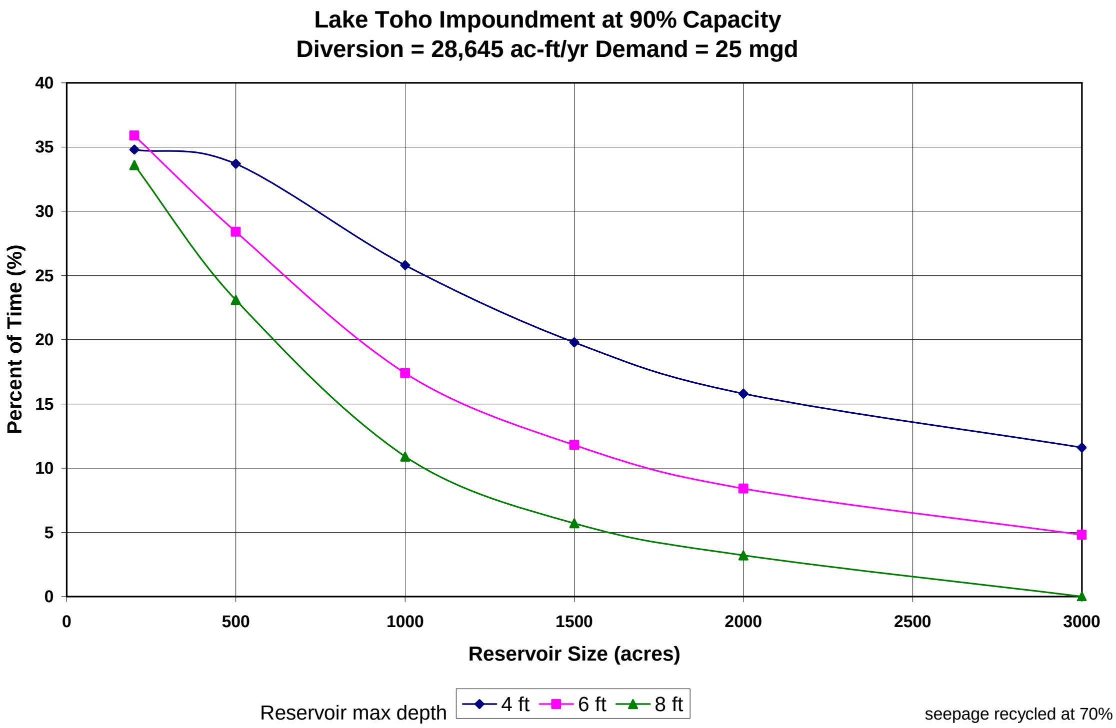

Figure 34. Percent of Time Impoundment at 90 Percent Capacity for the 25-MGD Demand Level.

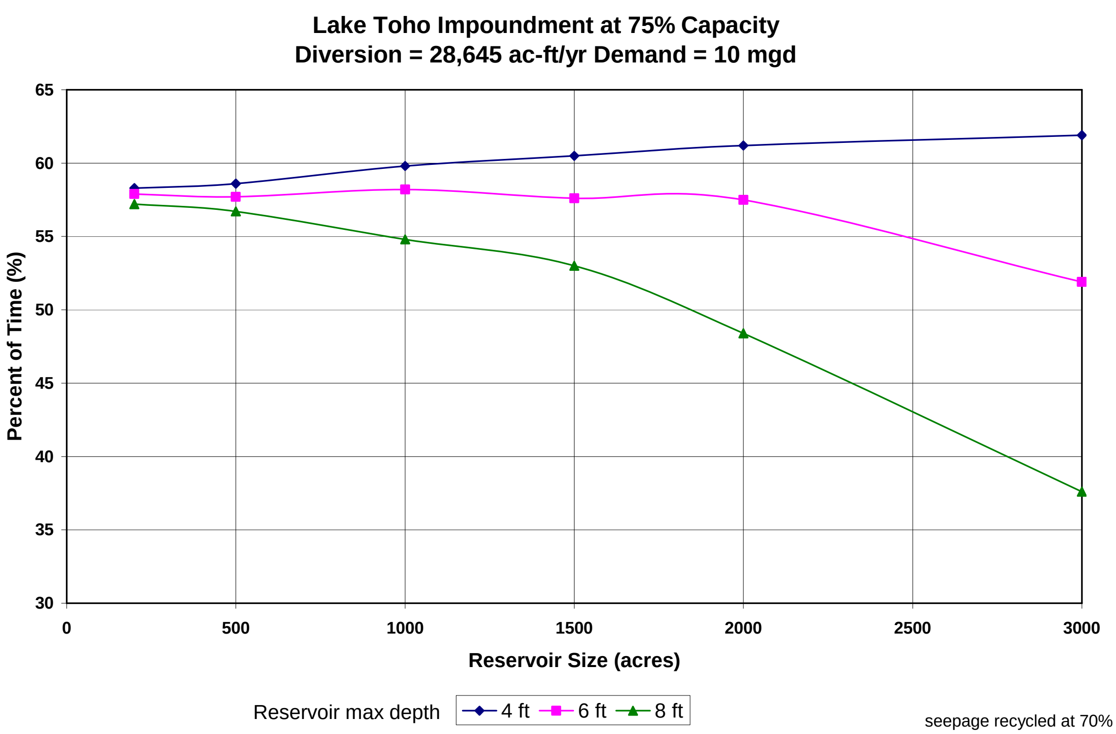

Figure 35. Percent of Time Impoundment at 75 Percent Capacity for the 10-MGD Demand Level.

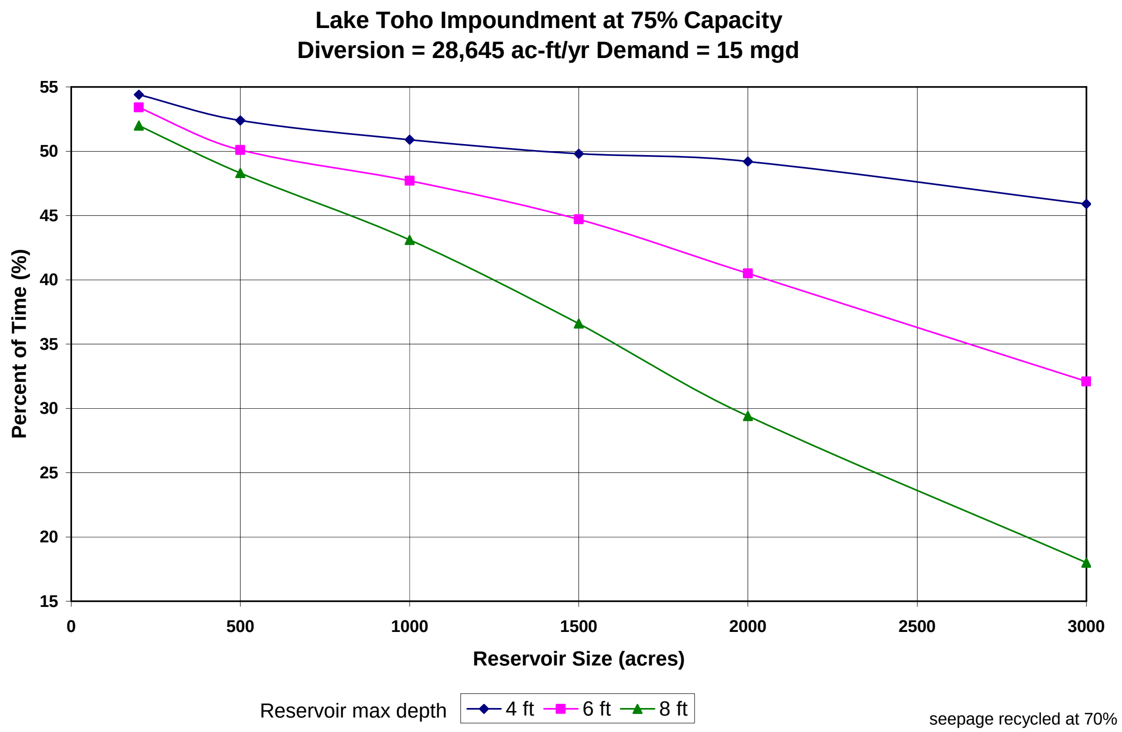

Figure 36. Percent of Time Impoundment at 75 Percent Capacity for the 15-MGD Demand Level.

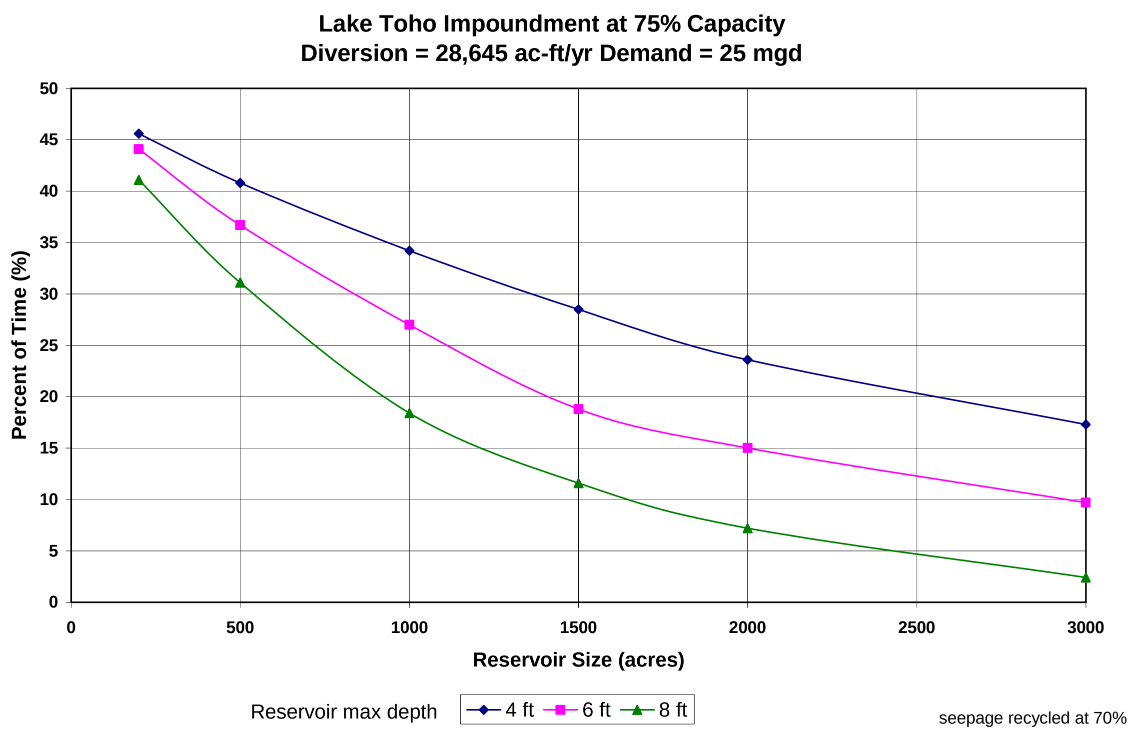

Figure 37. Percent of Time Impoundment at 75 Percent Capacity for the 25-MGD Demand Level.

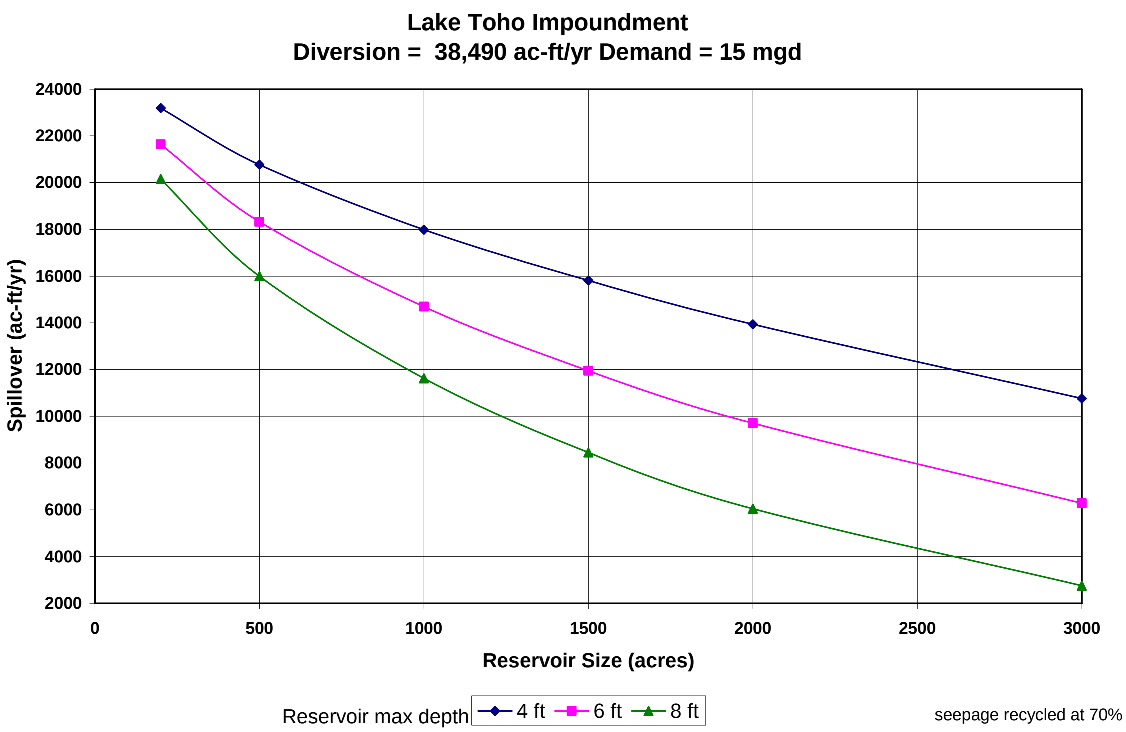

Figure 38. Lake Toho Impoundment Annual Average Spillover for the 15-MGD Demand Level.

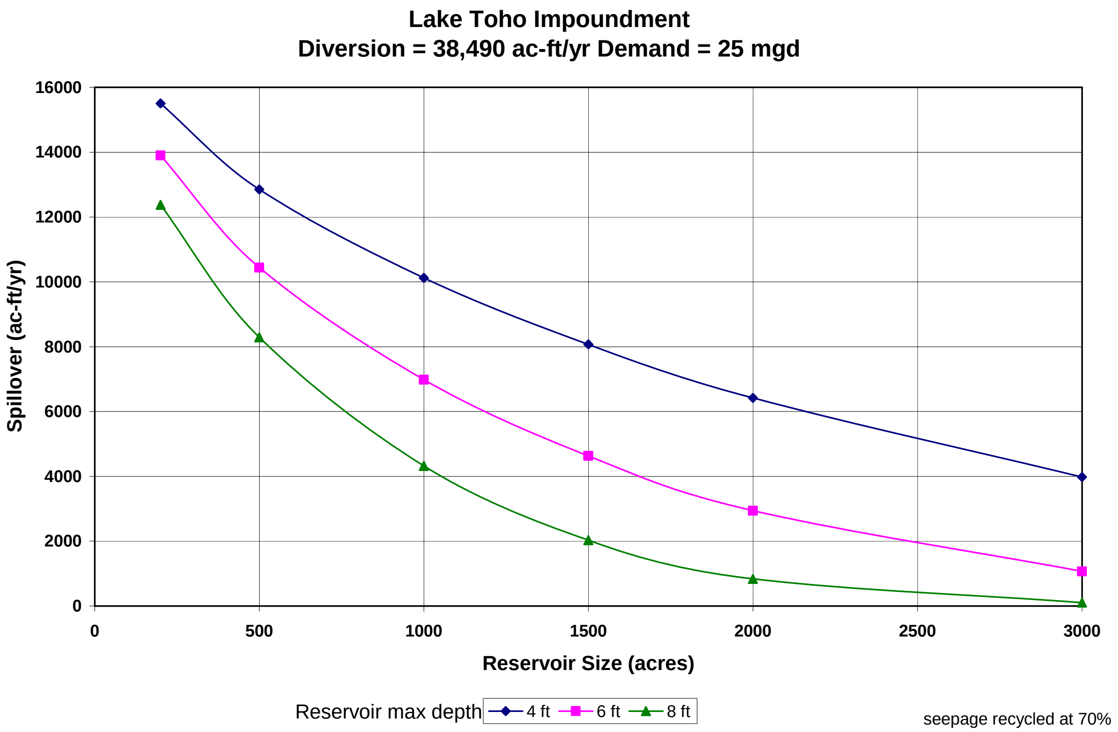

Figure 39. Lake Toho Impoundment Annual Average Spillover for the 25-MGD Demand Level.

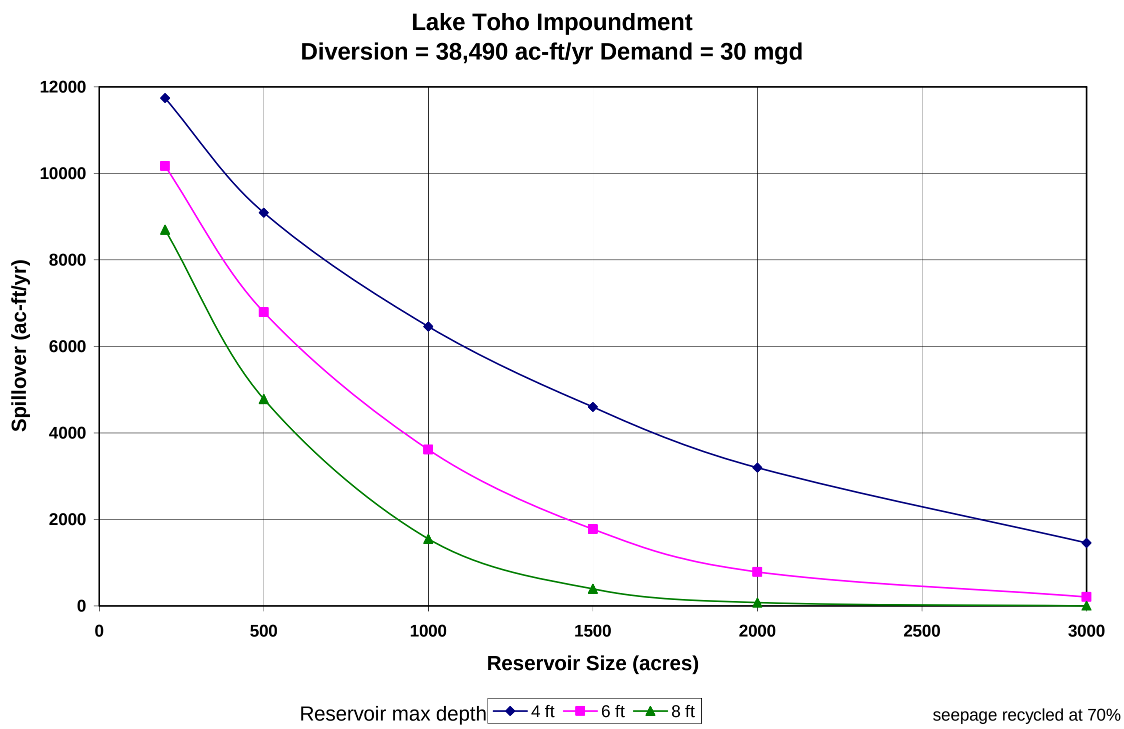

Figure 40. Lake Toho Impoundment Annual Average Spillover for the 30-MGD Demand Level.

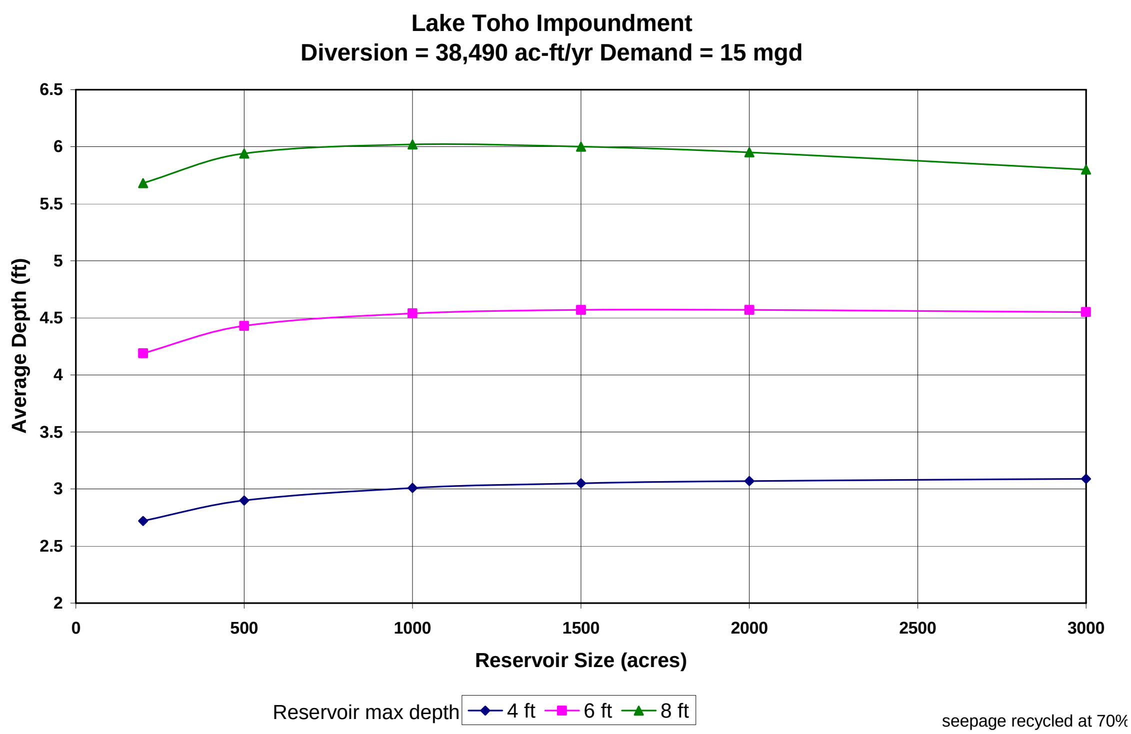

Figure 41. Lake Toho Impoundment Annual Average Water Levels for the 15-MGD Demand Level.

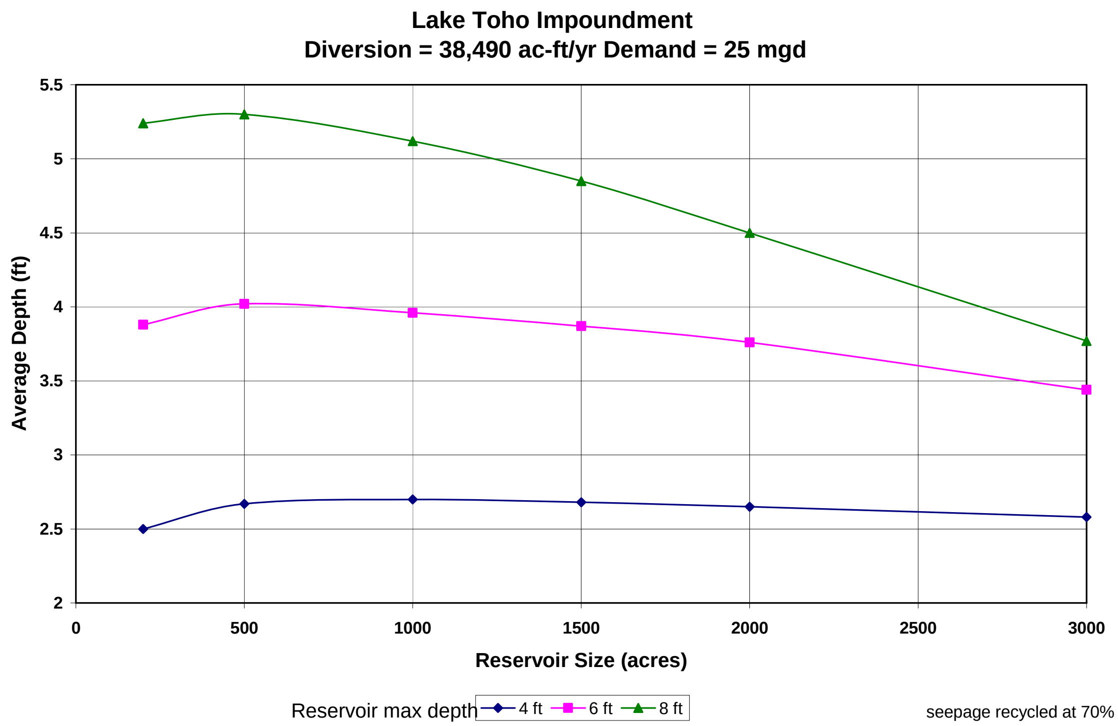

Figure 42. Lake Toho Impoundment Annual Average Water Levels for the 25-MGD Demand Level.

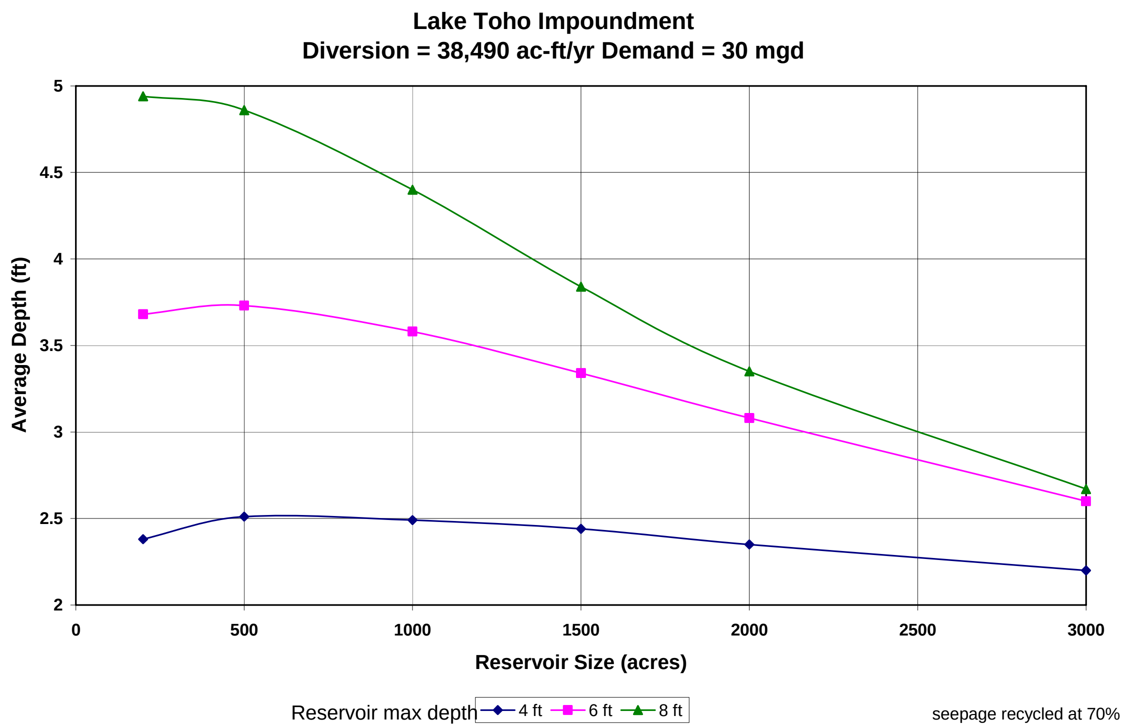

Figure 43. Lake Toho Impoundment Annual Average Water Levels for the 30-MGD Demand Level.

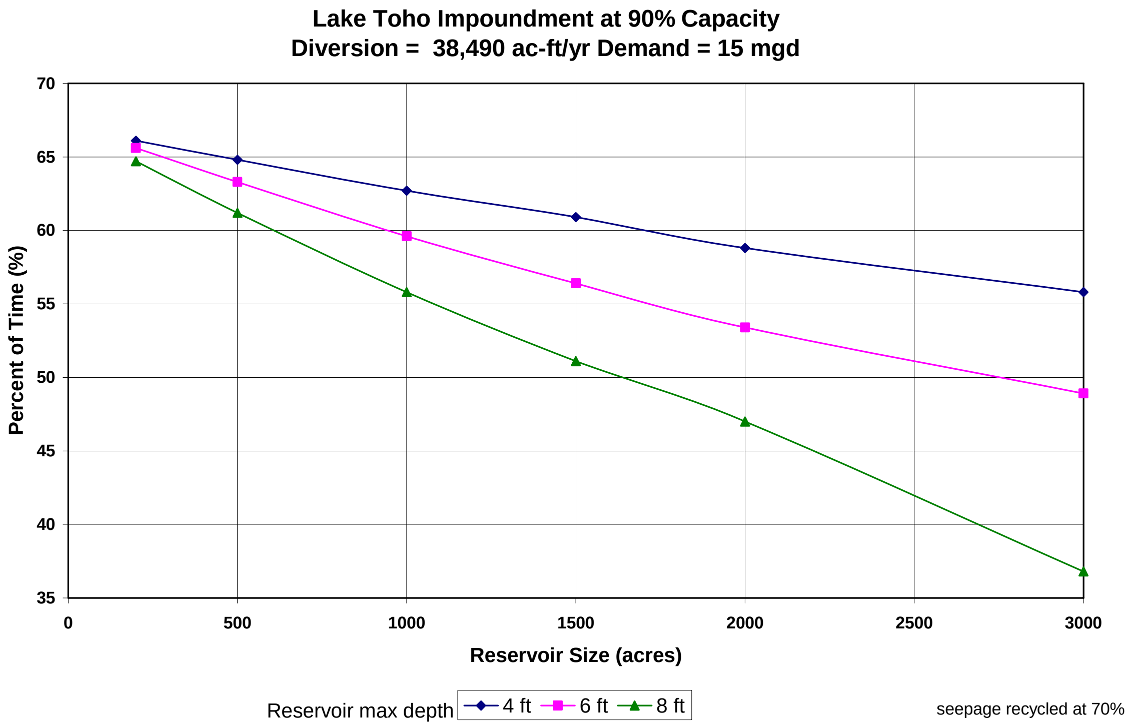

Figure 44. Percent of Time Impoundment at 90 Percent Capacity for the 15-MGD Demand Level.

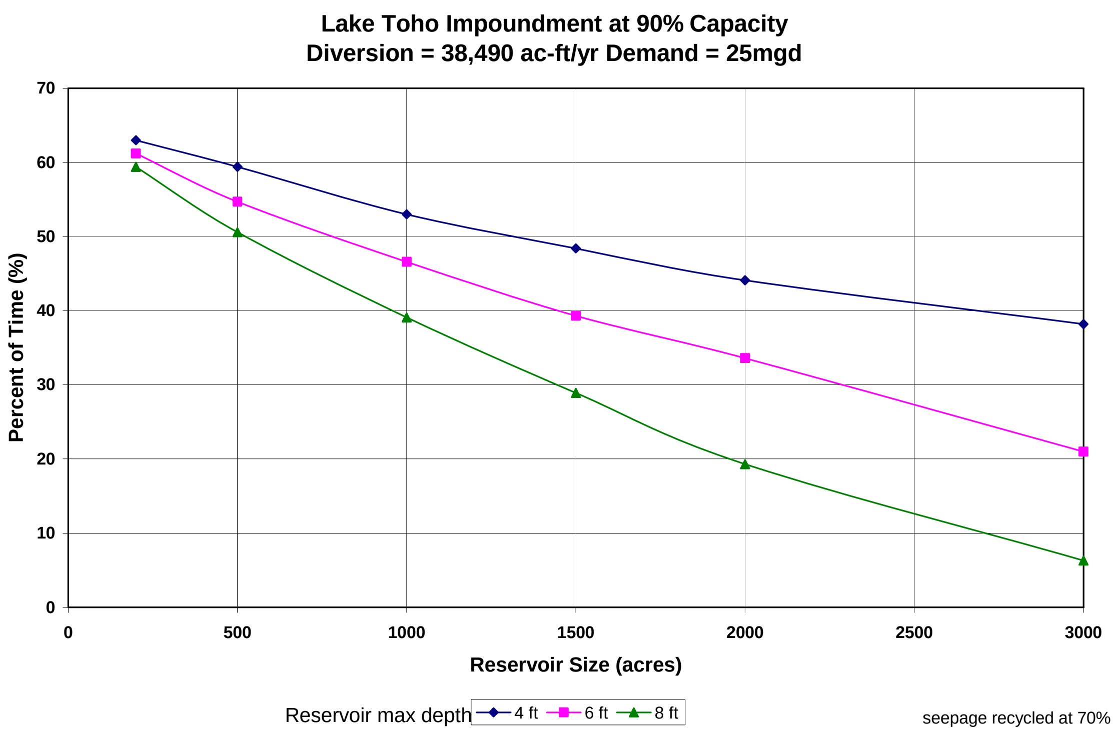

Figure 45. Percent of Time Impoundment at 90 Percent Capacity for the 25-MGD Demand Level.

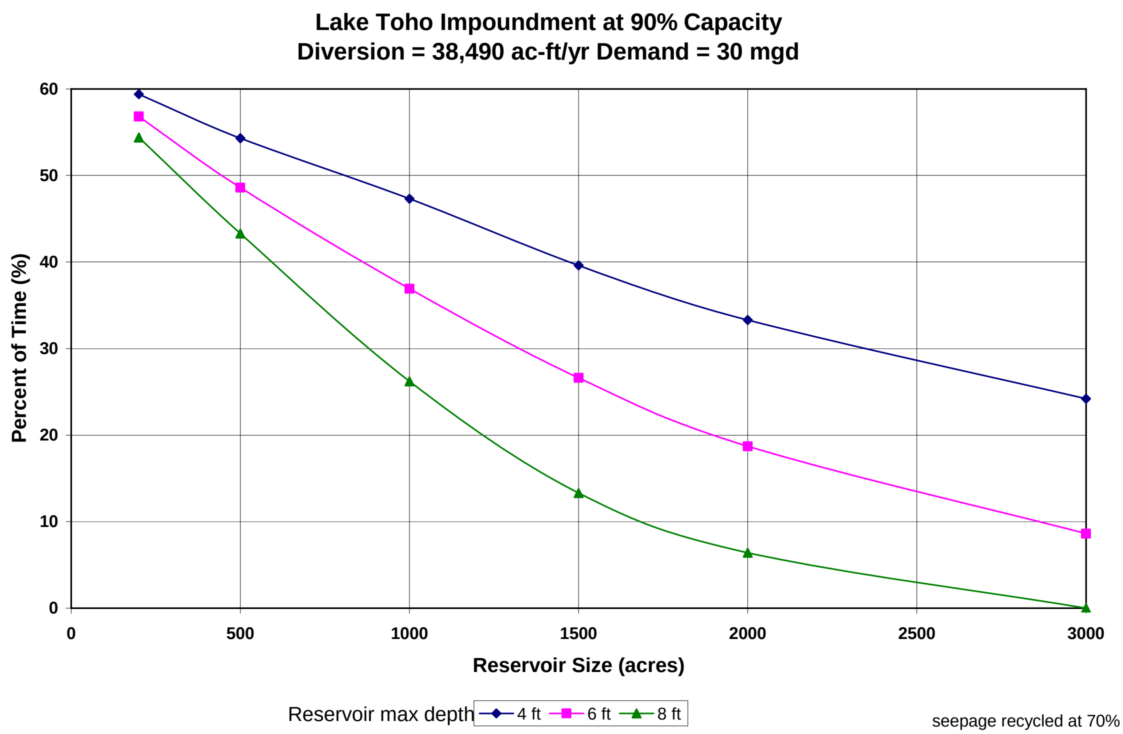

Figure 46. Percent of Time Impoundment at 90 Percent Capacity for the 30-MGD Demand Level.

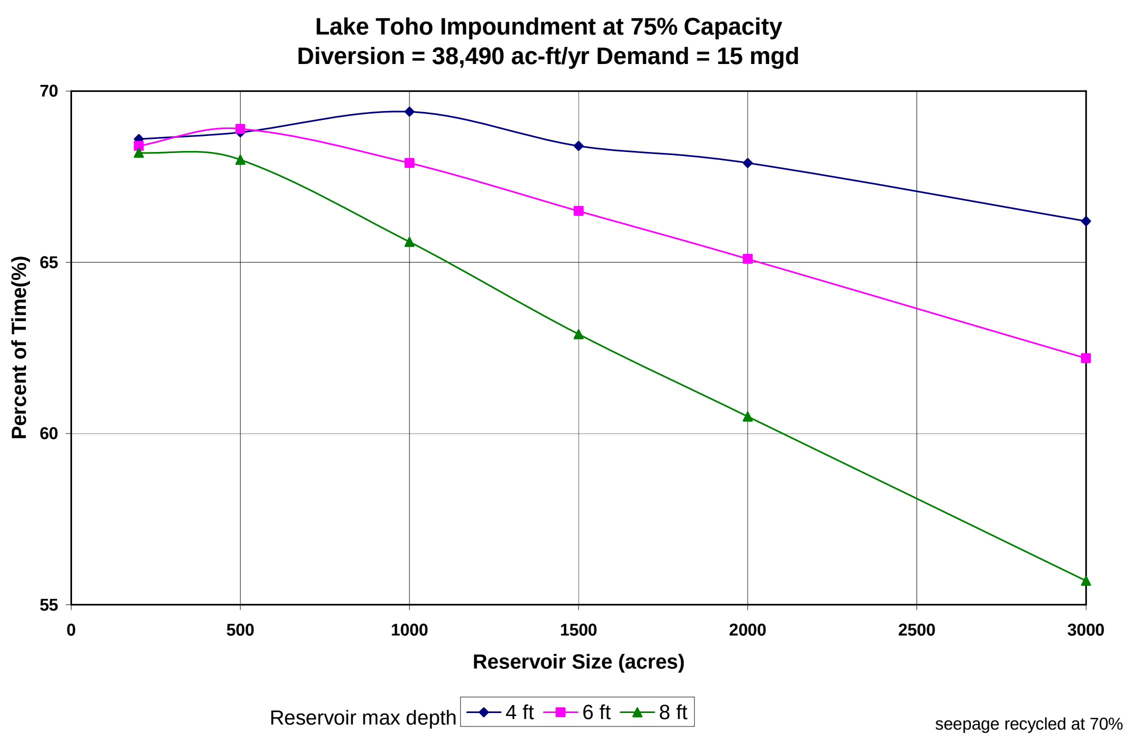

Figure 47. Percent of Time Impoundment at 75 Percent Capacity for the 15-MGD Demand Level.

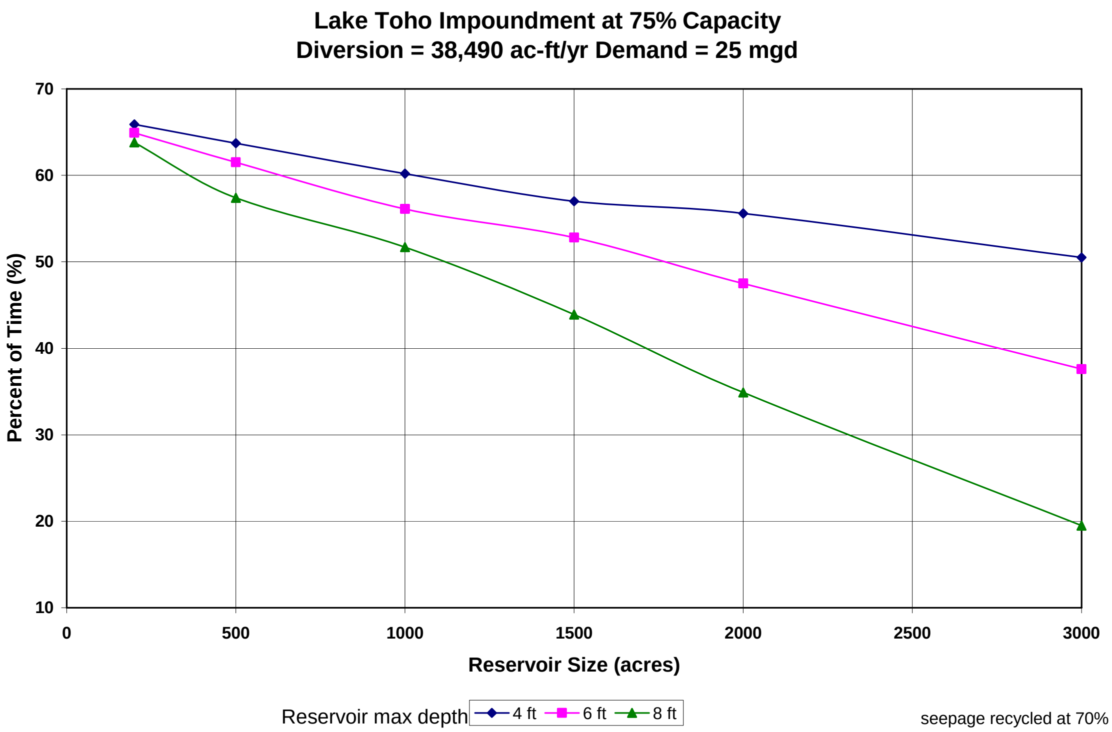

Figure 48. Percent of Time Impoundment at 75 Percent Capacity for the 25-MGD Demand Level.

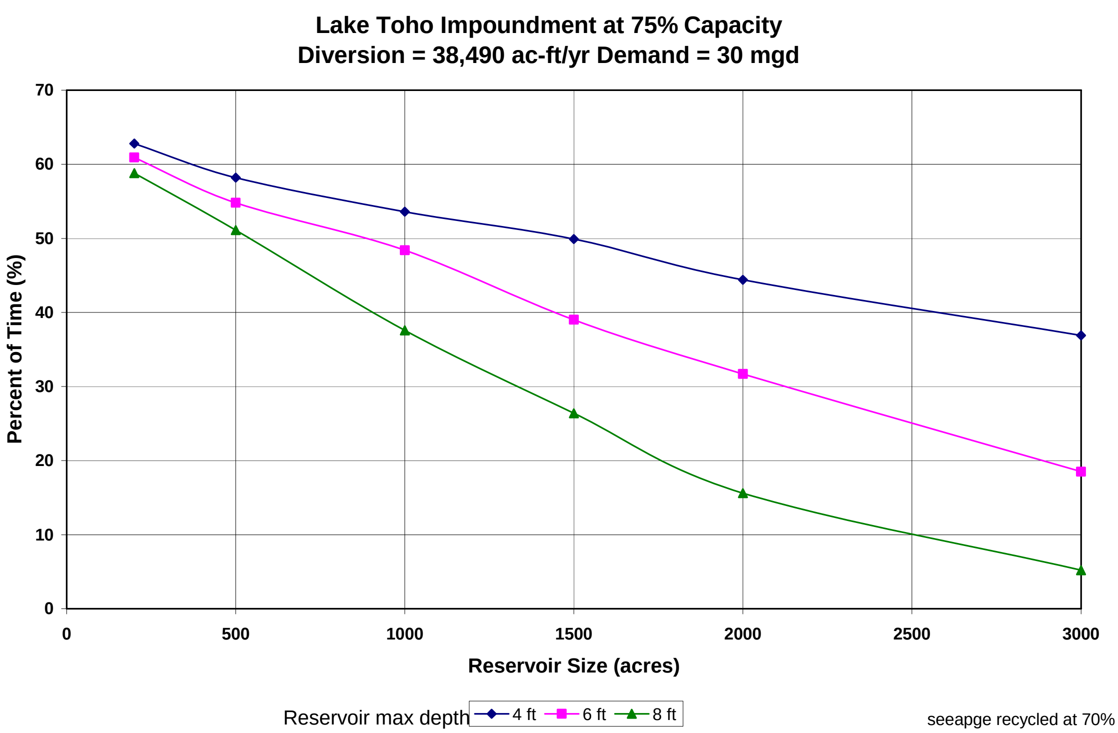

Figure 49. Percent of Time Impoundment at 75 Percent Capacity for the 30-MGD Demand Level.

TECHNICAL MEMORANDUM:

Alternative Water Supply Projects Cost Estimation – Potable Water Supply Using Brackish Water as Source from Upper Floridan Aquifer in Eastern Osceola County

This technical memorandum summarizes the conceptual design and provides planning level cost estimates for a potable water supply project using the Upper Floridan Aquifer (UFA) in eastern Osceola County as the source of raw water. To perform this cost estimate, a new saline water wellfield (within the Floridan Aquifer) was identified in eastern Osceola County, 25 miles from a local utility connection point. The water quality is of such saline and total dissolve solids (TDS) concentrations that a membrane treatment process is required for potable water delivery.

The following project components are included in the conceptual design:

- Wellfield site (land) for raw water production.
- Water treatment facilities, including raw water main and groundwater storage tank(s).
- Water delivery system, including a 25-mile pipeline and associated pumping facilities.
- Deep injection well for the disposal of concentrate.

The project conceptual design and associated cost estimates are provided for a range of water supply deliveries involving 10, 20 and 40 million gallons per day (MGD).

Well and Wellfield Design

Based on the preliminary water quality data, suggested well dimensions and yields are provided in **Table 9**.

Table 9. Proposed Well Dimensions and Well Yields.

Casing Diameter (inches)	Casing Depth (feet)	Total Depth (feet)	Well Yield (mgd)
20	600	1,000	2.0

Table 10 shows the required maximum raw water demand based on the recovery rate of 80 percent, and the number of primary and standby wells, for a range of water treatment plant capacities.

Table 10. Estimated Raw Water Demand and Number of Wells.

Water Treatment Plant Capacity (mgd)	Maximum Raw Water Demand (mgd)	Number of Wells (primary + standby)
10	12.5	7 + 1
20	25.0	13 + 1
40	50.0	25 + 2

Each well would be equipped with a submersible pump and aboveground equipment, including flow control elements. For cost estimation purposes, a spacing of 1,000 feet between the wells is assumed.

Water Treatment Plant Technology

Preliminary water quality data (chlorides 375–500 mg/L, TDS 900-1,100 mg/L) indicate that a water treatment technology using a nanofiltration membrane that rejects 85 percent of salt (sodium chloride) and 99 percent of total hardness, or an ultralow pressure (ULP) reverse osmosis (RO) membrane could be adequate to provide the necessary level of treatment. A thin film composite (TFC) ULP RO membrane (model TFC 18061 ULP MegaMagnum, Koch Membrane Systems Inc.) was selected for a planning level cost estimate analysis.

Typical operating pressure for a TFC ULP membrane is within the 75–175 pounds per square inch (psi) range. It provides a minimum chloride ion rejection rate of 97.5 percent. Each membrane element is 61 inches in length and 18 inches in diameter, providing a membrane area of 2,800 square feet. This is seven times the area of a typical 40-inch by 8-inch membrane element, and allows for up to 40 percent reduction in the membrane trains housing floor space, and significant savings on the civil engineering side of a project. Reduction in the construction time and costs, as well as operation and maintenance costs, should be expected. The planning level costs are based on the preliminary design report for the Lake Region Water Treatment Plant (CDM 2004), adjusted for the use of larger membrane elements and reduction in the process building floor space. The cost for the membrane element was obtained from the Koch Membrane Systems sale manager for the southeast region in Orlando, Florida, and is in the $3,000–$3,200 range. A set of 30 elements is capable of producing 1.00 MGD of permeate.

Water Delivery System Hydraulic Design

A hydraulic analysis for a 25-mile pipeline delivery system is provided to estimate the required pipe diameter and corresponding head losses for three water treatment plant capacities. The number of booster pumps to overcome the head loss within the pipeline system is also provided. The analysis does not include any hydraulic modeling of the water distribution system to the end user.

Therefore, the costs associated with the water distribution system to the end user, including the costs of high pressure service pumps, are not part of this analysis.

A Hazen-Williams equation was used to estimate the pipe flow velocity and head losses. The Hazen-Williams discharge coefficient, C, is assumed to be 150, corresponding to the high density polyethylene (HDPE) pipe material. In addition to being more cost-efficient as compared with a more traditional ductile iron material, HDPE pipe is also non-corrosive and significantly lighter. The HDPE pipe can be assembled in long sections on the ground, which shortens the construction time and time the trench stays open. **Table 11** details the flow, length of pipe, pipe diameter and resulting velocity and head loss for each water treatment plant capacity.

Table 11. Delivery System Hydraulic Analysis.

Plant Capacity (mgd)	Flow (cfs)	HDPE Pipe Diameter (inches)	Length (feet)	Velocity (fps)	Head Loss (feet)
10	15.5	24	132,000	4.98	320
10	15.5	30	132,000	3.17	108
20	30.9	36	132,000	4.39	160
40	61.9	48	132,000	4.93	142

For the 10-MGD plant capacity, the 24-inch diameter HDPE pipe is selected. Although this scenario requires a four-stage delivery system with a booster pump station installed every 6.25 miles (25 miles divided by four) to overcome a 320-foot head loss, the cost of a 24-inch pipe installation is significantly lower than that of a 30-inch pipe system, which would require only a two-stage delivery system. **Table 12** provides unit costs for material and labor from the *CostWorks 2004 Cost Estimation Manual* (CostWorks 2004). Based on the figures in **Table 12**, the cost estimate for the 24-inch pipe diameter option is approximately $4.0 million less than the cost for the 30-inch diameter option.

Table 12. Unit Costs for Water Delivery System.

Description	Qty	Unit	Mat.	Labor	Equip.	Unit Cost
Excavation and compaction for concrete base, pumps	1.0	Ea.	0.0	860.0	540.0	1,400.0
Pure reinforce concrete base slab for pumps 6'x6'x1.5'	36.0	SF	42.0	26.0	16.0	3,024.0
8 cfs, 3600 GPM, horizontal water pump at 60 ft head	1.0	Ea.	35,000.0	8,500.0	2,100.0	45,600.0
8 cfs, 3600 GPM, horizontal water pump at 80 ft head	1.0	Ea.	38,000.0	8,600.0	2,300.0	48,900.0
16 cfs, 7200 GPM, horizontal water pump at 100 ft head	1.0	Ea.	52,000.0	9,600.0	3,200.0	64,800.0
21 cfs, 9425 GPM, horizontal water pump at 80 ft head	1.0	Ea.	65,000.0	12,000.0	3,800.0	80,800.0
Electrical works	1.0	Ea.	935.0	1,030.0	280.0	2,245.0
High density polyethylene pipe of 24" diameter	1.0	Ea.	58.0	20.0	32.0	110.0
High density polyethylene pipe of 30" diameter	1.0	LF	84.0	24.0	35.0	143.0
High density polyethylene pipe of 36" diameter	1.0	LF	120.0	36.0	50.0	206.0
High density polyethylene pipe of 48" diameter	1.0	LF	145.0	42.0	65.0	252.0

SF = square foot; LF = linear foot. Mobilization & demobilization @ 6% of subtotal cost; markup @ 20% of subtotal cost.

For each plant capacity, the following total number of pumps (including standby pumps) is selected:

- For a 10-MGD plant, 12 pumps at 3,600 GPM and 80 foot head each (two online/one standby times four stages).
- For a 20-MGD plant, six pumps at 7,200 GPM and 100 foot head each (two online/one standby times two stages).
- For a 40-MGD plant, eight pumps at 9,425 GPM and 80 foot head each (three online/one standby times two stages).

Concentrate Disposal

The concentrate (brine) would be disposed of using a deep well injection to be located at the water treatment plant site. A second monitoring well will also be required. In the case of potential well problems, sufficient on-site space and construction of a temporary lined storage pond for the concentrate should be planned.

Although the cost for the deep well injection concentrate disposal is included in calculations of planning level costs, the presence of a nearby wastewater/reclaimed water treatment facility could provide for the concentrate disposal without the need for a deep well injection system.

Planning Level Cost Estimates

Table 13 summarizes planning level costs for the alternative, including the wellfield costs. The wellfield costs include cost for the wastewater treatment facilities (WTFs), which is comprised of cost for the raw water main, pretreatment of raw water, post treatment of permeate, a membrane treatment system, a ground storage tank, chemical systems and storage. The wellfield costs also include cost for the site work, which consists of cost for the finished water delivery system, and cost for the concentrate disposal system. All component cost data include installation, construction and project implementation costs, including engineering design, permitting and administration costs. In addition, the cost data derived from the CostsWorks manual include a 20-percent markup to account for HDPE pipe cost fluctuations due to increasing petroleum prices. Land costs include the cost of easement for the pipeline corridor and land for the water treatment plant.

Equivalent Annual Cost is a total annual life cycle cost of a project based on the economic service life of different project components and time value of money criteria. The Equivalent Annual Cost accounts for total capital cost and operations and maintenance costs, with the facility operating at average day design capacity. Economic service life varies from five years for reverse osmosis membranes to 40 years for water conveyance structures, such as pipelines and collection and distribution systems. An interest rate of 5.625 percent is used in all economic calculations.

Table 13. Planning Level Cost Estimates for Wellfield, WTF and Pipeline System from Western Osceola County.

System Component	10-MGD WTF Capacity	20-MGD WTF Capacity	40-MGD WTF Capacity
Production Wells	$4,800,000	$8,400,000	$16,200,000
WTFs, including:	$12,950,000	$22,350,000	$36,850,000
a. Process building	$1,192,400	$2,057,900	$3,393,000
b. Pre- and Post-treatment systems	$3,800,150	$6,558,500	$10,813,400
c. Membrane treatment system	$2,547,250	$4,396,200	$7,248,400
d. Ground storage tank	$1,480,400	$2,554,600	$4,212,000
e. Chemical systems and storage	$581,400	$1,003,500	$1,654,500
f. Site work	$3,348,600	$5,779,300	$9,525,700
Raw Water Main (10% of WTFs)	$1,295,000	$2,235,000	$3,685,000
Water Delivery System	$19,100,000	$34,785,000	$42,772,000
Concentrate Disposal	$4,200,000	$4,400,000	$4,600,000
Subtotal cost, including 25% project implementation cost	$42,345,000	$72,170,000	$104,107,000
Land Cost, including Land Acquisition Cost of 18%	$7,059,200	$8,277,400	$9,545,600
Contingency @ 20%	$6,351,800	$10,825,500	$15,616,100
Total Project Cost	$55,756,000	$91,272,900	$129,268,700
Annual O&M @ 3% of Construction Cost	$1,270,350	$2,165,100	$3,123,200
Equivalent Annual Cost	$5,732,177	$9,526,290	$13,841,115
Unit Production Cost, $1,000/gal	$1.57	$1.30	$0.95

References Cited

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Conlon, B. and R. Regalado. 2001. *Project Cost Estimate, Peer Review of Microfiltration Supplemental Technology Demonstration Project*. Prepared by PB Water in association with Milian, Swain & Associates for SFWMD, West Palm Beach, FL.

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Rainfall Analysis

RAINFALL ANALYSIS OVERVIEW

An understanding of climatic conditions is an essential part of predicting the availability of certain water resources. A goal of the Kissimmee Basin Water Supply Plan (KB Plan) is to identify areas of potential water supply shortfalls and sufficient supply sources to meet the 1-in-10 year demand needs occurring over a 20-year planning horizon. Rainfall is responsible for nearly all surface water inflows and outflows in the KB Planning Area, and is an important source of recharge to the Surficial Aquifer System and Floridan Aquifer System. Rainfall is the single most important factor in the occurrence of water shortages in the planning region.

RAINFALL DISTRIBUTION

Rainfall varies from county to county within the KB Planning Area. Eleven rainfall stations distributed throughout the planning area were used to assess mean rainfall conditions (**Figure 1**). The District chose these stations as they have a minimum of 30 years of reliable records. **Table 1** presents a summary of the data, and lists the period of record for each station along with the database keys (DBKEYs) used to retrieve the data from the District's DBHYDRO database. Abtew and Ali (1999) performed the most recent Districtwide analysis of rainfall distribution.

The mean annual rainfall for the KB Planning Area is 49.7 inches. **Figure 2** presents the mean monthly distribution of rainfall at the rainfall stations and **Table 2** lists the average monthly rainfall values. The wet period begins on June 1 and ends on October 31, with the heaviest rainfall usually occurring from June through August. The dry period begins on November 1 and ends on May 31. December is usually the month with the lowest rainfall.

RAINFALL DATA PREPARATION

Table 3 through **Table 13** present the monthly rainfall for each rainfall station during the entire period of record. **Figure 3** shows the statistical 1-in-10 year drought event plots for the rainfall stations in the Kissimmee Basin Planning Area and **Table 14** lists the values for 1-in-10 year drought events. In some instances, not every daily value was available for each station location. In these occurrences, the inverse distance squared method was used to fill in daily missing values in each data set before calculating monthly averages.

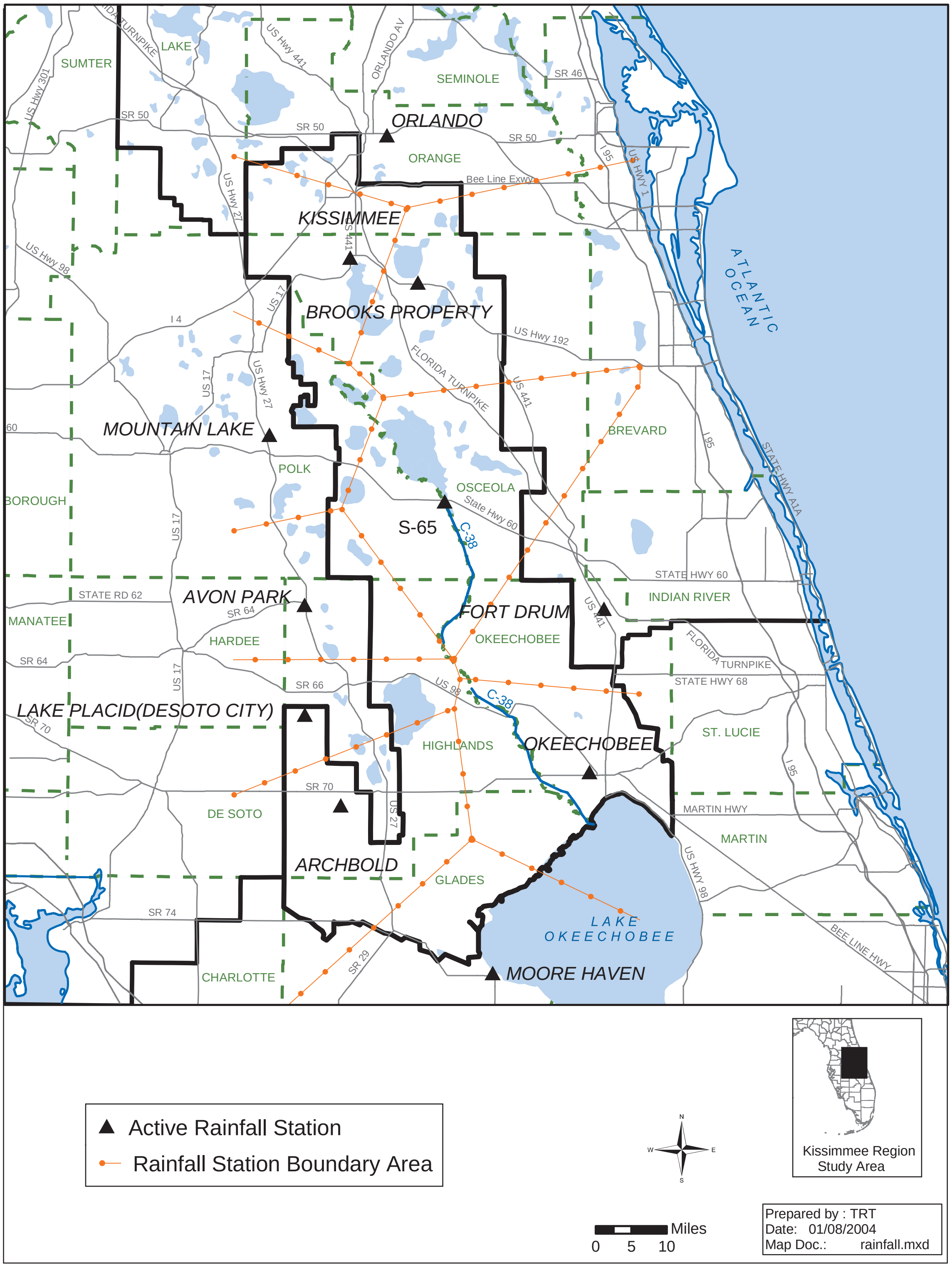

Figure 1. Rainfall Stations in the KB Planning Area.

Table 1. Average Rainfall Data for Rainfall Stations in the KB Planning Area.

County	Rainfall Station	Average Annual Rainfall	Period of Record[a]		Maximum Monthly Rainfall		Minimum Monthly Rainfall		% Rain Falling in Wet Season	Primary DBKEY[b]
			# of Years	Years	inches	month	inches	month		
Glades	Moore Haven	47.59	36	1965-2000	7.77	Jun	1.60	Dec	65%	PT322, PT323
Highlands	Archbold	50.99	36	1965-2000	8.20	Jun	1.87	Dec	64%	PT143, PT144
	Avon Park	50.91	36	1965-2000	8.17	Jun	1.89	Dec	64%	PT145-PT148
	Desoto City (Lake Placid)	48.52	36	1965-2000	8.35	Jun	1.59	Dec	64%	PT199, PT200
Okeechobee	Fort Drum	54.95	36	1965-2000	8.31	Jun	1.90	Dec	63%	PT218, PT219
	Okeechobee	48.03	36	1965-2000	6.92	Jun	1.71	Dec	62%	PT347-PT350, 06020
Orange	Orlando	49.32	36	1965-2000	7.45	Jul	2.22	Nov	61%	PT351, PT352
Osceola	Kissimmee	48.25	36	1965-2000	7.03	Aug	1.95	Apr	62%	PT283, PT284
	Brooks Property	49.11	33	1963-1995	7.25	Jul	1.87	Apr	61%	05813
	S-65	50.94	36	1965-2000	7.62	Jul	1.95	Dec	62%	05940
Polk	Mountain Lake	48.48	36	1965-2000	7.72	Jun	1.89	Apr	63%	PT326
Overall Average		49.73			7.71		1.86		63%	

a. Period of Record.
b. For those interested in accessing DBHYDRO. Missing daily data replaced by weighted averages of neighboring stations.

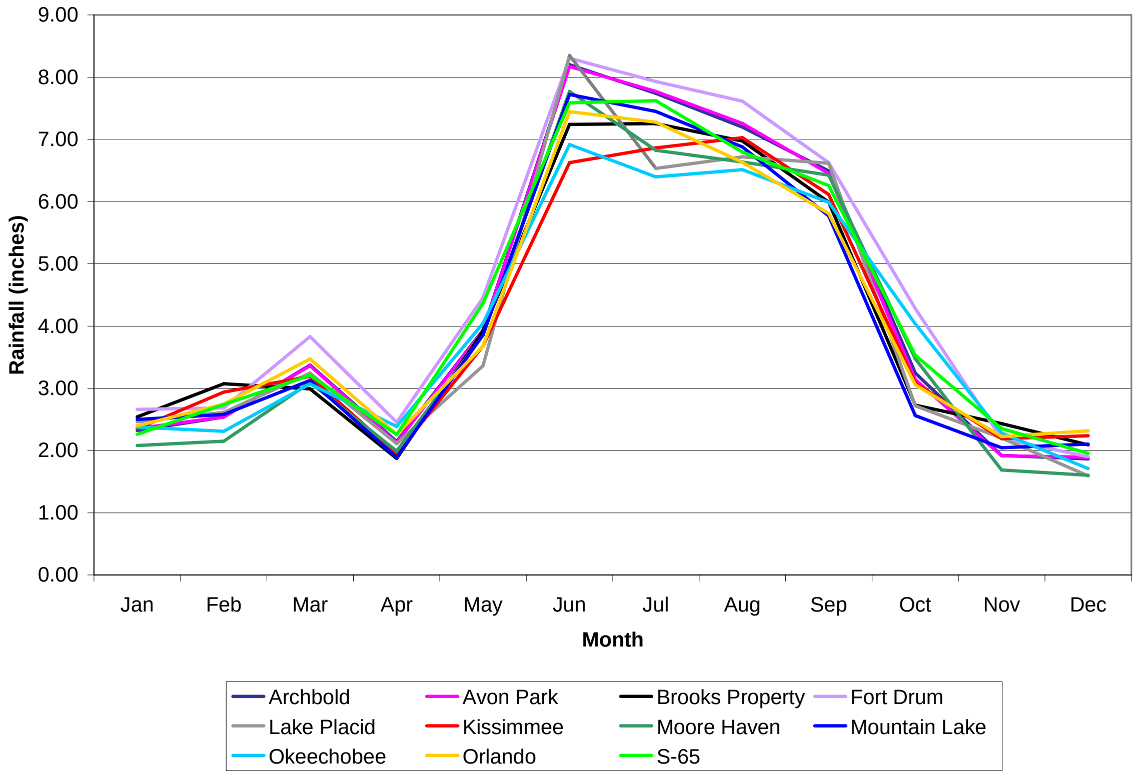

Figure 2. Mean Monthly Distribution of Rainfall at Stations in the KB Planning Area.

Table 2. Average Rainfall (in inches) for Rainfall Stations in the KB Planning Area.

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Archbold	2.32	2.54	3.37	2.14	3.94	8.20	7.74	7.20	6.49	3.25	1.92	1.87	50.99
Avon Park	2.35	2.54	3.37	2.13	3.92	8.17	7.77	7.26	6.45	3.14	1.92	1.89	50.91
Brooks Property	2.54	3.07	2.99	1.87	3.91	7.24	7.25	6.98	5.99	2.73	2.43	2.09	49.11
Fort Drum	2.66	2.69	3.83	2.45	4.45	8.31	7.93	7.61	6.63	4.28	2.19	1.90	54.95
Lake Placid	2.46	2.61	3.24	2.11	3.36	8.35	6.53	6.72	6.62	2.72	2.20	1.59	48.52
Kissimmee	2.35	2.94	3.19	1.95	3.68	6.63	6.86	7.03	6.12	3.08	2.19	2.24	48.25
Moore Haven	2.08	2.15	3.09	1.99	3.85	7.77	6.82	6.64	6.43	3.47	1.68	1.60	47.59
Mountain Lake	2.50	2.58	3.12	1.89	3.86	7.72	7.45	6.88	5.77	2.56	2.04	2.10	48.48
Okeechobee	2.38	2.31	3.07	2.39	4.04	6.92	6.40	6.51	5.99	4.04	2.28	1.71	48.03
Orlando	2.40	2.75	3.47	2.26	3.68	7.45	7.28	6.63	5.81	3.06	2.22	2.32	49.32
S-65	2.26	2.74	3.21	2.26	4.36	7.59	7.62	6.80	6.26	3.53	2.35	1.95	50.94
Average	2.39	2.63	3.27	2.13	3.91	7.67	7.24	6.93	6.23	3.26	2.13	1.93	49.73

Table 3. Monthly and Mean Rainfall (inches) at Archbold Rainfall Station.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
1965	1.08	4.38	4.26	1.77	0.54	7.74	9.55	5.45	5.54	4.83	1.10	2.05	48.30
1966	5.32	5.05	1.47	2.66	4.83	9.94	6.78	7.10	6.88	3.25	0.47	1.09	54.84
1967	0.93	3.44	0.77	0.09	0.93	9.00	9.28	8.14	5.24	2.20	0.35	2.12	42.48
1968	0.59	2.09	1.08	0.65	6.50	15.47	8.38	5.49	5.45	4.97	2.52	0.38	53.56
1969	1.26	1.56	7.43	1.79	4.19	12.21	6.09	5.99	9.65	8.40	2.69	2.83	64.09
1970	4.78	3.57	8.85	0.19	4.97	8.62	8.94	4.24	4.93	3.16	0.12	0.31	52.68
1971	0.57	1.80	1.06	0.08	2.42	7.89	5.79	9.06	7.22	3.20	1.28	1.08	41.45
1972	0.25	2.99	0.78	5.90	2.25	10.53	3.90	5.35	4.27	3.35	3.52	1.97	45.06
1973	5.11	2.86	2.93	4.90	4.41	5.47	8.27	6.43	9.97	3.47	0.29	2.39	56.50
1974	0.33	1.09	0.05	1.41	5.39	14.12	16.89	10.23	4.87	0.56	0.53	2.93	58.40
1975	0.13	0.49	1.04	1.81	6.97	8.63	8.76	5.84	5.55	3.07	0.13	0.60	43.02
1976	0.08	0.76	2.45	1.88	4.98	9.75	6.50	7.65	6.61	3.42	1.75	1.19	47.02
1977	1.91	0.53	1.02	0.69	6.53	6.60	4.68	9.17	9.87	3.29	4.17	4.90	53.36
1978	1.81	2.38	3.16	0.43	7.00	9.04	10.00	7.71	4.24	3.63	1.76	4.16	55.32
1979	7.91	1.09	2.21	1.37	4.81	1.70	10.58	12.76	14.15	0.96	0.90	2.45	60.89
1980	3.72	1.65	1.47	3.90	3.90	2.40	6.64	4.71	4.05	0.40	3.21	1.34	37.39
1981	0.36	3.46	1.24	0.16	2.82	10.38	7.50	10.54	6.02	0.98	1.35	0.22	45.03
1982	1.16	2.06	6.52	4.15	6.96	11.14	7.79	5.97	10.65	2.59	1.57	0.51	61.07
1983	4.41	10.85	4.83	2.63	1.01	5.44	7.31	6.74	2.37	5.18	1.84	2.45	55.06
1984	0.45	2.93	6.42	2.75	5.09	7.39	13.09	2.71	3.70	0.13	3.13	0.61	48.40
1985	0.40	0.76	2.29	3.47	2.77	7.20	7.10	4.93	6.46	4.37	2.62	1.60	43.97
1986	1.33	0.78	6.03	0.21	1.56	15.85	7.75	8.14	5.06	4.05	0.08	3.35	54.19
1987	3.10	1.14	6.61	0.52	2.44	3.27	4.52	3.50	9.92	6.63	5.94	1.23	48.82
1988	2.39	2.37	6.21	1.47	2.90	3.01	9.29	10.20	2.41	1.81	3.80	1.73	47.59
1989	2.03	0.33	4.11	2.98	2.21	4.79	7.60	7.80	8.10	4.35	0.97	2.54	47.81
1990	2.21	3.27	1.79	1.34	1.72	9.20	10.89	9.40	3.88	0.53	0.45	1.01	45.69
1991	5.17	1.48	4.61	2.03	5.87	7.37	8.66	7.39	4.70	2.98	0.86	0.88	52.00
1992	0.36	4.73	2.26	4.91	3.84	15.77	4.67	12.12	6.71	1.91	4.37	0.58	62.23
1993	5.12	3.07	5.74	2.78	1.33	4.96	11.03	4.28	4.63	6.95	0.82	1.32	52.03
1994	3.82	1.84	3.49	2.00	4.30	11.35	3.64	9.03	8.31	2.57	4.16	3.83	58.34
1995	2.89	2.99	4.72	3.27	2.05	8.35	7.56	8.15	6.92	7.15	1.20	0.68	55.93
1996	2.42	1.71	4.76	1.16	7.61	8.32	5.57	6.03	0.70	3.72	0.20	1.64	43.84
1997	1.19	3.02	1.67	5.47	4.98	6.76	6.29	4.40	9.16	0.68	4.46	7.60	55.68
1998	5.65	8.28	5.39	0.95	3.94	0.90	7.08	6.22	8.73	2.90	5.16	0.94	56.14
1999	2.29	0.27	0.76	3.48	6.52	10.89	5.34	14.31	8.93	3.86	1.19	2.26	60.10
2000	1.15	0.37	2.00	1.92	1.17	3.76	5.06	1.94	7.95	1.37	0.24	0.38	27.31
Mean	2.32	2.54	3.37	2.14	3.94	8.20	7.74	7.20	6.49	3.25	1.92	1.87	50.99

Table 4. Monthly and Mean Rainfall (inches) at Avon Park Rainfall Station.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
1965	1.54	4.10	4.00	1.53	0.19	8.41	10.62	5.71	5.64	3.73	0.92	2.47	48.86
1966	5.91	4.95	1.47	2.38	4.65	8.02	6.23	6.97	6.31	2.23	0.31	1.25	50.68
1967	0.87	3.86	0.68	0.04	1.19	9.93	9.68	9.60	4.35	1.34	0.22	2.46	44.22
1968	0.57	2.10	1.10	0.64	6.44	14.81	8.54	6.10	5.64	4.05	2.78	0.43	53.20
1969	1.26	1.56	7.43	1.79	4.19	12.21	6.09	5.99	9.65	8.40	2.69	2.83	64.09
1970	4.78	3.57	8.85	0.19	4.97	8.62	8.94	4.24	4.93	3.16	0.12	0.31	52.68
1971	0.57	1.80	1.06	0.08	2.42	7.89	5.79	9.06	7.22	3.20	1.28	1.08	41.45
1972	0.25	2.99	0.78	5.90	2.25	10.53	3.90	5.35	4.27	3.35	3.52	1.97	45.06
1973	5.11	2.86	2.93	4.90	4.41	5.47	8.27	6.43	9.97	3.47	0.29	2.39	56.50
1974	0.33	1.09	0.05	1.41	5.39	14.12	16.89	10.23	4.87	0.56	0.53	2.93	58.40
1975	0.13	0.49	1.04	1.81	6.97	8.63	8.76	5.84	5.55	3.07	0.13	0.60	43.02
1976	0.08	0.76	2.45	1.88	4.98	9.75	6.50	7.65	6.61	3.42	1.75	1.19	47.02
1977	1.91	0.53	1.02	0.69	6.53	6.60	4.68	9.17	9.87	3.29	4.17	4.90	53.36
1978	1.81	2.38	3.16	0.43	7.00	9.04	10.00	7.71	4.24	3.63	1.76	4.16	55.32
1979	7.91	1.09	2.21	1.37	4.81	1.70	10.58	12.76	14.15	0.96	0.90	2.45	60.89
1980	3.72	1.65	1.47	3.90	3.90	2.40	6.64	4.71	3.71	0.40	3.21	1.34	37.05
1981	0.36	3.46	1.24	0.16	2.82	10.38	7.50	10.54	6.02	0.98	1.35	0.22	45.03
1982	1.16	2.06	6.52	4.15	6.96	11.14	7.79	5.97	10.65	2.59	1.57	0.51	61.07
1983	4.41	10.85	4.83	2.63	1.01	5.44	7.31	6.74	2.37	5.18	1.84	2.45	55.06
1984	0.45	2.93	6.42	2.75	5.09	7.39	13.09	2.71	3.70	0.13	3.13	0.61	48.40
1985	0.40	0.76	2.29	3.47	2.77	7.20	7.10	4.93	6.46	4.37	2.62	1.60	43.97
1986	1.33	0.78	6.03	0.21	1.56	15.85	7.75	8.14	5.06	4.05	0.08	3.35	54.19
1987	3.10	1.14	6.61	0.52	2.44	3.27	4.52	3.50	9.92	6.63	5.94	1.23	48.82
1988	2.39	2.37	6.21	1.47	2.90	3.01	9.29	10.20	2.41	1.81	3.80	1.73	47.59
1989	2.03	0.33	4.11	2.98	2.21	4.79	7.60	7.80	8.10	4.35	0.97	2.54	47.81
1990	2.21	3.27	1.79	1.34	1.72	9.20	10.89	9.40	3.88	0.53	0.45	1.01	45.69
1991	5.17	1.48	4.61	2.03	5.87	7.37	8.66	7.39	4.70	2.98	0.86	0.88	52.00
1992	0.36	4.73	2.26	4.91	3.84	15.77	4.67	12.12	6.71	1.91	4.37	0.58	62.23
1993	5.12	3.07	5.74	2.78	1.23	4.96	11.03	4.28	4.63	6.95	0.82	1.32	51.93
1994	3.82	1.84	3.49	2.00	4.30	11.35	3.64	9.03	8.31	2.57	4.16	3.83	58.34
1995	2.89	2.99	4.72	3.27	2.05	8.35	7.56	8.15	6.92	7.15	1.20	0.68	55.93
1996	2.42	1.71	4.76	1.16	7.61	8.32	5.57	6.03	0.70	3.72	0.20	1.64	43.84
1997	1.19	3.02	1.67	5.47	4.98	6.76	6.29	4.40	9.16	0.68	4.46	7.60	55.68
1998	5.65	8.28	5.39	0.95	3.94	0.90	7.08	6.22	8.73	2.90	5.16	0.94	56.14
1999	2.29	0.27	0.76	3.48	6.52	10.89	5.34	14.31	8.93	3.86	1.19	2.26	60.10
2000	1.15	0.37	2.00	1.92	1.17	3.76	5.06	1.94	7.95	1.37	0.24	0.38	27.31
Mean	2.35	2.54	3.37	2.13	3.92	8.17	7.77	7.26	6.45	3.14	1.92	1.89	50.91

Table 5. Monthly and Mean Rainfall (inches) at Brooks Rainfall Station.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
1963	2.41	7.67	2.03	0.63	8.05	7.71	3.15	5.19	3.35	1.20	9.69	2.63	53.71
1964	4.85	3.86	3.38	1.23	2.67	5.03	9.55	5.87	6.28	2.88	0.97	1.26	47.83
1965	1.64	5.42	1.44	1.75	0.36	9.56	11.21	7.41	7.42	3.21	0.68	2.74	52.84
1966	5.95	6.90	0.75	1.36	5.40	8.86	3.46	5.03	9.73	0.69	0.32	1.21	49.66
1967	2.02	3.57	1.07	0.00	0.18	5.76	11.38	9.97	6.54	0.46	0.04	2.84	43.83
1968	0.19	2.36	1.34	0.54	5.88	19.87	4.72	3.23	4.56	3.46	3.26	0.38	49.79
1969	4.65	1.38	5.93	1.99	2.09	4.45	7.67	9.03	5.60	5.64	1.77	4.98	55.18
1970	2.61	2.73	5.76	0.73	5.49	3.03	9.34	2.06	4.54	2.24	0.24	0.91	39.68
1971	0.17	3.83	1.65	0.88	2.93	5.46	6.34	5.24	1.92	6.01	2.13	2.36	38.92
1972	1.48	4.42	2.68	2.17	3.27	11.22	7.20	10.10	0.59	0.87	2.44	2.24	48.68
1973	3.41	2.74	2.40	1.83	5.03	2.95	5.08	4.74	9.28	3.86	0.75	2.01	44.08
1974	0.25	0.57	1.21	0.82	3.25	15.05	15.74	9.27	9.42	0.86	0.14	1.86	58.44
1975	0.93	1.79	0.70	1.30	7.57	4.41	8.19	3.34	7.25	1.41	0.95	0.63	38.47
1976	0.43	0.51	2.20	1.97	6.06	11.51	3.28	8.89	8.20	2.71	0.66	2.94	49.36
1977	2.58	1.94	0.78	0.26	1.52	1.85	9.36	10.03	5.92	1.65	2.26	2.99	41.14
1978	2.69	4.98	1.92	0.17	2.68	7.65	7.95	6.81	2.89	2.06	0.77	3.75	44.32
1979	6.22	1.13	1.93	1.37	6.46	3.59	6.45	8.32	12.68	1.64	2.02	1.36	53.17
1980	2.48	2.44	1.66	2.52	8.30	2.13	4.34	4.55	5.87	1.23	2.33	3.31	41.16
1981	0.50	4.85	2.02	0.24	3.20	10.49	6.12	10.89	5.88	3.74	3.89	2.20	54.02
1982	1.73	1.37	5.70	3.23	4.68	12.93	11.02	7.22	8.04	1.34	1.20	1.71	60.17
1983	2.06	9.47	5.41	3.19	1.34	9.10	5.08	4.46	5.00	5.47	2.05	5.27	57.90
1984	1.22	3.99	1.09	3.52	5.31	5.77	12.20	2.31	6.01	0.85	2.86	0.31	45.44
1985	0.63	0.70	3.53	2.31	2.61	6.35	5.83	8.58	6.56	1.28	1.17	3.30	42.85
1986	4.83	2.89	2.61	0.35	2.14	6.47	6.46	9.42	3.71	2.89	1.67	3.59	47.03
1987	3.55	2.51	11.62	0.18	4.45	2.87	8.24	0.75	6.64	4.66	8.89	0.00	54.36
1988	3.83	1.61	9.12	0.55	2.87	2.21	0.00	8.54	6.00	1.82	5.85	1.02	43.42
1989	3.96	0.04	2.51	2.44	3.39	10.33	5.58	10.51	4.77	1.93	2.36	5.48	53.30
1990	0.12	4.54	1.99	1.48	3.25	3.71	8.76	5.73	1.95	4.14	3.15	0.72	39.54
1991	1.89	0.48	4.83	6.61	7.39	4.90	6.35	4.96	4.70	3.63	0.16	0.03	45.93
1992	1.00	3.86	1.75	5.75	0.93	14.05	5.04	8.61	6.60	2.48	4.40	0.48	54.95
1993	7.02	0.57	4.21	2.37	0.00	3.52	8.09	4.03	5.96	1.49	2.30	0.96	40.52
1994	5.10	5.22	2.23	5.66	6.85	9.37	6.46	9.06	8.91	6.42	7.23	2.92	75.43
1995	1.44	1.08	1.18	2.40	3.58	6.76	9.76	16.08	5.05	5.85	1.71	0.58	55.47
Mean	2.54	3.07	2.99	1.87	3.91	7.24	7.25	6.98	5.99	2.73	2.43	2.09	49.11

Table 6. Monthly and Mean Rainfall (inches) at Fort Drum Rainfall Station.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
1965	0.38	3.55	4.71	0.64	0.05	4.55	8.13	5.72	5.94	7.77	0.69	1.61	43.74
1966	4.34	4.10	0.85	2.01	7.37	8.24	4.59	6.95	5.71	3.29	0.82	0.39	48.66
1967	0.31	3.88	1.10	0.00	0.47	8.98	12.18	5.13	6.31	1.30	0.77	2.20	42.63
1968	0.93	1.82	0.63	0.25	3.63	14.21	12.68	2.28	2.36	7.46	2.27	0.46	48.98
1969	2.63	1.46	7.11	3.84	4.89	2.42	3.88	10.72	4.00	11.09	2.89	2.08	57.01
1970	4.74	3.52	4.93	0.07	2.21	3.62	4.82	3.51	4.57	2.96	0.11	0.86	35.92
1971	0.11	3.38	1.62	0.53	5.28	12.60	10.44	5.14	6.90	4.27	0.41	1.40	52.08
1972	1.09	4.59	3.17	1.60	6.95	8.66	4.41	9.02	2.09	1.73	3.10	1.68	48.09
1973	4.97	2.52	2.83	2.24	6.41	10.40	13.83	7.07	7.81	2.89	1.24	1.70	63.91
1974	1.02	1.83	0.08	2.50	3.63	10.63	10.54	10.90	8.09	2.46	0.78	1.48	53.94
1975	0.18	1.89	2.22	1.24	10.66	4.71	15.95	4.22	6.39	5.43	1.31	1.00	55.20
1976	0.35	0.62	1.08	3.03	14.52	7.05	7.39	4.44	10.16	0.65	1.48	3.49	54.26
1977	1.10	1.23	0.53	0.55	3.14	6.41	6.24	8.62	7.13	0.84	5.00	4.29	45.08
1978	1.19	2.80	3.34	0.14	6.36	12.09	9.98	5.34	7.96	1.83	2.83	3.34	57.20
1979	6.82	0.77	0.98	2.91	14.33	1.74	5.69	3.80	22.40	0.77	0.89	1.80	62.89
1980	2.52	2.92	3.89	3.36	2.76	6.13	4.38	3.18	2.92	0.79	2.66	2.02	37.53
1981	0.33	3.35	1.85	0.20	1.54	4.29	4.08	8.82	3.54	2.43	1.52	0.79	32.74
1982	1.12	2.92	6.86	5.47	5.55	8.42	8.80	9.20	5.76	2.44	2.93	1.79	61.26
1983	4.02	7.60	5.20	1.15	1.48	10.85	7.20	10.68	4.65	4.46	2.38	4.62	64.29
1984	0.45	4.24	2.41	1.78	5.23	4.53	9.35	9.08	5.63	0.57	3.81	1.52	48.60
1985	0.53	0.40	2.99	2.49	1.75	5.11	7.48	7.38	14.89	2.38	1.17	1.18	47.75
1986	2.97	0.46	2.92	0.00	1.94	12.48	8.15	5.63	2.99	9.09	0.98	2.63	50.23
1987	4.82	0.68	11.61	0.38	3.79	6.82	5.20	1.66	8.14	3.45	6.77	0.01	53.34
1988	2.95	2.98	4.86	1.10	1.81	8.05	7.33	6.52	2.00	0.84	2.95	0.60	41.99
1989	2.98	1.05	5.27	3.22	1.07	6.96	3.16	9.58	9.12	8.25	1.10	3.06	54.83
1990	0.00	4.35	1.10	2.02	4.20	10.65	10.93	6.97	6.37	5.07	0.00	0.00	51.67
1991	4.86	3.27	5.73	9.60	7.55	14.26	13.17	6.43	6.13	2.62	0.00	0.00	73.62
1992	2.31	3.49	1.34	3.87	0.33	23.50	6.10	11.79	6.26	5.33	5.12	2.17	71.60
1993	8.75	2.19	9.00	3.78	4.30	4.68	5.59	6.60	3.94	10.24	2.80	3.60	65.46
1994	4.35	4.61	0.82	7.07	1.50	10.69	4.79	8.22	7.00	2.57	6.43	3.53	61.60
1995	4.15	4.24	5.13	3.10	2.85	6.55	10.04	14.31	8.35	9.11	1.20	0.67	69.70
1996	4.56	1.90	17.96	2.41	9.32	8.78	5.16	14.02	1.65	6.85	1.26	2.68	76.55
1997	3.98	0.75	1.90	6.67	4.45	11.20	5.80	13.91	7.23	1.73	2.70	7.92	68.23
1998	4.35	5.88	10.18	3.00	1.78	2.05	17.22	8.85	10.69	5.39	6.75	0.30	76.45
1999	2.15	1.15	0.25	2.55	6.94	13.49	4.02	9.69	8.62	13.88	1.90	0.70	65.35
2000	3.50	0.30	1.52	3.52	0.30	3.27	6.80	8.74	4.92	1.90	0.00	0.93	35.70
Mean	2.66	2.69	3.83	2.45	4.45	8.31	7.93	7.61	6.63	4.28	2.19	1.90	54.95

Table 7. Monthly and Mean Rainfall (inches) at Kissimmee Rainfall Station.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
1965	1.69	4.62	2.20	1.05	0.00	8.40	8.47	4.15	4.72	2.11	0.93	2.62	40.96
1966	5.16	7.07	0.45	1.93	4.39	9.82	5.11	7.04	6.10	2.25	0.12	1.68	51.12
1967	0.78	4.14	0.55	0.04	0.45	9.71	10.68	6.41	7.08	0.25	0.08	2.90	43.07
1968	0.27	3.10	0.88	0.47	5.02	15.42	9.38	4.74	3.56	3.12	2.65	0.31	48.92
1969	2.20	1.89	5.76	2.73	3.00	3.69	4.57	6.59	13.07	6.21	1.75	4.59	56.05
1970	2.73	3.09	5.59	1.09	4.43	4.95	9.04	3.89	2.97	2.07	0.82	1.21	41.88
1971	0.40	4.10	3.25	0.82	3.37	3.12	3.97	6.67	3.21	8.05	1.13	1.37	39.46
1972	0.88	3.90	1.22	1.65	2.64	7.44	5.08	8.59	0.96	2.13	3.90	2.45	40.84
1973	4.89	2.38	2.42	2.19	4.39	6.42	8.20	7.99	11.65	0.98	0.70	1.90	54.11
1974	0.32	1.23	2.10	0.67	2.48	11.93	6.62	4.07	4.22	0.38	1.06	1.63	36.71
1975	0.76	1.48	0.88	3.28	7.56	7.86	6.79	5.27	9.18	5.87	0.72	0.42	50.07
1976	0.20	0.40	2.26	1.43	7.70	5.89	4.09	6.80	4.52	0.94	1.77	4.08	40.08
1977	1.64	2.01	2.06	0.23	2.15	3.03	5.69	12.69	7.47	1.96	4.38	5.04	48.35
1978	3.02	3.36	1.69	0.25	2.63	9.01	10.20	6.77	1.20	1.90	0.26	3.19	43.48
1979	6.42	1.57	2.48	1.92	10.91	2.85	3.29	7.32	12.52	0.12	1.71	1.45	52.56
1980	2.22	2.51	2.33	3.43	5.85	1.48	3.86	2.99	1.32	0.58	3.94	0.45	30.96
1981	0.22	5.08	1.59	0.11	3.34	9.51	2.91	8.71	6.15	4.47	1.73	3.07	46.89
1982	1.75	1.53	5.81	3.28	4.04	2.60	9.34	4.33	8.28	2.41	0.70	1.03	45.10
1983	1.92	9.62	6.11	2.45	1.94	7.57	8.58	5.32	5.48	8.84	1.44	4.64	63.91
1984	2.20	3.22	1.70	1.15	5.50	2.88	10.53	8.96	3.09	1.11	2.12	0.15	42.61
1985	1.17	0.96	4.15	0.73	4.32	6.32	7.06	6.68	7.99	2.87	0.86	2.62	45.73
1986	4.44	1.94	3.08	0.45	0.56	6.00	4.63	8.36	3.15	3.99	0.84	3.20	40.64
1987	2.92	1.91	12.11	0.53	2.65	4.87	5.98	4.01	6.06	4.09	10.26	0.44	55.83
1988	2.95	1.99	3.56	1.05	3.23	5.15	15.73	10.55	4.79	0.89	8.29	1.06	59.24
1989	3.10	0.07	2.39	1.84	2.89	6.29	6.93	8.39	7.22	2.57	1.69	6.96	50.34
1990	1.49	5.45	1.91	1.81	0.99	5.29	8.19	7.65	6.44	4.47	0.74	0.81	45.24
1991	1.87	0.41	6.12	5.09	8.58	6.96	10.13	6.11	4.88	2.72	0.25	0.37	53.49
1992	1.36	3.09	2.01	5.65	3.30	7.91	2.75	10.73	9.91	3.85	3.19	0.53	54.28
1993	3.63	1.81	6.41	3.08	1.36	5.66	2.74	1.67	4.94	5.79	0.26	0.94	38.29
1994	4.41	3.78	1.34	5.97	5.05	11.49	6.84	8.78	11.29	3.68	7.25	3.13	73.01
1995	1.78	1.75	1.46	2.91	0.99	6.52	9.66	9.91	7.94	4.93	0.96	0.75	49.56
1996	6.97	2.97	9.85	1.83	2.91	9.19	2.77	7.37	7.08	2.48	0.62	2.75	56.79
1997	2.42	2.65	1.77	4.41	2.05	5.72	9.81	10.76	2.58	5.39	5.96	10.01	63.53
1998	1.91	7.84	6.13	1.09	1.30	2.18	5.99	5.08	7.69	0.79	2.39	0.87	43.26
1999	2.72	1.99	0.78	2.34	8.37	8.41	2.22	11.04	5.52	5.57	2.46	0.85	52.27
2000	1.79	0.9	0.53	1.11	2.1	7	9.24	6.6	5.92	1.2	0.88	1.0746	38.345
Mean	2.35	2.94	3.19	1.95	3.68	6.63	6.86	7.03	6.12	3.08	2.19	2.24	48.25

Table 8. Monthly and Mean Rainfall (inches) at DeSoto City (Lake Placid) Rainfall Station.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
1965	1.29	0.46	2.25	4.88	0.18	8.79	5.88	2.43	9.19	4.11	1.13	0.96	41.55
1966	2.94	8.22	0.87	0.04	2.97	4.25	2.20	5.93	13.75	1.69	0.16	0.08	43.11
1967	0.63	2.01	0.31	0.00	0.00	10.36	3.43	5.78	1.78	1.36	0.46	3.28	29.40
1968	0.16	1.35	0.12	0.00	4.27	15.31	4.26	1.56	1.31	3.94	3.06	0.16	35.50
1969	0.58	1.64	8.60	1.50	1.74	4.55	1.63	12.68	10.33	4.87	1.89	3.53	53.54
1970	7.85	3.41	7.61	0.00	1.62	7.34	6.06	1.69	4.77	2.47	0.00	0.31	43.13
1971	0.52	2.66	4.32	1.17	4.95	5.09	5.68	9.45	6.77	4.70	1.39	1.50	48.20
1972	2.23	3.34	4.60	0.64	3.94	10.01	8.43	8.26	0.41	3.38	5.55	2.08	52.87
1973	6.85	1.35	2.06	2.86	3.11	6.74	6.50	10.09	6.36	1.28	1.80	1.54	50.54
1974	0.59	2.17	0.26	0.44	6.66	13.89	9.69	7.42	5.99	0.28	0.60	2.47	50.46
1975	0.48	1.38	1.11	1.91	8.98	10.56	6.45	8.54	9.36	1.86	0.49	0.46	51.58
1976	0.31	1.78	1.39	1.19	5.93	11.04	11.30	7.63	11.08	1.65	2.93	1.45	57.68
1977	1.69	1.06	1.51	0.70	1.02	4.10	8.99	4.99	5.57	1.59	4.35	3.69	39.26
1978	2.20	3.45	2.66	0.21	4.60	5.88	15.17	2.87	1.89	4.08	1.25	2.48	46.74
1979	9.40	1.38	2.19	2.53	5.20	6.79	6.74	7.99	13.35	0.18	1.29	1.83	58.87
1980	3.76	2.53	2.14	3.54	5.21	2.40	6.38	1.52	3.64	3.05	3.08	1.19	38.45
1981	0.27	4.42	0.97	0.35	3.54	4.50	3.49	12.75	6.98	1.43	1.76	0.17	40.63
1982	1.74	1.97	7.09	3.71	6.47	18.54	13.64	6.24	6.97	1.15	1.81	1.09	70.42
1983	3.01	10.54	4.85	2.48	1.13	8.08	4.55	4.40	3.13	3.27	2.23	4.31	51.98
1984	0.50	3.93	4.44	2.61	7.77	5.11	8.96	5.32	4.11	0.27	3.46	0.77	47.25
1985	0.65	0.54	2.24	2.23	2.14	7.24	7.66	7.62	9.28	2.66	2.00	0.77	45.03
1986	1.66	1.82	6.96	0.24	1.66	14.15	3.41	4.86	7.06	1.93	1.67	1.76	47.18
1987	3.77	1.06	6.23	0.18	0.81	5.24	5.11	3.53	6.38	5.97	4.17	1.06	43.51
1988	3.41	2.76	4.20	0.17	3.71	5.75	7.18	3.47	4.67	0.40	3.47	1.15	40.34
1989	2.25	0.92	2.71	3.65	2.55	4.65	4.81	10.85	8.24	4.65	0.69	2.88	48.85
1990	0.33	4.05	3.14	2.30	1.52	7.52	6.83	11.74	3.36	1.04	0.68	1.14	43.65
1991	4.42	1.94	3.05	3.10	4.94	11.43	10.22	6.39	2.91	3.19	1.32	0.45	53.36
1992	0.76	4.53	2.50	3.81	0.55	13.56	3.95	12.12	2.59	1.71	3.97	0.60	50.65
1993	6.70	3.85	5.21	4.14	1.56	8.55	6.03	7.25	7.89	5.59	0.42	0.90	58.09
1994	2.83	1.73	1.49	4.17	2.19	9.75	4.74	7.28	11.65	2.44	2.27	3.11	53.65
1995	2.26	2.25	1.93	4.09	1.13	8.22	5.76	7.99	6.73	8.90	1.75	0.52	51.53
1996	3.13	0.83	3.55	0.84	5.88	8.24	2.45	3.27	4.05	3.86	0.59	0.88	37.56
1997	1.58	0.94	1.87	8.42	3.10	9.16	8.25	7.02	7.47	0.71	7.76	6.25	62.53
1998	3.87	6.54	9.53	2.54	3.99	2.60	8.59	6.85	12.77	0.73	8.05	0.39	66.44
1999	2.71	0.96	1.44	1.57	5.69	16.37	5.41	11.28	4.98	5.96	1.07	1.33	58.77
2000	1.30	0.31	1.27	3.74	0.29	4.77	5.36	2.92	11.47	1.54	0.67	0.77	34.41
Mean	2.46	2.61	3.24	2.11	3.36	8.35	6.53	6.72	6.62	2.72	2.20	1.59	48.52

Table 9. Monthly and Mean Rainfall (inches) at Moore Haven Rainfall Station.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
1965	0.42	3.59	3.16	1.76	1.11	10.16	5.57	2.78	4.71	9.06	0.34	1.89	44.55
1966	5.47	3.67	0.42	3.01	5.97	9.26	10.93	11.19	6.76	2.62	0.11	0.40	59.81
1967	0.84	1.69	0.24	0.14	2.58	11.27	7.02	3.74	8.53	3.37	0.08	1.95	41.45
1968	0.58	1.72	1.03	0.85	8.64	10.73	7.13	4.23	6.81	3.21	2.25	0.21	47.39
1969	1.76	2.28	6.19	0.69	4.10	10.09	3.68	10.04	8.49	11.75	1.46	3.82	64.35
1970	3.55	2.40	12.63	0.02	2.98	8.74	5.91	7.35	3.46	4.70	0.13	0.28	52.15
1971	0.25	0.51	0.37	0.14	1.50	13.86	7.28	8.29	7.18	6.35	0.90	1.20	47.83
1972	0.30	1.55	2.24	2.34	7.52	10.50	2.77	6.40	0.93	0.40	2.21	1.39	38.55
1973	2.72	2.73	3.34	1.02	5.88	10.48	8.01	5.58	8.43	1.38	0.03	1.52	51.12
1974	0.14	1.36	0.08	0.97	3.00	14.91	18.56	7.99	5.91	1.35	1.64	1.71	57.62
1975	0.20	1.95	0.74	1.22	4.89	5.29	7.00	3.13	11.11	4.88	0.27	0.38	41.06
1976	0.65	1.41	1.59	1.81	4.43	3.10	9.98	12.31	5.74	0.80	1.88	1.55	45.25
1977	4.87	1.38	1.12	0.20	5.17	3.74	6.19	5.51	6.29	1.01	5.33	4.74	45.55
1978	1.78	1.39	2.64	2.06	8.38	5.43	9.32	2.67	6.40	2.23	2.13	4.39	48.82
1979	5.83	0.23	2.30	0.84	7.64	1.09	1.45	5.66	17.69	2.06	1.83	1.96	48.58
1980	2.76	1.08	2.32	5.29	2.23	3.10	7.58	7.61	6.88	1.47	2.20	0.62	43.14
1981	0.87	1.52	1.28	0.38	2.06	3.33	3.70	10.29	4.54	0.24	1.27	0.15	29.63
1982	0.55	2.81	6.70	3.04	10.13	11.07	10.81	3.09	4.70	5.38	0.26	0.76	59.30
1983	4.22	8.04	5.57	1.75	0.38	7.46	4.36	5.95	3.36	4.29	1.61	2.78	49.77
1984	0.33	4.06	5.20	2.63	6.50	4.92	11.34	6.32	2.84	0.46	2.97	0.09	47.66
1985	0.54	0.41	2.11	7.04	1.11	4.51	8.52	5.34	6.17	1.88	1.41	3.25	42.29
1986	2.34	1.07	6.36	0.24	1.59	12.04	3.59	7.89	6.29	4.91	0.41	2.41	49.14
1987	3.65	1.94	6.59	0.00	1.33	4.18	6.42	3.77	9.91	6.06	8.53	0.59	52.97
1988	1.52	2.57	2.92	0.76	1.54	2.87	6.35	5.81	1.62	0.80	4.15	0.72	31.63
1989	1.62	0.10	2.76	5.02	1.62	5.76	6.45	3.01	8.33	2.93	0.35	2.19	40.14
1990	0.04	2.79	0.68	3.03	2.57	5.47	9.23	10.82	2.77	3.02	0.88	0.39	41.69
1991	5.57	0.90	3.93	4.47	6.58	6.18	6.93	8.02	3.05	4.90	1.85	0.33	52.71
1992	1.06	3.73	3.55	1.45	0.71	24.10	2.40	9.47	1.41	1.31	1.63	0.61	51.43
1993	4.72	2.01	2.54	2.15	2.38	3.98	3.19	5.28	5.60	5.05	1.01	1.04	38.95
1994	3.32	3.12	3.37	2.23	5.26	6.99	5.07	3.91	12.38	3.70	3.79	4.99	58.13
1995	2.97	2.89	5.52	3.57	2.23	7.56	15.02	7.33	4.72	10.69	0.24	0.30	63.04
1996	3.04	0.87	3.53	0.92	7.45	7.60	3.89	6.27	0.75	3.19	0.38	0.73	38.62
1997	0.92	1.05	1.88	6.32	4.22	3.69	4.32	10.28	8.10	0.38	2.24	5.04	48.44
1998	1.02	7.59	4.59	0.24	1.13	4.15	2.86	14.22	8.37	2.18	4.15	1.68	52.18
1999	3.75	0.20	0.19	1.51	3.15	14.57	7.10	6.96	13.05	4.20	0.48	1.07	56.23
2000	0.74	0.78	1.67	2.57	0.62	7.62	5.77	0.40	8.08	2.87	0.24	0.57	31.93
Mean	2.08	2.15	3.09	1.99	3.85	7.77	6.82	6.64	6.43	3.47	1.68	1.60	47.59

Table 10. Monthly and Mean Rainfall (inches) at Mountain Lake Rainfall Station.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
1965	2.01	4.39	2.82	2.26	0.13	9.75	10.34	4.48	5.26	3.59	0.48	2.03	47.54
1966	7.16	5.60	1.71	2.79	6.43	6.44	4.55	10.84	5.84	0.54	0.02	2.30	54.22
1967	0.84	3.91	1.16	0.00	0.38	11.11	6.86	14.22	3.58	0.76	0.23	2.94	45.99
1968	0.47	1.98	0.84	0.45	7.53	13.24	7.65	6.18	6.91	2.11	2.74	0.12	50.22
1969	5.26	1.53	6.43	0.90	2.53	6.58	5.06	6.93	5.91	6.32	2.85	4.15	54.45
1970	2.89	2.08	5.74	0.48	4.14	5.52	9.17	5.82	3.94	1.32	0.48	1.11	42.69
1971	0.13	4.48	1.76	0.82	3.42	4.42	8.27	4.62	2.53	5.55	2.13	1.33	39.47
1972	1.09	5.26	2.64	1.69	3.25	6.72	4.63	7.37	1.86	1.89	2.07	2.84	41.31
1973	7.15	2.35	5.72	4.41	4.42	4.96	14.76	7.72	9.65	1.16	1.45	1.65	65.40
1974	0.29	1.20	0.56	0.86	2.07	11.84	11.97	6.74	8.21	0.09	0.18	1.80	45.81
1975	0.76	2.04	0.93	0.85	4.08	5.55	5.94	12.02	6.32	5.63	0.99	0.49	45.60
1976	0.29	0.85	1.16	2.30	9.65	10.91	5.76	8.90	9.18	1.20	3.25	2.59	56.04
1977	2.22	1.68	1.59	0.20	2.28	5.50	9.60	10.20	4.69	1.95	2.38	3.34	45.63
1978	2.73	3.65	2.77	0.67	7.62	10.09	9.95	3.78	2.78	1.05	0.50	3.42	49.01
1979	6.51	1.05	1.92	1.41	11.99	8.56	4.04	7.54	15.80	0.04	2.58	1.91	63.35
1980	3.87	2.65	1.96	1.57	6.65	3.04	6.44	4.77	2.41	1.57	3.89	1.11	39.93
1981	0.36	3.78	1.02	0.00	2.26	3.86	6.84	5.73	6.01	0.34	0.95	1.62	32.77
1982	1.31	1.03	7.73	3.90	8.44	11.93	9.50	6.03	8.34	1.21	0.33	1.02	60.77
1983	2.83	9.39	6.37	2.37	1.71	8.51	7.41	3.78	4.72	4.94	4.33	7.80	64.16
1984	0.75	3.32	2.80	1.33	5.52	3.66	11.16	4.65	3.51	0.41	1.61	0.25	38.97
1985	0.75	0.53	2.28	2.36	3.11	8.39	7.72	7.43	8.26	2.30	1.44	1.07	45.64
1986	2.86	1.80	5.52	0.52	0.45	18.65	5.72	8.36	3.22	3.77	0.14	5.80	56.81
1987	2.36	1.49	9.05	1.05	2.85	5.91	4.71	5.39	6.49	5.25	8.98	0.10	53.63
1988	2.60	1.73	5.31	1.02	3.17	4.67	8.99	8.31	4.94	0.80	4.40	0.90	46.84
1989	2.72	0.04	2.77	2.06	3.11	4.99	8.22	5.15	5.10	2.19	3.75	3.84	43.94
1990	0.16	3.57	1.32	2.15	4.68	6.37	8.21	5.00	2.69	4.55	1.65	1.25	41.60
1991	2.03	1.06	4.43	5.02	8.28	6.54	9.31	5.41	1.27	4.52	1.04	0.68	49.59
1992	1.31	3.81	0.84	4.57	3.03	9.08	3.20	11.79	7.00	4.45	3.50	0.76	53.35
1993	5.78	3.55	4.56	4.20	2.36	3.29	5.85	3.82	6.75	3.37	0.31	1.03	44.86
1994	4.20	2.33	2.28	1.84	1.97	12.19	6.06	4.32	11.42	4.04	3.99	3.31	57.95
1995	2.14	2.03	1.43	4.26	1.35	9.56	9.20	8.54	10.90	3.07	2.40	0.41	55.29
1996	5.61	0.45	5.72	1.69	2.22	12.60	5.02	8.61	4.08	3.33	0.90	2.90	53.13
1997	1.33	0.93	2.82	5.21	2.65	6.09	9.29	6.84	3.16	2.88	3.54	6.50	51.24
1998	2.95	6.55	4.81	0.33	0.89	0.20	6.37	5.13	7.38	0.28	2.08	1.06	38.03
1999	3.34	0.50	0.62	1.69	4.31	10.86	3.18	4.44	3.20	4.88	1.27	2.17	40.46
2000	0.88	0.24	1.10	0.72	0.02	6.39	7.22	6.78	4.47	0.85	0.73	0.13	29.53
Mean	2.50	2.58	3.12	1.89	3.86	7.72	7.45	6.88	5.77	2.56	2.04	2.10	48.48

Table 11. Monthly and Mean Rainfall (inches) at Okeechobee Rainfall Station.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
1965	0.34	4.99	2.89	2.03	0.84	6.37	5.20	5.71	3.75	6.22	1.10	0.95	40.39
1966	4.32	3.83	1.56	3.38	3.16	12.93	8.74	7.55	7.04	4.71	0.28	0.51	58.01
1967	1.22	2.64	0.30	0.17	0.17	7.19	7.27	4.39	4.77	3.82	0.07	1.13	33.14
1968	0.46	2.01	0.85	0.29	6.75	16.47	6.99	2.81	7.32	5.07	1.57	0.00	50.59
1969	3.82	1.43	5.08	1.98	6.69	4.08	6.64	5.20	3.71	7.83	3.41	2.87	52.74
1970	4.92	3.14	7.21	0.00	4.83	8.48	7.21	7.12	5.10	7.72	0.04	0.87	56.64
1971	0.32	0.95	2.29	0.48	2.49	8.01	6.95	6.44	6.27	5.24	1.73	2.28	43.44
1972	1.24	4.06	2.82	3.52	5.41	9.34	5.26	6.72	2.42	2.92	3.98	2.09	49.76
1973	4.91	2.82	3.01	2.87	5.18	7.33	9.10	6.99	8.39	3.87	1.06	2.02	57.55
1974	1.16	1.31	0.97	1.76	4.10	11.46	11.08	7.35	5.70	2.02	0.79	1.97	49.66
1975	0.25	3.30	0.55	0.58	5.79	2.25	6.63	1.60	4.47	1.16	1.09	0.21	27.88
1976	0.20	1.32	0.59	1.70	6.14	5.62	3.54	6.52	5.32	1.02	2.08	2.00	36.05
1977	2.01	0.60	0.69	1.02	1.34	5.30	4.24	4.75	3.08	1.35	4.24	3.09	31.71
1978	1.90	1.31	3.18	1.87	1.73	5.58	6.35	7.81	6.82	3.04	1.69	4.71	45.99
1979	5.00	0.32	2.45	1.51	12.95	1.29	6.15	8.18	14.10	1.60	1.93	1.87	57.35
1980	3.28	1.49	2.22	6.71	5.28	4.84	6.90	7.32	5.60	2.10	3.92	1.41	51.08
1981	0.99	2.45	0.79	0.50	2.37	2.70	2.92	11.58	8.88	0.97	1.86	0.13	36.14
1982	0.80	2.72	9.23	4.69	4.38	6.09	3.94	10.20	7.42	3.81	3.78	0.76	57.82
1983	4.02	7.78	3.82	1.58	3.01	6.09	6.71	5.66	4.48	8.92	1.39	2.88	56.34
1984	0.14	2.59	3.00	3.10	5.15	4.92	10.60	3.94	4.46	1.36	3.03	0.60	42.89
1985	0.23	0.15	2.77	2.78	0.78	5.99	7.92	7.01	5.24	1.93	0.78	2.01	37.59
1986	1.02	0.35	3.50	0.09	3.22	7.52	5.74	5.82	7.18	4.47	2.75	2.90	44.56
1987	3.46	1.61	4.68	0.50	3.57	7.93	5.77	1.47	5.48	5.37	7.35	0.96	48.15
1988	3.29	3.46	3.39	0.65	5.28	6.89	7.19	8.78	1.68	1.55	3.22	1.10	46.48
1989	1.30	0.53	2.92	3.61	0.83	1.52	6.86	6.87	6.68	6.99	0.95	2.97	42.03
1990	0.58	1.90	0.35	2.67	4.04	4.62	11.37	9.74	3.78	6.09	1.16	0.48	46.78
1991	4.87	1.38	4.95	6.37	3.72	5.15	8.06	7.93	7.78	1.80	2.67	1.25	55.93
1992	1.35	3.25	1.83	2.53	1.06	18.82	4.09	7.49	4.27	2.49	3.32	0.69	51.19
1993	8.41	2.92	6.04	1.15	1.54	4.59	2.00	6.50	5.45	4.73	1.92	0.83	46.08
1994	3.15	4.43	2.61	6.22	3.98	3.81	4.97	11.53	6.50	4.25	4.92	4.49	60.86
1995	2.68	1.45	3.55	2.25	2.14	10.58	5.64	7.00	8.15	12.80	0.41	0.69	57.33
1996	3.83	1.37	10.64	1.74	6.31	7.83	4.92	6.52	4.19	5.95	1.07	2.24	56.60
1997	2.94	1.79	2.60	6.84	13.17	7.70	5.26	4.55	6.75	2.19	5.80	5.55	65.15
1998	3.06	6.02	4.85	1.73	2.25	3.22	8.09	9.47	7.30	4.62	5.27	1.05	56.93
1999	2.92	0.56	1.03	3.96	5.82	13.73	6.47	3.46	7.40	4.65	1.33	1.42	52.74
2000	1.12	0.97	1.29	3.05	0.11	2.82	3.52	2.51	8.76	0.66	0.12	0.50	25.43
Mean	2.38	2.31	3.07	2.39	4.04	6.92	6.40	6.51	5.99	4.04	2.28	1.71	48.03

Table 12. Monthly and Mean Rainfall (inches) at Orlando Rainfall Station.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
1965	1.85	4.34	2.84	1.32	0.35	8.11	9.83	6.25	4.48	3.81	0.97	2.50	46.65
1966	4.69	5.61	1.49	2.57	5.08	10.86	5.76	7.01	7.81	2.20	0.35	1.24	54.68
1967	1.27	4.31	0.83	0.08	1.69	8.98	9.67	10.10	5.63	0.73	0.16	2.41	45.87
1968	0.58	2.59	1.66	0.57	4.92	14.91	7.56	6.90	4.02	5.32	3.04	1.03	53.10
1969	2.15	2.61	5.73	1.97	2.90	4.18	6.36	8.58	8.52	8.22	2.02	4.81	58.04
1970	3.92	3.87	5.22	1.23	3.92	4.86	7.00	5.91	4.39	3.09	0.81	1.21	45.41
1971	1.17	4.87	2.31	1.50	3.65	5.27	6.91	6.68	4.13	5.86	1.77	2.21	46.34
1972	1.46	4.74	4.43	1.58	4.37	6.84	5.00	9.79	1.83	3.14	5.46	2.38	51.01
1973	4.84	2.47	3.83	2.95	4.33	4.99	8.41	7.20	8.76	1.82	0.93	3.19	53.74
1974	0.35	0.63	3.67	1.17	2.69	15.28	6.01	6.56	5.78	0.48	0.31	1.62	44.55
1975	0.98	1.49	1.10	1.36	7.52	9.70	9.26	4.75	4.97	4.74	0.66	0.51	47.04
1976	0.37	0.83	1.72	2.16	10.36	9.93	7.05	3.25	5.87	0.74	2.03	2.77	47.08
1977	1.81	1.76	1.82	0.14	1.47	4.47	6.61	6.28	7.03	0.43	2.60	3.70	38.12
1978	2.49	5.45	2.14	0.61	3.16	10.00	11.92	5.13	4.31	1.51	0.18	3.69	50.59
1979	6.48	1.45	3.24	1.08	7.66	4.00	7.95	5.88	9.19	0.43	1.93	0.94	50.23
1980	2.45	1.64	1.51	4.07	6.96	5.25	5.14	2.92	3.70	0.55	6.55	0.47	41.21
1981	0.21	4.36	1.85	0.18	2.02	12.49	3.53	5.60	8.26	3.13	2.50	2.97	47.10
1982	1.72	1.34	4.85	6.27	5.29	6.06	11.81	5.03	6.96	0.74	0.53	1.01	51.61
1983	2.08	8.32	5.37	3.21	1.77	7.82	6.49	4.83	5.16	3.78	1.36	5.33	55.52
1984	2.01	2.73	1.85	6.21	3.20	5.32	6.19	7.89	6.19	0.56	2.10	0.19	44.44
1985	0.91	1.27	4.59	1.69	3.00	4.54	7.28	11.63	5.45	2.55	0.82	3.46	47.19
1986	7.23	1.84	2.63	0.49	0.88	9.50	5.85	5.99	4.50	5.63	1.69	3.60	49.83
1987	1.27	1.74	11.38	0.59	1.40	3.54	7.95	6.07	8.64	3.41	10.29	0.51	56.79
1988	3.12	1.38	6.07	2.02	2.82	4.17	9.44	7.94	5.67	1.42	7.44	1.00	52.49
1989	3.80	0.15	1.35	2.28	2.38	6.79	4.74	6.20	10.29	1.75	1.44	4.49	45.66
1990	0.23	4.13	1.92	1.73	0.55	6.22	6.68	3.78	2.46	2.10	1.05	0.83	31.68
1991	2.37	0.98	6.66	7.72	9.48	5.98	10.78	7.13	4.53	4.76	0.27	0.24	60.90
1992	1.35	2.42	3.67	9.10	1.19	8.68	2.60	8.03	7.13	5.17	2.74	0.88	52.96
1993	4.89	1.48	6.26	1.78	2.32	4.47	6.49	5.95	5.35	4.61	0.17	0.76	44.53
1994	4.00	3.58	1.21	3.03	2.87	10.28	13.27	6.23	7.84	5.18	7.32	3.04	67.85
1995	1.50	1.13	2.12	0.81	4.24	8.23	5.10	9.48	3.59	4.35	1.74	0.76	43.05
1996	5.39	1.52	9.87	0.68	5.12	6.51	4.06	11.33	6.04	3.28	0.72	2.14	56.66
1997	1.13	2.44	3.46	4.02	3.17	8.20	11.51	7.99	2.59	4.22	3.15	12.63	64.51
1998	1.99	8.74	5.26	0.52	3.17	1.58	8.61	5.59	5.36	0.64	1.67	0.62	43.75
1999	2.99	0.36	0.56	2.40	5.43	13.84	5.14	4.50	6.40	8.40	2.13	2.65	54.80
2000	1.23	0.36	0.45	2.22	1.00	6.19	4.07	4.48	6.37	1.33	1.10	1.58	30.38
Mean	2.40	2.75	3.47	2.26	3.68	7.45	7.28	6.63	5.81	3.06	2.22	2.32	49.32

Table 13. Monthly and Mean Rainfall (inches) at S-65 Rainfall Station.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
1965	1.15	3.56	4.10	2.05	1.28	8.14	12.11	4.95	5.97	4.81	0.91	2.46	51.48
1966	5.56	5.82	1.69	1.49	4.58	5.29	6.87	4.86	4.67	3.14	0.08	0.89	44.94
1967	1.33	2.70	0.22	0.00	0.38	6.61	7.00	7.25	6.65	0.46	0.13	1.89	34.62
1968	0.60	2.03	1.31	0.33	9.16	14.64	5.30	2.98	5.71	7.45	2.39	0.20	52.10
1969	1.85	1.34	7.81	1.89	1.89	6.92	8.32	6.67	9.64	10.17	3.17	3.66	63.33
1970	2.34	2.20	5.41	0.79	3.58	5.60	8.79	3.79	2.48	6.05	0.34	1.00	42.37
1971	0.00	4.77	1.15	0.38	1.07	8.34	8.24	5.41	2.31	5.79	0.41	1.39	39.26
1972	2.99	4.21	2.79	2.47	5.52	8.02	2.74	4.46	0.66	1.37	5.58	3.16	43.97
1973	5.23	1.58	2.58	7.26	5.22	4.42	7.98	6.44	7.05	3.86	0.08	1.69	53.39
1974	0.40	1.86	0.08	3.40	8.17	13.98	20.28	10.97	6.84	0.47	0.32	4.69	71.46
1975	1.08	2.71	2.10	2.38	10.18	5.65	9.00	8.27	7.68	5.19	0.85	0.58	55.65
1976	0.57	0.33	0.94	1.40	5.67	11.65	5.08	14.37	7.13	2.70	1.30	2.99	54.13
1977	2.78	1.48	1.42	0.82	10.18	5.65	9.00	7.17	5.28	1.49	4.01	3.42	52.71
1978	2.30	3.60	2.76	0.29	6.74	13.41	10.14	7.89	6.98	4.98	1.24	3.36	63.69
1979	5.45	1.47	1.52	2.26	10.57	3.94	2.50	7.16	19.52	0.52	1.21	1.33	57.45
1980	2.75	5.29	2.60	3.24	5.02	10.32	6.54	10.41	3.88	1.86	7.96	1.36	61.23
1981	0.49	3.51	1.47	0.30	2.61	6.26	6.66	10.13	11.20	1.16	1.58	0.29	45.66
1982	2.15	3.23	6.43	7.47	7.06	8.68	8.05	2.60	7.97	4.60	0.95	1.49	60.68
1983	4.47	8.08	4.77	2.36	1.96	9.52	3.74	3.74	4.79	4.51	1.90	4.15	53.99
1984	0.77	2.52	2.15	2.35	6.36	4.51	8.88	5.64	2.91	1.10	3.99	0.56	41.74
1985	0.69	0.69	1.45	1.92	3.45	7.21	6.72	5.89	4.16	1.26	3.00	1.69	38.13
1986	2.46	1.52	5.15	0.30	0.97	8.93	6.55	5.92	5.57	1.59	1.46	2.32	42.74
1987	2.80	1.92	8.34	0.26	1.38	7.41	5.72	1.81	8.74	6.70	10.39	0.12	55.59
1988	2.16	2.96	6.31	0.44	1.85	5.36	13.09	8.88	4.76	1.07	2.92	1.82	51.62
1989	3.39	0.60	4.47	2.08	4.68	7.28	5.06	3.46	7.81	1.66	2.04	3.39	45.92
1990	0.38	5.14	0.38	1.13	1.18	7.31	9.55	9.00	4.75	2.66	0.88	0.72	43.08
1991	2.63	1.23	5.68	4.16	6.61	4.71	7.15	7.24	4.25	8.26	0.27	0.82	53.01
1992	0.22	2.80	1.35	4.05	2.06	12.87	8.91	12.00	2.85	2.01	0.75	0.53	50.40
1993	4.15	2.44	4.17	3.39	2.97	0.72	3.17	8.01	5.96	4.00	1.17	0.71	40.86
1994	1.44	3.05	1.48	3.17	1.54	13.34	11.68	4.54	10.44	4.75	4.46	2.63	62.52
1995	1.71	3.61	4.47	3.97	2.18	8.93	4.23	9.60	5.41	5.57	2.88	0.26	52.82
1996	4.67	0.67	5.29	0.97	7.47	7.93	1.59	5.67	3.46	4.38	0.37	2.82	45.29
1997	2.08	1.12	3.48	5.01	5.35	5.05	11.49	9.23	5.99	1.81	10.17	7.44	68.22
1998	4.89	6.70	7.31	0.85	2.47	0.98	9.93	6.09	9.51	1.17	3.06	1.21	54.17
1999	2.58	1.12	1.09	5.12	3.03	7.87	4.07	8.40	7.95	7.98	2.11	2.14	53.46
2000	0.83	0.75	1.82	1.51	2.69	5.79	8.35	3.78	4.42	0.55	0.41	1.13	32.03
Mean	2.26	2.74	3.21	2.26	4.36	7.59	7.62	6.80	6.26	3.53	2.35	1.95	50.94

FREQUENCY ANALYSIS

1-in-10 Year Drought Event

Water supply needs, of existing and future reasonable-beneficial uses, are estimated based upon demand requirements during a 1-in-10 year drought event (Subsection 373.0361, (2)(a) Florida Statutes (F.S.). A 1-in-10 year drought event is a drought of such intensity that it is expected to have a return frequency of once in 10 years. This means that there is only a 10 percent chance that such a small amount of rain will fall in any given year.

Statistical Method

Because of correlations between rainfall amounts in different months, the sum of the 12 monthly 1-in-10 rainfall events will not equal the annual 1-in-10 rainfall event; in almost all cases a 1-in-10 annual drought will be less severe (have more rainfall) than 12 successive monthly 1-in-10 rainfall droughts. The sum of the monthly 1-in-10 drought rainfalls in all cases was less than the annual 1-in-10 drought rainfall.

Attempts to reconcile these 1-in-10 concepts depend upon the assumptions made with respect to the starting month and patterns of serial correlation in rainfall. Based on the results of Abtew and Ali, the gamma distribution was used to estimate 1-in-10 year drought levels of rainfall.

Maximum likelihood estimates of monthly and annual 1-in-10 drought rainfalls based on a two-parameter gamma distribution were calculated using Number Cruncher Statistical System™ software. This method consists of finding the values of the distribution parameters that maximize the log-likelihood of the data values. These values provide a high degree of probability that the current set of data values will occur. For a discussion of maximum likelihood estimation, see *Maximum Likelihood Estimation* by S. Purcell of the Statistical Genetics Group at Kings College, London.

For more information on the use of gamma distribution in engineering statistical analysis, see the Engineering Statistics Handbook, Section 1.3.6.6.11 available from: http://www.itl.nist.gov/div898/handbook/eda/section3/eda366b.htm.

Figure 3 shows the statistical 1-in-10 year drought event plots for the rainfall stations and **Table 14** lists the values for 1-in-10 year drought events**.**

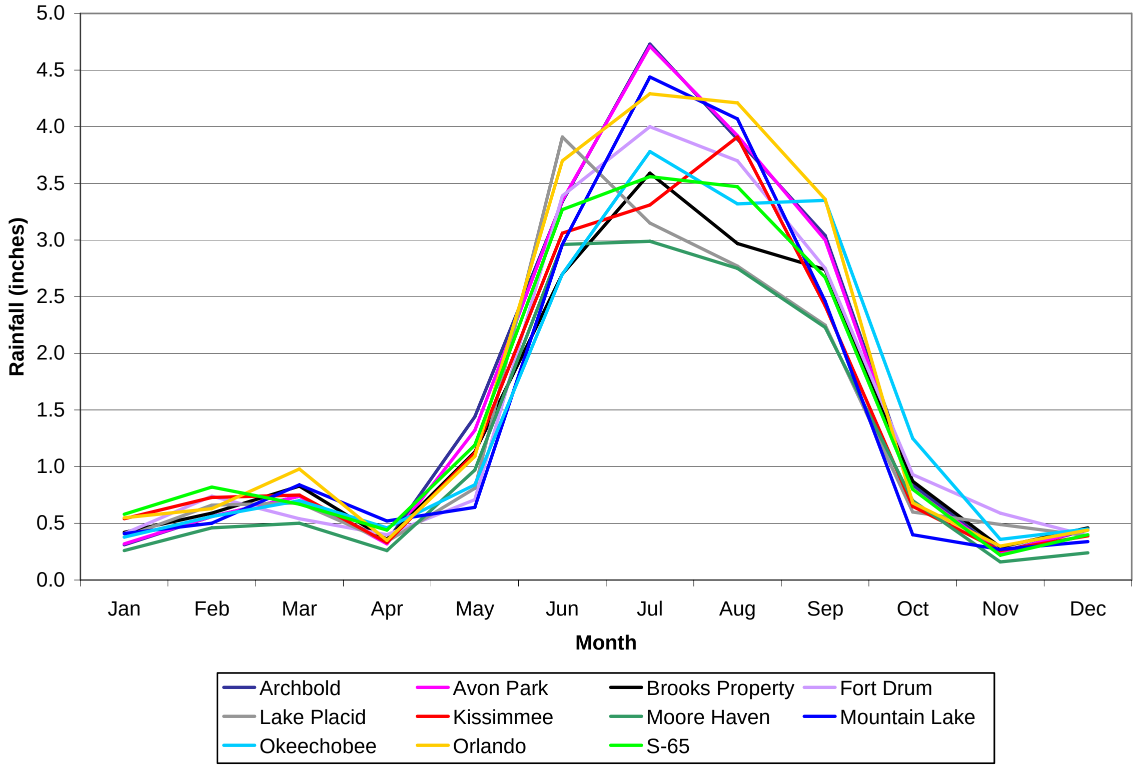

Figure 3. Statistical 1-in-10 Year Drought Event for Rainfall Stations in the KB Planning Area.

Table 14. Statistical 1-in-10 Year Rainfall (in inches) for Stations in the KB Planning Area.

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum	Annual
Archbold	0.3	0.6	0.7	0.3	1.4	3.3	4.7	3.9	3.0	0.8	0.3	0.4	19.9	40.9
Avon Park	0.3	0.6	0.7	0.3	1.3	3.4	4.7	3.9	3.0	0.8	0.2	0.5	19.7	40.9
Brooks Property	0.4	0.6	0.8	0.4	1.1	2.7	3.6	3.0	2.7	0.9	0.3	0.5	17.0	39.8
Fort Drum	0.4	0.7	0.5	0.4	0.7	3.4	4.0	3.7	2.8	0.9	0.6	0.4	18.6	40.5
Desoto City (Lake Placid)	0.4	0.7	0.7	0.3	0.8	3.9	3.2	2.8	2.3	0.6	0.5	0.4	16.4	37.4
Kissimmee	0.5	0.7	0.8	0.3	1.1	3.1	3.3	3.9	2.4	0.7	0.3	0.4	17.5	37.8
Moore Haven	0.3	0.5	0.5	0.3	1.0	3.0	3.0	2.8	2.2	0.7	0.2	0.2	14.5	37.0
Mountain Lake	0.4	0.5	0.8	0.5	0.6	3.0	4.4	4.1	2.5	0.4	0.3	0.3	17.9	37.9
Okeechobee	0.4	0.6	0.7	0.5	0.8	2.7	3.8	3.3	3.4	1.3	0.4	0.5	18.2	35.5
Orlando	0.6	0.6	1.0	0.4	1.1	3.7	4.3	4.2	3.4	0.7	0.3	0.4	20.6	39.5
S-65	0.6	0.8	0.7	0.4	1.2	3.3	3.6	3.5	2.7	0.8	0.2	0.4	18.1	39.5

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Central Florida Regional Reuse Evaluation

This appendix was prepared as of October 2004.

EXECUTIVE SUMMARY

Central Florida has long been a leader in the application of highly treated reclaimed water as a source of irrigation, industrial application and as a means of recharging the local aquifer system. While this practice began as a tool for wastewater management and for reducing environmental impacts, more recently the role of reclaimed water reuse is seen as a valuable way to offset increasing groundwater demands. In 2000, the District identified limitations on the availability of groundwater as the primary source to meet all the future needs in the Orange, Osceola and Polk County area. As such, reuse was identified as a key component of central Florida's water supply future.

This study addresses that portion of central Florida including all of Orange County, the northern portion of Osceola County and those portions of Polk County in and adjacent to the South Florida Water Management District (SFWMD or District). In general, this study reviews only those wastewater reclamation facilities with flow averaging greater than 0.1 million gallons per day (MGD) based on the Year 2001 reported flows. This report was compiled to provide an inventory of existing and projected water reclamation facilities, to document existing and estimated future supplies of reclaimed water, and to examine future reclaimed water demands. In addition, this study reviews ways to improve system reliability and efficient use of reclaimed water.

In 2001, the 19 major wastewater utility providers within the study area generated just over 122.0 MGD of reclaimed water suitable for reuse. While all of the supply generated was used in some beneficial manner, only about 89.0 MGD or 73 percent was used in a highly beneficial manner related to aquifer recharge, industrial application and irrigation replacement. The remaining portion of the reclaimed water (39.0 MGD) was directed to surface water discharge or ponds in low recharge/discharge areas. Projected wastewater flows are expected to exceed 243.0 MGD, an increase of 125.0 MGD, by the Year 2025. This represents a significant portion of the projected deficit in groundwater supply.

Estimation of potential reclaimed water demands was made to assure that adequate locations would be available for the application of reclaimed water. The identification of potential reuse application sites was made using the District's Consumptive Use Permitting database, a Geographic Information System (GIS) application using future land maps and interviews with local utilities to identify projected application sites. These site locations were then screened to limit the potential reuse list of sites to those most likely to be in a position to receive reclaimed water when available. Results of this evaluation concluded that a conservative estimate in the increase in reclaimed water demand is 260.0 MGD by Year 2025. Residential reuse is expected to represent the largest category of potential increase in reclaimed water use.

While the estimated demand for reclaimed water is expected to be larger that the anticipated supply, it is possible to extend the use of reclaimed water by improving its use through conservation, supplemental sources of water and improvement of water storage. Improved efficiency of reclaimed water use in residential irrigation is estimated to increase the availability of reclaimed water by as much as 45.0 MGD within the study area.

1. INTRODUCTION

The State of Florida encourages and promotes the use of reclaimed water. The Water Resource Implementation Rule, Chapter 62-40 of the Florida Administrative Code (F.A.C.) requires the Florida Department of Environmental Protection (FDEP) and water management districts to advocate and direct the reuse of reclaimed water as part of the water management programs, rules and plans.

Water reuse is defined as the deliberate application of reclaimed water for a beneficial purpose, in compliance with FDEP and water management district rules. Potential uses of reclaimed water include landscape irrigation, agricultural irrigation, groundwater recharge via percolation basins, industrial and utility uses, environmental enhancement and fire protection. In addition to the more common use of reclaimed water, Chapter 62-610, F.A.C. addresses the use of high-quality reclaimed water for groundwater recharge using injection wells and indirect potable use.

The South Florida Water Management District (SFWMD or District) has a reuse program in place. It is comprised of regulatory rules, goals and construction funding assistance. The reuse goals are set forth in the District Water Management Plan (DWMP), stating that the District will encourage and promote the use of reclaimed water where appropriate. The District's regulatory program requires all water use permittees use the lowest quality water source available where technically and economically feasible. Reclaimed water users are provided with a backup source of water through the issuance of a water use permit. The

District has provided millions of dollars in funding through its Alternative Water Supply Funding Program to local governments, utilities and other water users developing alternative water supplies. Alternative water supplies include the construction of reclaimed water distribution lines and treatment facilities. As part of the District's strategy to encourage the best and most efficient application of reclaimed water, a review of current and future reclaimed water availability and demand was completed.

The purpose of this report is to provide an inventory of existing and projected water reclamation facilities, to document existing and estimated future supplies of reclaimed water, and to examine future reclaimed water demands. In addition, this study reviews ways to improve system reliability and efficient use of reclaimed water.

This report addresses that portion of central Florida including all of Orange County, the northern portion of Osceola County and those portions of Polk County in and adjacent to the District. In general, this study reviews only those wastewater reclamation facilities with flow averaging greater than 0.1 million gallons per day (MGD) based on the 2001 reported flows. Those reclamation facilities identified as being part of the system operated by a listed provider, but less than 0.1 MGD, were also included in the developed database. **Figure 1** shows the location of the study area.

This study focuses on reuse in central Florida due to the area's progressive use of reclaimed water and the significance placed on reuse as a projected water supply solution recommended in the *2000 Kissimmee Basin Water Supply Plan* (2000 KB Plan).

Central Florida has long been a leader in the application of highly treated reclaimed water as a source for irrigation, industrial applications and as a means of recharging the local aquifer system. While this practice started as a tool for wastewater management and for reducing environmental impacts, more recently the role of reclaimed water reuse is seen as a valuable way to offset increasing groundwater demands. Reuse is considered a key component of central Florida's water supply future.

In developing this reuse plan, the concepts of supply, demand, storage, supplemental sources, utility interconnects, regulation and conservation are addressed. The goal of this regional reuse evaluation is to identify options where beneficial use of reclaimed water could occur and to provide insight into the potential benefits of reuse in addressing future water supplies in central Florida.

This regional reuse study includes the following tasks:

1. Conduct an inventory of existing and proposed wastewater facilities, reclaimed water infrastructure and customer information.
2. Perform an evaluation to determine the availability of wastewater and reclaimed water supplies.
3. Perform an evaluation to determine existing and future reclaimed water customers and other potential uses.
4. Develop screening tools to prioritize project options and complete the initial list of opportunities.
5. Use public workshops and interviews to narrow identified opportunities list.
6. Identify water storage and supplemental supply options.
7. Identify a means of conservation and supply management for reclaimed water.
8. Identify the benefits of reclaimed water use options.
9. Identify strategies to promote reclaimed water reuse.

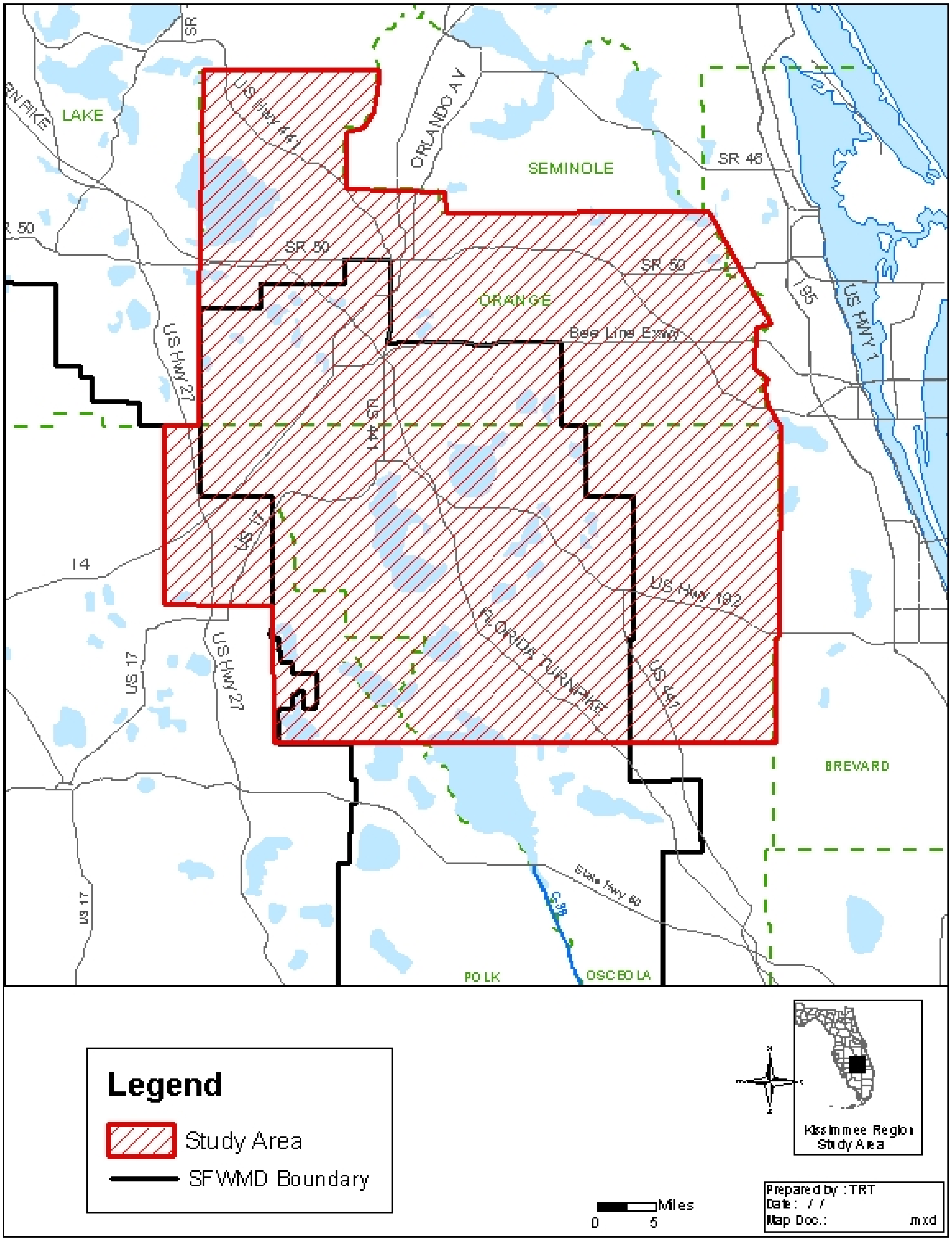

Figure 1. Project Study Area.

2. INVENTORY OF WASTEWATER TREATMENT FACILITIES

2.1 Inventory of Existing Facilities

An inventory of existing wastewater treatment facilities located in Orange, Osceola and eastern Polk counties having a 2001 average annual flow of greater than 0.1 MGD was prepared using Microsoft Excel and the Environmental Systems Research Institute (ESRI) ArcGIS database. Sources of information included the Florida Department of Environmental Protection (FDEP), utility interviews, and SFWMD databases. In addition, the St. Johns River Water Management District (SJRWMD) provided information on facilities located within the SJRWMD jurisdiction in Orange County and adjacent areas. Types of information collected included existing and proposed wastewater treatment facility capacity; recorded flows; location of reclaimed water distribution lines; and information regarding current and proposed customers. Information about system recharge/disposal areas, utility rate charges, management practices, storage, treatment levels and supplemental sources was also collected.

In 2001, there were 19 domestic wastewater treatment providers located within the study area operating facilities with greater than 0.1 MGD of flow. Of these utilities, 12 provided public access reuse. Since 1996, the amount of reclaimed water used has grown from 74.0 MGD to just over 100.0 MGD, an increase of 33 percent. **Figure 2** shows a graph of reclaimed water made available for reuse in the study area from 1996 to 2003. Wastewater treatment capacity for the same period increased just over 9 percent. This figure also shows that the portion of reuse compared to treatment capacity has increased from 55 percent to 69 percent.

Table 1 summarizes the water reclamation facility capacity and flow information for the Year 2001 for those facilities treating more than 0.1 MGD on an average annual basis. The summary of reuse has been separated into public access reuse (PAR) and recharge basin applications.

Table 1 does not show the relative benefits of the different types of reuse applications. This is particularly important with respect to reclaimed water applied to surface storage basins, as not all basins are equally beneficial in recharging the aquifer. Depending on a number of factors, including location, geologic conditions, pond design and depth of the water table, the amount of water that makes its way to the Floridan Aquifer as recharge can vary significantly. The fraction of applied water that makes its way to the Floridan Aquifer as recharge is called the *recharge fraction*. This term was developed cooperatively between the five water management districts and the FDEP. It is identified as part of the report entitled, *Water Reuse for Florida – Strategies for Effective Use of Reclaimed Water* (Reuse Coordinating Committee 2003).

Those facilities located in low recharge areas are believed to provide little effective recharge to the Floridan Aquifer system. They are considered to have low recharge fractions. These discharge systems are typically percolation ponds and retention areas. They are included in the discharge column of **Table 1**.

Facilities located in higher recharge areas are expected to contribute a larger amount of recharge to the aquifer and are identified as having moderate to high recharge fractions. **Table 1** shows an estimated 36.4 MGD is applied in areas of central Florida with moderate to higher recharge fractions.

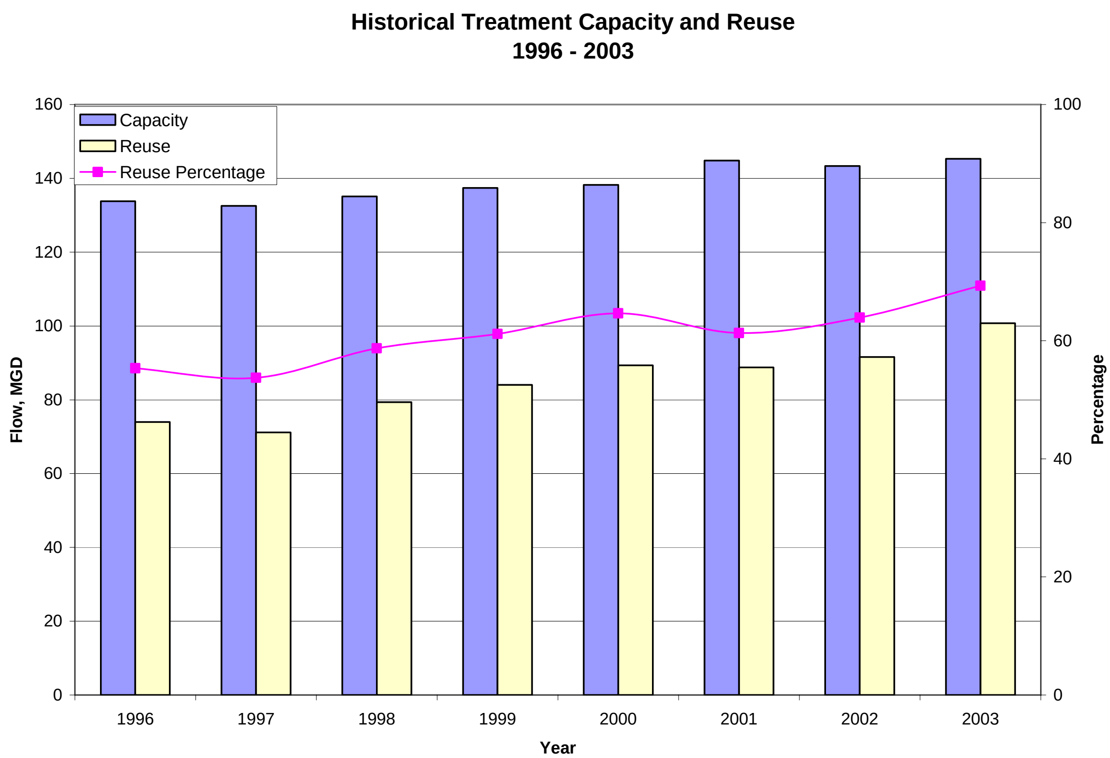

Figure 2. Historic Treatment Capacity and Reclaimed Water Reuse – 1996 to 2003.

Table 1. Wastewater Flows and Treatment Capacity for 2001.

Facility	FDEP Rated Capacity (MGD)	Disinfect Level[b]	2001 Avg Daily Flow (MGD)	Discharge (MGD)	Reuse (MGD)	
					PAR	RIB
Orange County						
Orange County Utilities						
Cypress Walk	0.69	H	0.38	0.00	0.38	0.00
Southern	30.50	H	24.72	0.50	17.17	7.05
Southwest (Horizons)[a]	---	H	---	---		
Northwest	7.50	B	4.12	0.00	0.32	3.80
Eastern	19.00	H	11.91	1.91	9.00	1.00
Plymouth Hillsa	---	H	---	---	---	---
Northern (Zellwood)[a]	0.30	H	0.17	0.17	0.00	0.00
University Shores	1.13	H	0.57	0.02	0.24	0.31
City of Orlando						
Water Conserv I	7.50	H	2.76	0.00	1.97	0.79
McLeod Road (Water Conserv II)	25.00	H	12.85	0.00	4.29	8.56
Iron Bridge	40.00	H	28.62	[c]26.12	2.50	0.00
Reedy Creek	15.00	H	9.90	0.00	5.90	4.00
Ocoee	3.00	H	1.47	0.00	1.38	0.09
Winter Garden	2.00	H	1.46	1.03	0.08	0.35
Apopka	4.00	H	2.11	0.00	1.80	0.31
Rock Springs M.H.P.	0.15	I	0.10	0.00	0.00	0.10
Starlight M.H.P.	0.15	H	0.13	0.00	0.00	0.13
Wedgefield	0.37	H	0.18	0.00	0.18	0.00
Winter Park	0.75	H	0.35	0.00	0.35	0.00
Osceola County						
Buenaventura Lakes (FWS)	1.80	H	1.64	0.08	0.11	1.45
Toho Water Authority (TWA)						
Camelot	5.00	H	2.92	0.00	2.34	0.58
Parkway	1.50	H	1.04	0.00	0.71	0.33
Sandhill Road	5.00	H	2.59	0.00	1.91	0.68
South Bermuda	7.00	H	5.24	0.00	0.92	4.32
West Regional	1.50	B	1.25	0.00	0.08	1.17
Harmonya	---	B	---	---	---	---
Orlando Hyatt Hotel	0.30	B	0.17	0.17	0.00	0.00
Siesta Lago M.H.P.	0.20	B	0.18	0.00	0.00	0.18

a. Wastewater Treatment Facility (WWTF) offline or under construction.
b. Disinfection levels: High (H), Intermediate (I) and Basic (B) as defined under Rule 62-600.440, F.A.C.
c. With this discharge of 26.2 MGD, the flow of 16.5 MGD was discharged into the manmade wetland and finally discharged into St. Johns River.

Table 1. Wastewater Flows and Treatment Capacity for 2001 (Continued).

Facility	FDEP Rated Capacity (MGD)	Disinfect Level[b]	2001 Avg Daily Flow (MGD)	Discharge (MGD)	Reuse (MGD)	
					PAR	RIB
Good Samaritan Retirement	0.20	B	0.10	0.00	0.00	0.10
Poinciana Utilities						
#1	0.35	B	0.25	0.25	0.00	0.00
#2	0.60	B	0.60	0.60	0.00	0.00
St. Cloud						
Lakeshore	2.40	H	1.38	0.60	0.78	0.00
Southside	0.80	H	0.32	0.00	0.32	0.00
Polk County						
Poinciana Utilities						
#3	0.35	B	0.22	0.22	0.00	0.00
#5	1.20	B	1.15	1.15	0.00	0.00
Polk Co. Utility (NEPCSA)						
Northeast Regional	3.00	B	0.79	0.00	0.17	0.62
Polo Park WWTF	0.60	B	0.39	0.00	0.00	0.39
Oakhill Estates	0.20	B	0.10	0.00	0.00	0.10
Total	189.04		122.13	38.82	52.90	36.41

a. Wastewater Treatment Facility (WWTF) offline or under construction.
b. Disinfection levels: High (H), Intermediate (I) and Basic (B) as defined under Rule 62-600.440, F.A.C.
c. With this discharge of 26.2 MGD, the flow of 16.5 MGD was discharged into the manmade wetland and finally discharged into St. Johns River.

The Year 2001 service areas for those utilities identified in **Table 1** are shown in **Figure 3**. **Exhibit 1** provides a summary of the information collected from each inventoried wastewater provider located within the SFWMD.

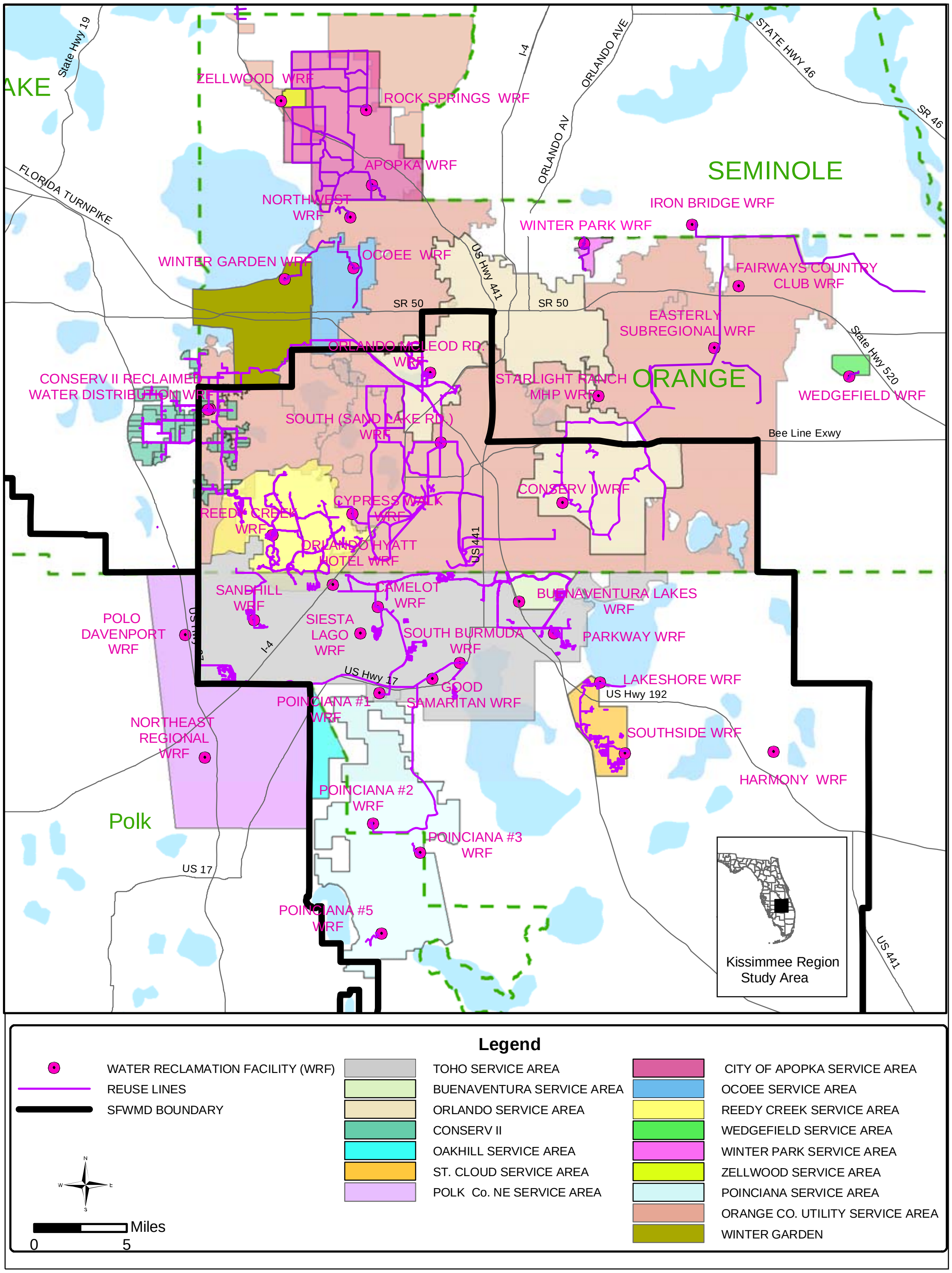

Figure 3. 2001 Service Areas of Reuse Providers.

2.2 Treatment Levels

As defined in Chapter 62-600, F.A.C., all reuse systems shall receive a minimum of secondary treatment. Basic disinfection shall be provided as a minimum for reclaimed water applications with restricted public access. Irrigation sites that allow public access receive a minimum of secondary treatment and high-level disinfection. Facilities providing reclaimed water for public access irrigation must provide a minimum of advanced secondary treatment of wastewater that includes filtration, high-level disinfection and online continuous water quality analyzers. **Table 1** provides the level of disinfection provided by each utility in 2001.

In accordance with Chapter 62-600, F.A.C., disinfection processes are provided in all wastewater treatment facilities to protect public health. Three different levels of disinfection are completed in wastewater treatment facilities.

Basic disinfection is a common level of disinfection typically used for surface water discharge and for some reuse projects, such as rapid infiltration basins (RIBs) and other groundwater recharge systems featuring restricted public access.

Intermediate disinfection is required for all new and existing facilities. The level of disinfection ranges from basic disinfection to high-level disinfection in terms of fecal coliform value and the total chlorine residual.

High-level disinfection is required for many types of reuse activities, particularly those using reclaimed water to irrigate residential lawns, public access areas and edible crops. Groundwater recharge by injection and surface water augmentation are other possible reuse applications. Injected, reclaimed and surface water discharge may be subject to additional water quality standards depending on the water quality of the zone of injection or natural system.

There are currently no indirect potable reuse projects located in the study area.

2.3 Seasonal Distribution of Supply


Reclaimed Water Facility

The amount of wastewater treated by a reclamation facility can vary significantly throughout the year. The largest factors influencing the amount of wastewater flow are the fluctuating tourist population and local rainfall amounts, both of which generally peak during the summer months. The demand for reclaimed water can also vary throughout the year, generally peaking during spring and early summer. This results in increased supplemental irrigation requirements. **Figure 4** shows the seasonal distribution of reclaimed water flows for the four largest utilities in the study area. The depicted curves show normalized recorded flows for the period of 2000–2003.

Figure 4, the seasonal variation of supply, is presented as a percentage of the average flow. This is calculated by dividing the monthly flows from January to December by the annual average daily flow. The average flow is given a value of one. The monthly flow can be represented by a percentage of this value. For most utilities, wastewater flows were the lowest from November through March and peaked during July through September. The exception to the general trend is the City of Orlando Water Conserv I water reclamation facility (WRF), which had its peak flow during the spring for this period. The graph indicates that average flows may fluctuate by about 20 percent over the course of the year.

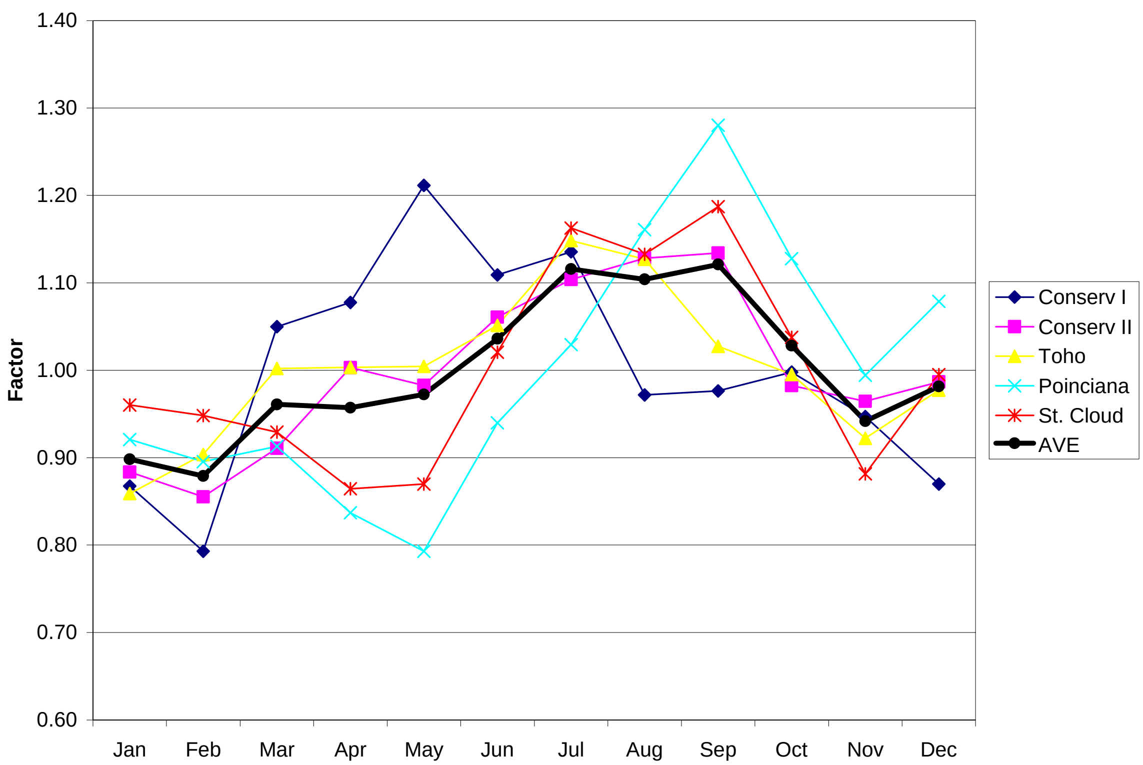

Figure 4. Seasonal Average Factor of Wastewater Flows (2001–2003).

2.4 Projected Reclaimed Water Availability

Initial estimates of domestic wastewater flows for Year 2025 were developed based on growth within the corresponding potable water system. In order to generate a baseline estimate of growth in wastewater production for each utility, it is presumed that future generation of wastewater flows will remain proportional to the growth in the potable system for those utilities operating both wastewater and potable water systems. Although it is understood that growth in wastewater flows will not directly correspond to public water supply growth due to service area differences, demographics and other issues, the estimates are presented as reasonable baseline approximations of potential wastewater generation. The period of January 2000 to December 2002 was used to develop the approximate wastewater/potable water proportionality. The generated wastewater flow estimates were compared to utility generated estimates for Year 2025, where available. In all cases, Year 2025 wastewater flow utility projections were used, when available and deemed reasonable.

For those utilities operating solely within the SJRWMD, estimates of Year 2025 flow projections were taken from the report, *Central Florida Aquifer Recharge Enhancement, Phase II* (Dorn 2004). A November update to the report was used for some values. The report summarizes projected wastewater generation for Orange County and the cities of Apopka, Ocoee and Winter Garden. This information was collected from interviews conducted by the consultant in preparation of the report. Wastewater flows in the report correspond to the Year 2020 and were projected for an additional five years using a simple straight-line projection.

Table 2 provides a summary of the projected Year 2025 wastewater flows for utilities located within the study area. The wastewater flow distribution between facilities within individual utility service areas is based on the current distribution of wastewater within each utility or information provided by the utility.

Most of the larger wastewater treatment providers expect to see significant increases in reclaimed water availability in the future. The total amount of treated wastewater available is estimated to double by Year 2025. The treatment facilities of Iron Bridge and Poinciana Utilities are expected to have significant amounts of reclaimed water that do not have current plans for reuse. These sources could be used by other utilities to supplement expanding systems. The Toho Water Authority (TWA) for example, has an agreement with Poinciana Utilities for up to 1.0 MGD of reclaimed water to augment the South Bermuda Service Area.

Table 2. Year 2025 Projected Wastewater Flows.

Facility	2025 Est. Daily Flow (MGD)	Discharge[c] including Perc Ponds	Reuse (MGD)	Increase in Flows from 2001 (MGD)
Orange County				
Orange County Utilities				
Cypress Walk	0.41	0.00	0.41	0.03
Southern	46.50	0.00	46.50	21.78
Southwest (Horizons)	5.05	0.00	5.05	5.05
Northwest	12.07	0.00	12.07	7.95
Eastern	23.23	6.67	16.56	11.32
Plymouth Hills[a]	0.02	0.00	0.02	0.02
Northern (Zellwood)	1.25	0.00	1.25	1.08
University Shores	0.00	---	---	---
City of Orlando				
Water Conserv I [d,e]	---	---	---	---
McLeod Road (Water Conserv II)	18.70	0.00	18.70	5.85
Iron Bridge	47.00	13.70	33.30	18.38
Reedy Creek	17.50	0.00	17.50	7.60
Ocoee	4.20	0.00	4.20	2.73
Winter Garden	4.50	0.00	4.50	3.04
Apopka	12.00	0.00	12.00	9.89
Rock Springs M.H.P.	0.10	0.00	0.10	0.00
Starlight M.H.P.	0.13	0.13	0.00	0.00
Wedgefield	0.20	0.00	0.20	0.02
Winter Park	1.00	0.00	1.00	0.65
Osceola County				
Buenaventura Lakes (FWS)[a]	2.45	1.96	0.49	0.81
Toho Water Authority (TWA)				
Camelot	4.50	0.00	4.50	1.58
Parkway	1.50	0.00	1.50	0.46
Sandhill Road	5.00	0.00	5.00	2.41
South Bermuda	18.00	0.00	18.00	12.76
West Regional	0.00	0.00	0.00	0.00
Harmony	1.20	0.00	1.20	1.20
Orlando Hyatt Hotel[a]	0.00	---	---	0.00
Siesta Lago M.H.P.[a]	0.10	---	0.10	0.00

a. Flows directed to other Toho Water Authority facilities.
b. Flows proposed for direction to other Polk County facilities (future).
c. Includes discharge to sprayfields and basins in low recharge areas.
d. Water Conserv I reclamation plant is to be abandoned and the flow directed to Iron Bridge WRF.
e. Water Conserv I reclamation plant is to be abandoned and the flow directed to Iron Bridge WRF.

Table 2. Year 2025 Projected Wastewater Flows (Continued).

Facility	2025 Est. Daily Flow (MGD)	Discharge[c] including Perc Ponds	Reuse (MGD)	Increase in Flows from 2001 (MGD)
Good Samaritan Retirement[a]	0.00	---	---	0.00
Poinciana Utilities				
#1	0.53	0.00	0.53	0.28
#2	1.47	0.00	1.47	0.87
St. Cloud				
Lakeshore	0.00	---	---	0.00
Southside	6.60	0.00	6.60	3.40
Polk County				
Poinciana Utilities				
#3	0.50	0.50	0.00	0.28
#5	2.70	2.70	0.00	1.55
Polk Co. Utility (NEPCSA)				
Northeast Regional	4.00	---	4.00	3.21
Polo Park WWTF	1.20	---	1.20	0.81
Oakhill Estates[b]	0.00	---	---	0.00
Total	243.61	25.66	217.95	125.01

a. Flows directed to other Toho Water Authority facilities.
b. Flows proposed for direction to other Polk County facilities (future).
c. Includes discharge to sprayfields and basins in low recharge areas.
d. Flows directed to Orange County facilities.
e. Water Conserv I reclamation plant is to be abandoned and the flow directed to Iron Bridge WRF.

3. ESTIMATION OF RECLAIMED WATER DEMAND

Florida permits a wide range of reuse options. Among these are public access irrigation, agricultural irrigation, commercial and industrial uses, wetland maintenance and groundwater recharge. The methods employed to best estimate reclaimed water use for each water use type varies depending on the use category. Estimates for larger uses, such as agricultural, industrial and golf course irrigation are typically easier to estimate, as most of these customers are metered and the factors used to estimate water demands are better defined. The estimates for residential irrigation are more difficult to determine as a smaller percentage of the customers are individually metered and the determination of actual irrigated area is less well known.

An important category of reclaimed water use is aquifer recharge. Typically, the volume of water directed to recharge basins is water available in excess of irrigation demand. For the purpose of this study, aquifer recharge is recognized as a desirable use of reclaimed water. The estimates of recharge demands are calculated because of excess reclaimed water availability. Flow records for rapid infiltration basin (RIB) discharges were collected where available to characterize the seasonal nature of this application.

Another category of reuse is utility use. These uses are related to operations in treatment plants, maintenance and line losses. Wetland maintenance is included in this category if the wetland is part of the treatment system. Both Orange County Utility and the City of Orlando have identified flow requirements for wetland maintenance. Unless otherwise identified, these uses are presumed to be 5 percent of the total amount of treated flow.

3.1 Existing Reclaimed Water Applications

The estimates of reclaimed water use were compiled from records of delivery for each use type. The primary information sources were local utility interviews and data provided in the *2001 Reuse Inventory* (FDEP 2002). In 2001, the recorded amount of reclaimed water applied to reuse activities averaged 89.0 MGD within the study area. The remaining 39.0 MGD of reclaimed supply was discarded with minimal benefit.

Not all reuse applications are considered equally beneficial with respect to efficiency in addressing future water supply concerns. In 2003, the five water management districts and the FDEP developed a table of reuse desirability as part of an effort to begin evaluating the relative benefits of reuse. This guideline is part of a report titled, *Strategies for Effective Use of Reclaimed Water* (Reuse

Coordinating Committee 2003). In this report, examples of potable reuse offset and recharge fractions are provided for estimating the degree of water supply benefit from each type of reuse. These guidelines are considered reasonable estimates in lieu of site-specific information or models that can more accurately predict groundwater reactions to specific reuse applications. **Exhibit 2** presents a table of the desirability reuse types included with this report. The levels of desirability are grouped according to high, moderate and low levels of efficient returns on reuse.

Figure 5 shows the distribution of reclaimed water use in the study area for the Year 2001. Water reuse is separated according to use types. Aquifer recharge represents reclaimed water discharged to RIBs located in high and moderate groundwater recharge areas. Utility use includes water used at the treatment plant and for wetland maintenance. Reclaimed water is categorized as disposal when directed toward basins located in low recharge areas, directed toward sprayfields or discharged to surface water features. Disposal represents reclaimed water, which contributes little to the offset of potable demand and could be used in a more efficient manner.

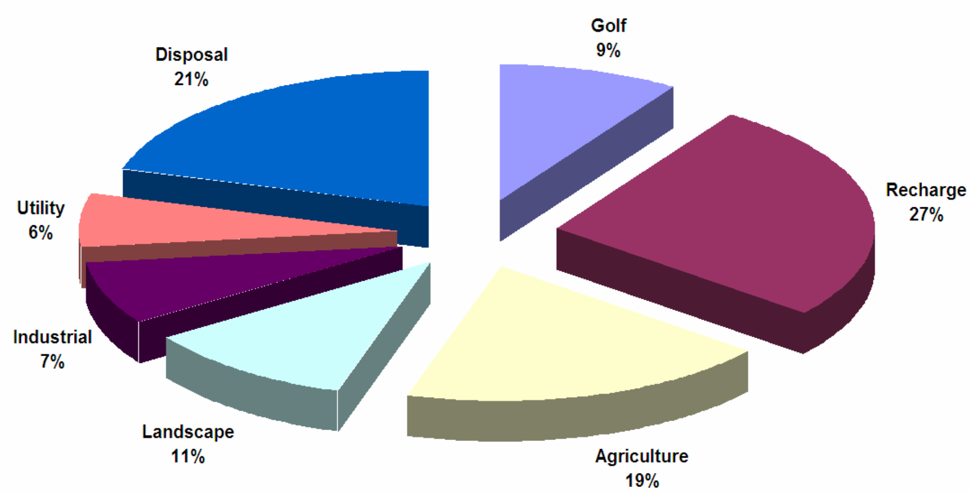

Figure 5. Year 2001 Distribution of Reuse. (Year 2001 Reclaimed Supply = 122.1 MGD).

In 2001, the largest application of reclaimed water was aquifer recharge, averaging 36.4 MGD or 27 percent of the wastewater treated. Three facilities—the Water Conserv II, Reedy Creek recharge basins and the Toho Water Authority recharge basins—accounted for 92 percent of the application for aquifer recharge.

The second largest application of reclaimed water was directed toward agricultural irrigation. In this category, Water Conserv II represents the largest agricultural irrigation project irrigating almost 7,000 acres of citrus in western Orange and eastern Lake counties.

Landscape reuse as identified in **Figure 5** includes irrigation of commercial landscaping, medians, parks, residential lots and other green spaces. Residential irrigation represents approximately 62 percent, or 5.0 MGD of the landscape irrigation reuse total. While landscape irrigation accounts for only small portion of the current overall reuse total, it represents the sector with the largest potential growth in demand over the next 20 years. Agricultural irrigation reclamation opportunities are expected to decline as existing citrus groves are converted to urban growth areas.

Disposal of reclaimed water includes water discharged to sprayfields, basins in low recharge areas and discharges to open water bodies. Approximately 86 percent of the water (32.8 MGD) in this category comes from two sources, the Iron Bridge WRF, operated by the City of Orlando and Poinciana Utilities. The majority of the reclaimed water produced at the Iron Bridge WRF is transmitted east to the Wetlands Park Facility and is eventually discharged into the Econ River. The wetland system is identified as part of the treatment process, requiring about 5.0 MGD of water flow for maintenance (included under utility use). The city has pending agreements with Orlando Utility Commission (OUC), Orange County Utilities (OCU) and several other communities to use a portion of this water to augment reuse systems. The Toho Water Authority (TWA) currently has interconnects with Poinciana Utilities for delivery of up to 3.0 MGD to supplement the South Bermuda Service Area.

With the exception of commercial and industrial type uses, the recorded Year 2001 amounts of reclaimed water use do not necessarily represent need or demand. These uses are thought to represent a combination of true demand, wet weather disposal needs of the utility and inefficient use by the customer. Wet weather disposal and efficiency of use are addressed as opportunities for system improvements.

3.2 Identification of Potential Reclaimed Water Recipients

Potential reclaimed water recipients need to be identified to determine the role of reclaimed water in the future demand picture. Sources of information for potential recipients include the utility provider, the District's consumptive use permit database and future land use growth plans. Local utilities have the best sources of information on potential customer growth. Many utilities have detailed 5-year and 10-year water supply facilities work plans for construction and funding of future reuse projects. District consumptive use permit holders represent another good source of potential reclaimed water recipients. Many of these permitted uses require the use of reclaimed water where available and feasible. Future land use maps were used to determine the direction of new residential and commercial growth. The inventory of potential recipients was limited to those areas within or directly adjacent to the identified future reclaimed water service areas.

Through a series of interviews, utilities were questioned about plans for growth and asked to identify potential customers. In most cases, the demands estimated for potential customers by the utility were included in the inventory. Exceptions occurred for utility-identified sites having a consumptive use permit. In these cases, the consumptive use permit allocated amount was used for the demand estimation. Where the utility-identified demands may not represent the most efficient use of water, the potential for water savings through conservation is addressed in later sections.

Agricultural, Recreational and Industrial Recipients

The estimates of future growth in agricultural, recreational and industrial sectors were prepared using several of the previously referenced sources. The future service commitments identified by each utility were the first source. In these cases, the location of the customer and the estimate of demand were summarized from the utility's water supply facilities work plans or from other plans identified by the utility.

Many of the agricultural, recreational and landscape irrigation uses were identified using the District's water use permit files. Those sites currently using reclaimed water were removed from the list of potential sites. This information was then compared to future land use maps to adjust for agricultural activities expected to be replaced by future urban development. In Orange and Osceola counties, many of the existing citrus groves are anticipated to be replaced with developments over the next 20 years. A net reduction of 6,000 acres of citrus is anticipated for the study area between Year 2000 and Year 2025.

Potential Residential Uses


Reuse – Potential Residential Uses

Residential and urban landscape uses of water are expected to represent the largest growth in potential reclaimed water demands over the next 20 years. While utility plans can provide the best insight to the location of residential connections, future land use maps from municipal comprehensive planning efforts provide insight to the expected location of residential growth within a utility's service area over the long-term. The District compiled and evaluated future land use maps from all the county and city governments in central Florida. The future land use maps were then compared to the 2000 land use information to identify areas of expected growth. **Figure 6** shows the differences between 2000 land use and future land use for the study area. Areas defined in yellow are regions predicted to change from agriculture or undeveloped lands to residential areas. Areas in red show an increase in urban density from the Year 2000 land use classification. The growth information was combined with the University of Florida Bureau of Economic and Business Research (BEBR 2004) population estimates and traffic analysis zone information to identify the potential number of residential housing units likely to be constructed within a given region.

The population and residential construction estimates resulting from the land evaluation were then cross-referenced as a control total with housing market projections from the Florida Housing Data Clearinghouse (FHDC 2003) available from: http://www.flhousingdata.shimberg.ufl.edu/. Projections of residential demands are discussed further in Section 3.4.

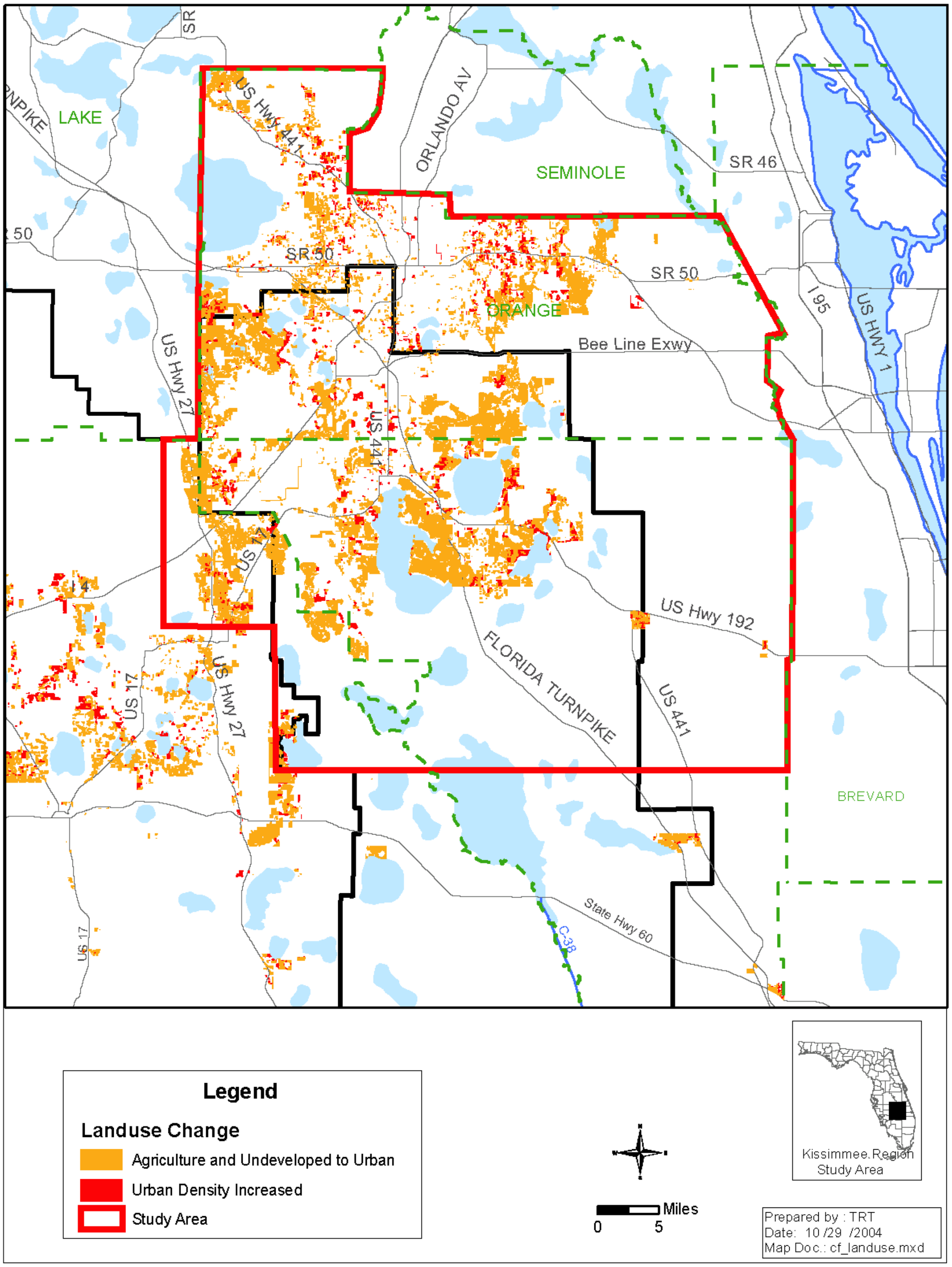

Figure 6. Location of Urban Growth Areas in Orange, Osceola and Polk Counties.

3.3 Screening of Potential Reuse Recipients

While a practically limitless number of potential reclaimed water customers could be identified, it is likely a smaller subset of this number may be identified as having the greatest potential of becoming reclaimed water recipients due to cost and site access. In order to identify those potential uses having the greatest likelihood of being connected, the District applied a screening process to the list of identified sites. As part of this screening process, the following assumptions were made:

- The expansion of reuse into areas of new residential construction is preferable to retrofitting older subdivisions.
- Larger uses, such as golf courses, parks and agricultural sites, are preferred for reuse as this minimizes the number of customer accounts, and initial installation costs. In addition, these sites often have consumptive use permits that encourage reuse.
- Agricultural sites not having a consumptive use permit are categorized as inactive and were not considered.
- Existing sites located with a limited distance of existing distribution lines are preferred to minimize costs. A one-third mile radius from the existing pipeline was applied.
- Installation of new service lines is prioritized for regions within a given service area. Not all areas within a service area (or adjacent to the service area) are expected to be served with reclaimed water.
- Locations identified by utilities are included in all cases.

3.4 Estimates of Potential Demands

The estimates of new potential demands on reclaimed water sources were calculated for those areas identified through the screening process. For the purpose of this study, the estimates of potential uses are grouped into utility identified demands, agricultural, golf and industrial type uses and residential landscape uses.

The following sections present a description of how demands for each of these uses were compiled. Uses identified by individual utilities are included in the following demand estimate, but were not screened as previously described unless obvious disposal components are included in the estimate.

Agricultural, Recreational and Industrial Demands Increased

Potential agricultural uses identified through the District's consumptive use permit database were reviewed using Year 2000 land use to verify and adjust for observed crop acreage. The screening criteria described in Section 3.3 were then applied to prioritize those sites more likely to receive reclaimed water. Potential demand was calculated using acreage amounts from the GIS land use review and Agricultural Field Scale Irrigation Requirements Simulation (AFSIRS) demand estimation tool. The permitted amounts identified in the District consumptive use permit database for recreational and industrial uses were used as demand estimates for these use types, unless water use records were available to provide actual water use accounting.

Agricultural acreage is expected to generally decrease over the next 20 years. Reductions of approximately 6,000 acres in Orange County, 2,500 acres in Osceola County and 2,500 acres in northern Polk County are expected by Year 2025. A bulk of the reduction of citrus acreage in Orange County is anticipated for groves serviced by the Water Conserv II facility. The county and city have estimated a demand reduction of 4.1 MGD from reduced citrus irrigation supplied by the Water Conserv II facility.

The estimates of growth in future recreational use include new golf courses and existing golf courses that are not currently using reclaimed water for irrigation. Golf course construction has a well-documented history of growth, which can be used to predict future increase in acreage. The projected increases in golf course construction are about 2,300 acres for Orange County, and 2,500 acres in Osceola County by Year 2025. Two new golf courses are projected within the Polk County Northeast Service Area over the next 20 years. The distribution of the course locations was made based on population growth for the different service areas.

Growth in industrial uses is much more difficult to estimate. While some growth is projected for this use category, the location of the demand is difficult to predict. Predicted demands in industrial uses are limited to those having a consumptive use permit and demands identified by the utility. The Stanton Energy and Kissimmee Utility Authority power generation plants are examples of future industrial growth.

Figure 7 and **Figure 8** show the locations of potential agricultural, recreational and industrial reuse sites within the study area. Potential reuse recipients are labeled with numbered points. **Exhibit 3** provides a list of the identified reclaimed water customers.

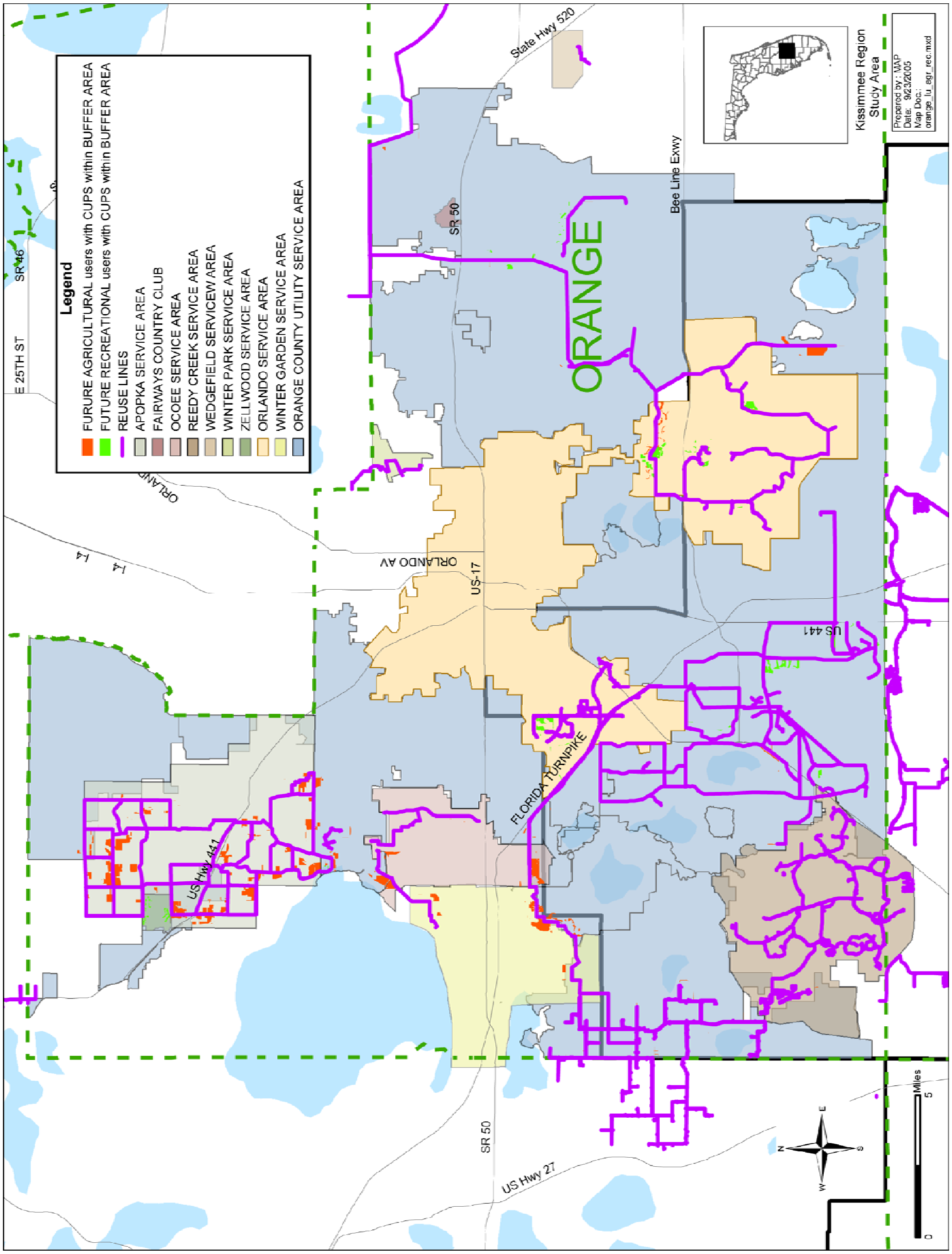

Figure 7. Location of Potential Agricultural, Recreational and Industrial Reuse Sites in Orange County.

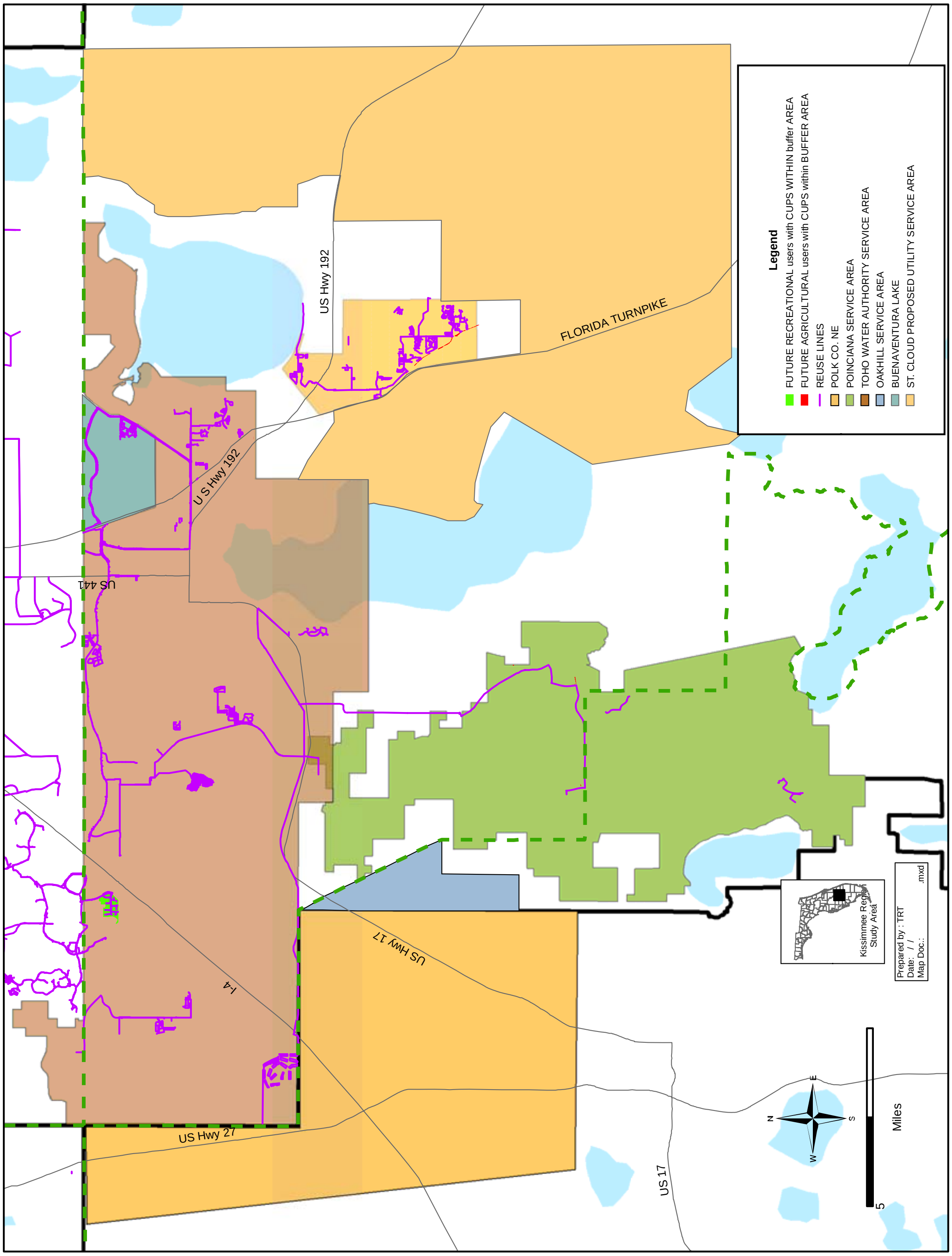

Figure 8. Location of Potential Agricultural, Recreational and Industrial Reuse Sites in Osceola and Eastern Polk Counties.

Table 3 provides a summary of the predicted increase in potential customer demands for reclaimed water through the planning horizon. Any utility not represented in **Table 3** has projected no new agriculture, recreational or industrial uses.

Table 3. Potential New Agricultural, Landscape and Industrial Demands.

Utility	Agricultural		Landscape		Industrial Demand MGD
	Acres	Demand MGD	Acres	Demand MGD	
Orange County Utilities	920	4.00	300	0.81	[a]3.30
City of Orlando	100	0.44	352	0.95	
Reedy Creek Improvement District	0	0.00	[c]1,500	4.07	
Toho Water Authority	106	0.46	185	0.50	[b]0.50
St. Cloud	24	0.10	0	0.00	
Poinciana	7	0.03	0	0.00	
Ocoee	234	1.02	7	0.02	
Winter Garden	211	0.92	0	0.00	
Apopka	1,684	7.60	0	0.00	
Polk County N.E.	0	0.00	---	[d]7.03	
Winter Park	0	0.00	0	0.00	
Total	3,286	14.57	2,344	13.38	3.80

a. Projected demand increased for Stanton Energy.
b. Projected demand increased for Kissimmee Utility Authority (KUA).
c. Based on estimated available reclaimed water.
d. The number was provided by the local utility.

Table 4 presents the projected irrigation demands for golf course use by Year 2025. The distribution of golf courses per utility service area is based on the projected service area population growth through Year 2025. The results were rounded to the nearest whole number of courses. A size of 120 acres was applied per course. An average irrigation rate of 27 inches per year for golf course turf grass was applied to obtain an estimate of irrigation demand. Existing courses not receiving reclaimed water in Year 2000 were added to the totals.

Table 4. Projected New Golf Course Acres and Irrigation Demands.

Utility	Number Golf Courses Increased	Increased Golf Courses Irrigated Area, Acre	Irrigation Demands, MGD	Existing Golf Courses, MGD	Total MGD
Orange County Utilities	5	600	1.21	2.40	3.61
City of Orlando	7	840	1.69	0.60	2.29
Reedy Creek Improvement District	N/A	N/A	N/A	0.90	0.90
Toho Water Authority	16	1,920	3.86	0.75	4.61
St. Cloud	2	240	0.48	0.30	0.78
Poinciana	3	360	0.72	0.00	0.72
Ocoee	1	120	0.24	---	0.24
Winter Garden	2	240	0.48	---	0.48
Apopka	3	360	0.72	---	0.72
Polk County N.E.	2	240	0.48	---	0.48
Winter Park	1	120	0.24	---	0.24
Total	42	5,040	10.12	4.95	15.07

Identified Residential Demands

An examination of current residential irrigation use shows that most reclaimed water use is in excess of the amount recommended. This can be related to a number of factors including customer education, utility encouragement of use for disposal reasons and poor irrigation system efficiency. While reclaimed water use for irrigation could and should be used in a manner that is reasonable and consistent with the landscape requirements, an examination of metered residential use of reclaimed water shows that use is much higher than the calculated requirement.

For the purpose of this study, a value was sought that represented a real world number for residential irrigation based on actual data. A number of studies, particularly those completed by the Southwest Florida Water Management District (SWFWMD) and Florida's west coast utilities, have monitored residential irrigation using both reclaimed and potable water sources. These studies show reclaimed water use as being nearly twice that of potable use. A survey of residential reclaimed water use conducted by the SWFWMD showed that metered use of reclaimed water averaged 508 gallons per day (GPD) per connection for systems charging block rates for usage. Those utilities not charging block rates saw use exceeding 900 GPD per connection. Additional information provided by the Toho Water Authority (TWA) and the City of St. Cloud estimated reuse rates of 415 GPD and 451 GPD per connection respectively. For this study, a rate of 450 GPD per connection is used to predict reclaimed demand for residential customers.

Figure 6, presented earlier, shows the locations of new residential housing projected for development between Year 2000 and Year 2025. Not all of these new housing areas are likely to be serviced. A subset of the total will have a greater likelihood of receiving reclaimed water. New service areas are likely to be a continuation of current trunk lines. For economic reasons, new service regions will be developed in areas with the largest projected growth. **Figure 9** and **Figure 10** present identified regions or corridors of concentrated new residential growth projected to occur prior to Year 2025. Areas where reclaimed water may have a higher likelihood to be provided due to future growth patterns are identified. These identified areas are used to limit estimates of potential residential irrigation demands for reclaimed water.

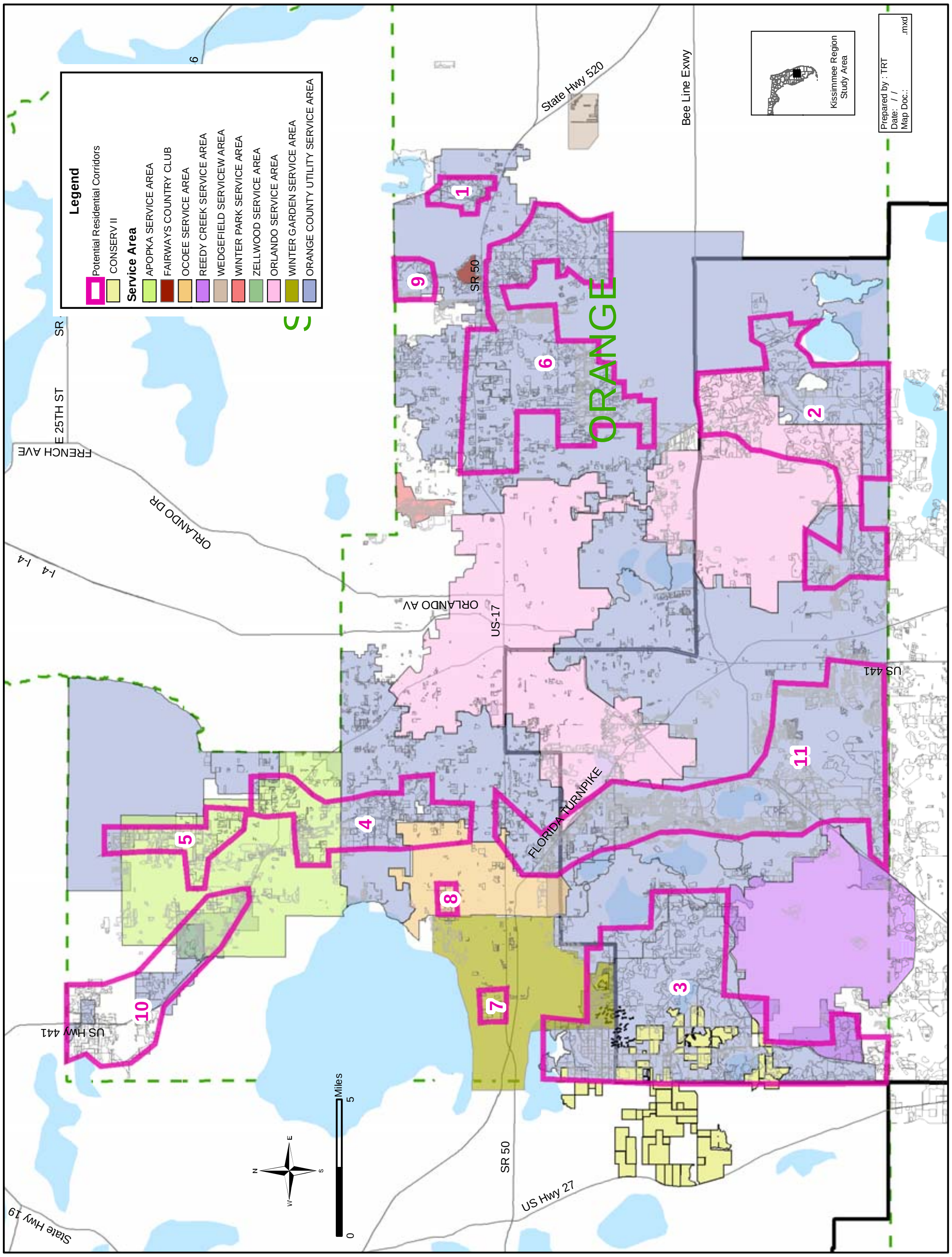

Figure 9. Future Urban Growth Corridors in Orange County.

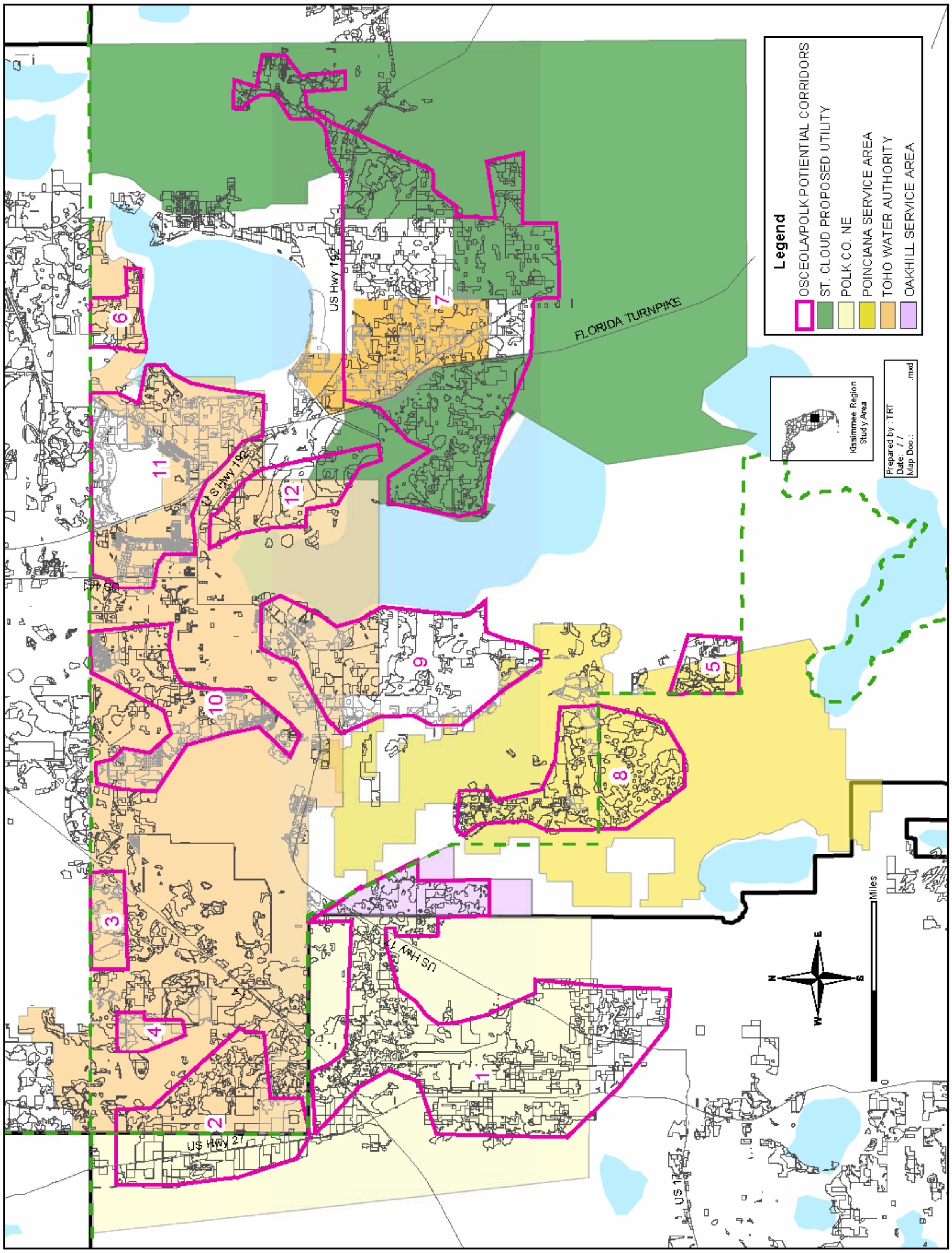

Figure 10. Future Urban Growth Corridors in Osceola and Eastern Polk Counties.

Table 5 shows the number of single-family homes projected within the regions identified in **Figure 9** and **Figure 10**.

Table 5. Estimated New Residential Reuse Demand Through Year 2025.

Utility[c]	Based on Increased Population		Based on Increased Res. Areas	
	# New Residential Unit	Demand[a] (MGD)	# New Residential Unit	Demand (MGD)
Orange County (Blocks # 3,6,9,10,11)	68,722	30	42,620	19.2
Orlando Utilities (Block #2)	42,503	19	55,324	24.9
Toho Water Authority (Block # 2,3,4,6,9, 10,11,12)	25,525	11	30,073	13.5
City of St. Cloud (Block #7)	14,639	6	12,236	5.5
Poinciana Utilities (Block #5,8)	16,053	7	14,896	6.7
Reedy Creek Improvement District	0	0	0	0.0
Ocoee (Block #8)	11,845	5	4,371	2.0
Winter Garden (Block #7)	12,086	5	904	0.4
Apopka (Block #4,5)	13,900	6	20,291	9.1
Winter Park[b]	3,918	1	-----	----
Polk County NEUSA (Block #1)	6,152	2	6,046	2.7
Total	215,343	92	186,761	84.0

a. Based on reclaimed use of 450 GPD residential use.
b. Majority of new homes in Winter Park to be located in Seminole County, demand is not included in the total.
c. Refer to the maps for the block numbers.

4. ANALYSIS OF SUPPLY AND DEMAND

4.1 Summary of Projected Demand and Availability

The estimated Year 2025 reclaimed water demand is expected to increase over Year 2001 use by 208.0 MGD to a total of 262.9 MGD. **Table 6** provides a breakdown of the projected increase within the study area by the Year 2025. It summarizes the total projected demands and includes Year 2001 existing demands. A majority of the utilities in the study area project potential demands greater than the estimated availability of reclaimed supply. A portion of the shortfall might be met by system interconnection, supplemental sources or improvements in efficiency in reclaimed use. The analysis also indicates that future residential irrigation will be the largest use type by Year 2025, which represents approximately 35 percent of the total projected demand.

As in any reuse system, 100 percent of the generated wastewater flow will not be directed toward needed potable replacement due to changes in daily demand. Discharge to recharge basins or disposal is a necessary part of any reuse system; in many cases, it is considered a beneficial use. Unless a utility has a specific goal in mind, discharges toward recharge basins are not true water demands on the system as previously estimated. The amount of reclaimed water going to recharge basins is generally a reflection of negative demand or water left over after all potable replacement demands have been met.

Discharge to recharge basins (or disposal) ranged from 24 to 63 percent of the raw wastewater flows in Year 2001 for those utilities providing reclaimed water services. An examination of these and other providers statewide suggests that 70 percent to 75 percent of the annual reclaimed water is directed toward potable replacement in the more efficient systems. The remaining 25 percent to 30 percent of annual flow is directed towards recharge basins or discharged due to reduced demand and changes in availability caused by changing climatic conditions. To estimate future discharge demands, it is presumed that reuse systems will develop the base of potable replacement uses to 75 percent of the annual raw wastewater flows through improved storage, improved management and supplemental sources. Unless a utility specifically identified a target or goal for discharge to recharge basins, an estimate of 25 percent of the annual wastewater flow for a utility is presumed to be directed towards these discharge basins by Year 2025. **Table 6** shows this projected recharge basin demand.

Table 6. Estimated Total Reclaimed Water Demand (MGD) through Year 2025.

Utility	Projected New Demand (MGD)					2001 Use	Ground-water Recharge	Total	Projected Availability
	Industrial	Residential	Landscape	Golf Course	Agriculture				
Orange County	3.30	30.00	2.45	3.61	4.05	[b]23.01	[c]26.00	92.42	88.53
City of Orlando	---	19.00	2.22	2.29	0.62	8.76	[c]11.60	44.49	65.70
Toho Water Authority	0.50	11.00	1.64	4.61	2.18	5.96	7.50	33.39	30.20
City of Poinciana	---	7.00	0.06	0.72	0.00	0.00	1.30	9.08	5.20
City of St. Cloud	---	6.00	0.06	0.78	0.87	1.10	1.00	9.81	4.00
Reedy Creek Improvement District	---	---	4.07	0.90	---	5.90	4.30	15.17	17.50
Ocoee	---	5.00	0.51	0.24	4.27	1.38	1.10	12.50	4.20
Winter Garden	---	5.00	0.01	0.48	6.79	0.08	1.10	13.46	4.50
Apopka	---	6.00	1.01	0.72	8.06	1.80	3.00	20.59	12.00
Starlight M.H.P.	---	---	---	---	---	---	0.03	0.03	0.13
Wedgefield	---	---	---	---	---	0.18	0.05	0.23	0.20
Buenaventura Lakes (FWS)	---	---	---	---	---	0.11	0.60	0.71	2.45
Siesta Lago M.H.P	---	---	---	---	---	0.00	0.03	0.03	0.10
Good Samaritan Retirement	---	---	---	---	---	0.00	---	0.00	0.00
Polk County, N.E.	---	2.00	[d]5.03	0.48	---	0.17	1.30	8.98	5.20
Total	3.80	91.00	17.06	14.83	26.84	48.45	58.91	260.89	[e] 239.9

a. The total projected demand for Polk County, N.E. includes the existing demand at Year 2001 and the local utility projected demand.
b. The Year 2001 use was reduced by 4.1 MGD to reflect reduction of citrus irrigation at Water Conserv II.
c. Utility specified future discharge to RIBs and wetland.
d. This number is provided by the local utility.
e. The projected flows for Rock Springs M.H.P. and Winter Park as shown in Table 2 are not included.

A simple comparison of the total available supply with the potential demand demonstrates that in most cases, the potential number of locations to apply reclaimed water is larger than the expected supply to be generated by Year 2025. Projected reclaimed water availability for the study area is expected to increase by 125.3 MGD by Year 2025, while potential demand is estimated to increase by 208.0 MGD to 260.9 MGD over the same period. These values include a 25 percent estimate for basin recharge and disposal requirements.

5. IDENTIFICATION OF SUPPLEMENTAL SOURCES AND STORAGE OPTIONS

5.1 Supplemental Sources

Use of another water source, such as surface water, groundwater, storm water or treated drinking water can enable better use of water resources to augment supplies of reclaimed water, largely to meet peak demands. The use of supplemental water supplies to meet peak demands for reclaimed water may enable a reclaimed water utility to be more aggressive in implementing its reclaimed water system. More customers can be served with reclaimed water and less excess reclaimed water would need to be diverted for disposal uses. Use of supplemental water supplies is normally subject to consumptive use permitting by the water management districts. In some areas, these sources of water may not be available as a supplemental source in times of drought.

There are three primary sources of supplemental supply in central Florida: groundwater, surface water (including stormwater), and system interconnects with other wastewater utilities. Three reuse systems, The City of Apopka, the joint City of Orlando – Orange County Water Conserv II project and Wedgefield subdivision, use groundwater as a supplemental source according to the *FDEP 2001 Reuse Inventory*. Combined supplemental use of the three systems is permitted for an average of 0.8 MGD.

5.2 System Interconnects

The most common source used to support reclaimed supplies is system interconnects. Known system interconnects exist between Reedy Creek Improvement District and the Toho Water Authority; Toho Water Authority and Poinciana Utilities; the cities of Ocoee and Winter Garden; and, Orange County and the City of Orlando. These interconnects are not addressed under consumptive use permits. Several future interconnects were identified. Additional interconnect options exist for smaller domestic wastewater treatment facilities with flows below the 0.1 MGD threshold. In Year 2000, there were 18 of these smaller domestic facilities in the study area having a flow averaging 0.02 MGD.

Reuse system interconnects offer a means to increase both the efficiency and reliability of reuse systems. When two or more reuse systems are interconnected, additional flexibility is gained to meet the demand of the reuse system customers. This also increases the reliability of providing acceptable reclaimed water for reuse. In addition, if one reclaimed water facility experiences a temporary problem with producing reclaimed water of acceptable quality, the interconnect with another facility can provide a means to enable continued delivery of reclaimed water to system customers while the problem is resolved.

Interconnects offer the ability to share system storage facilities. Records were not collected to account for the amount of water transferred between utilities.

5.3 Surface Water Supplemental Sources

Within the study area, several surface water options are available to supplement reuse systems. Along with local stormwater collection systems, larger drainage systems are available to supplement supplies. These include Boggy, Shingle and Reedy creeks and the Kissimmee Chain of Lakes. The District completed two preliminary studies in 2005 to evaluate the availability of surface water from these regional surface water systems, *A Preliminary Evaluation of Water Availability in East Lake Tohopekaliga and Lake Tohopekaliga* (Cai 2005) and *A Preliminary Evaluation of Water Availability in Boggy and Shingle Creeks* (Cai 2005).

The results indicate that up to 4.0 MGD may be available from Boggy Creek, 6.0 MGD from Shingle Creek and in excess of 50.0 MGD may be available from the Kissimmee Chain of Lakes. Reliability is the largest concern regarding surface water supplemental sources. The availability of surface water is subject to climate conditions. The source is often most limited when demands on the reclaimed system are at a peak. The reliability of the surface water drainage systems within the study areas was reviewed as part of the surface water availability studies. Additionally, water treatment requirements for providing supplemental surface water to the reclaimed system are significantly less than requirements for treatment to potable standards.

Local sources of surface water and groundwater can play an important role in supplementing reclaimed water supplies. Golf course and agricultural uses are common examples of local sources serving as supplemental reclaimed water supplies. Golf courses often use internal water features or horizontal wells to supplement reclaimed use. Many citrus groves maintain backup wells or storage ponds to supplement supplies, particularly during freeze protection events.

5.4 Conservation and Management Tools

The reuse of reclaimed water is considered a method of water conservation. Reclaimed water is also a valuable source of future water supplies. Maximizing its use is important. Many conservation programs used to promote efficient use in potable systems can be applied to reclaimed water systems. Among these are customer education, water use restrictions, such as odd/even watering days, pressure regulation, system audits, rain sensors, landscaping assistance and volume-based rates.

An often overlooked water conservation method is the use of reclaimed water for toilet flushing. The unique benefit is that such use is recycled to the wastewater stream for another reuse application. Like other indoor uses, the rate of use is more predictable and less subject to seasonal peak variations. This use can also serve as a tool in managing peak demand problems. Significant residential growth makes this a viable option for central Florida. Growth in new single-family homes is estimated to exceed 200,000 units by Year 2025. Estimating a rate of 10 GPD per home in savings provides a return of 2.0 MGD of renewable use. Estimates increase if multi-family homes are included.

Metering and volume-based rates are among the most effective means of promoting conservation. Studies conducted by the Southwest Florida Water Management District (SWFWMD) concluded that simply providing meters could reduce the use of reclaimed water by residential customers by 50 percent. The SWFWMD review of application rates from 15 utilities showed that reclaimed water use was nearly double that of potable water irrigation for the same use. The SWFWMD also reviewed how this amount varied depending on rate charges by the utility. The average use among the seven utilities charging metered rates was 508 gallons per residential customer. Use among the eight utilities charging flat rates for service averaged 927 gallons per residential customer. Most of the larger utilities in the study are currently using a block rate for reclaimed water service. However, charges for reclaimed service are consistently lower than potable charges.

Metering of reclaimed water and implementation of volume-based charges for which users pay at least part of the actual metered volume are among the most strongly encouraged methods for managing reclaimed water supplies. These methods are a major strategy documented in *Water Reuse for Florida – Strategies for Effective Use of Reclaimed Water* (Reuse Coordinating Committee 2003). Using estimates of a reduction in residential reclaimed water use of 50 percent to bring this use in line with potable water use estimates, a reduction in reclaimed water demand is projected at 45.0 MGD based on the findings in **Table 5**. Additional water management tools include pressure regulation, prescribed water days (not hours) and audits for high users.

Water audits are effective in identifying specific measures for system improvement. Some measures may include, but are not limited to, proper operation timing, leak or break repair, and replacement of broken sprinkler heads.

Audits of industrial uses are less common. Mobile Irrigation Labs (MILs), often sponsored by the District, are useful for implementing irrigation system audits. The District sponsored over 500 residential and 150 agricultural audits using these labs over the past several years. Reported water savings from these audits averaged approximately 1,620 GPD per acre and 248 GPD per acre respectively.

5.5 Storage Options and Indirect Potable Reuse

Storage is a necessary component in any reuse system. Aboveground storage and local retention ponds are used by utilities to address short-term (less than a week) shortfalls in availability. Longer periods of high demand are often addressed by supplemental sources, such as wells or reservoirs. Recently, the City of St. Cloud constructed a 70 million gallon storage reservoir to address demand shortfalls. Other storage options include aquifer storage and recovery, which is an indirect potable reuse.

Surface Water Storage

Surface water storage has been used for a long time throughout the world. Regional scale surface water reservoirs are proposed for construction in south Florida as part of the Comprehensive Everglades Restoration Program (CERP). Reclaimed water storage is one of the functions of these CERP constructed reservoirs. The reservoir construction permitting process is relatively less complex when compared with other options. However, reservoirs are land intensive and have significant loss of water in the summer through evaporation. Initial costs and continued maintenance for this option are higher than for other options.

Aquifer Storage and Recovery

Aquifer storage and recovery (ASR) is the underground storage of water injected into an acceptable aquifer during times when there is excess water availability. The water is later recovered during high demand periods. The aquifer acts as an underground reservoir for the injected water, reducing water loss due to evaporation and seepage. With the ASR option, it is possible to conduct long-term (multiyear) storage and recovery. This option requires limited land and results in significant cost savings as compared with surface water reservoirs.

However, underground injection, particularly with reclaimed water, involves a relatively complex and usually difficult permitting process. The Florida Department of Environmental Protection (FDEP) regulates underground injection. It requires that injected water meet drinking water standards when injected into potable water aquifers like those found in central Florida. In addition, well recovery depends on several factors, such as well yield, water availability, variability in water supply and initial aquifer water quality. Few studies exist that track the correlation of reclaimed water injection and long-term health effects.

Indirect Potable Reuse

Under Chapter 62-610, F.A.C., indirect potable reuse is the planned use of reclaimed water to augment surface water and/or groundwater resources, which are used or will be used for public water supplies. Unlike ASR, there is no direct recycling of the water back through the injection well. Reclaimed water used for indirect potable reuse is required to meet the principle treatment and disinfection standards for primary and secondary drinking water.

In 2003, the SFWMD completed Phase I of an indirect potable reuse study to evaluate the injection of reclaimed water to recharge the Floridan Aquifer. This initial study reviewed the economic, technical and permitting requirements for reuse injection. The study found that the injection of highly treated reclaimed water was comparable in cost to land applications when land and construction costs were considered. The increasing cost of land and the likelihood of new federal water treatment requirements in the future will make indirect potable reuse (IPR) more attractive.

Aquifer storage and recovery and IPR injection into potable aquifer systems have received widespread public objections due to reliability concerns with water treatment. Similar projects, such as the Water Factory 21 in California, and the Huech Bolston project, in Texas, have been in operation for years. Studies of these facilities have shown that certain contaminates bypass the treatment system.

The keys to making ASR or IPR work in central Florida are to provide assurance of water treatment prior to injection and to change public perception of the risks associated with potable aquifer injection.

The Phase I study provided a pilot testing program, which the District continues to pursue.

6. CONCLUSIONS AND REUSE IMPROVEMENT OPPORTUNITIES

Central Florida is a leading user of reclaimed water for potable replacement and aquifer recharge. According to the *FDEP Reuse Inventory for 2001*, 73 percent of the 122.0 MGD of reclaimed water collected within the study area was identified as being reused. A more detailed evaluation of these reuse applications finds that not all reuse applications provide the same level of benefits for improving the future water supply outlook. An estimated 80 percent (96.0 MGD) of the reclaimed water applied in Year 2001, was used in a desirable manner, but only about 21 percent (26.0 MGD) of it was used in a highly desirable manner for maximum efficient use.

Reclaimed water is expected to play an increasingly significant role in meeting the future water demands of the Kissimmee Basin Planning Area. Its use is part of an integrated set of water supply options available to utilities, which include groundwater and surface water sources. Maximizing the use of reclaimed water requires development of supplemental sources, improvements in short- and long-term storage and improvements in efficient use. Improvements in the efficient use of reclaimed water will make the most difference in maximizing availability of supply.

Conclusions:

- Reclaimed water availability is projected to increase 98 percent for the study area by Year 2025 for a total of 244.0 MGD.
- Potential demand for reclaimed water for the same period is estimated to increase to in excess of 261.0 MGD. The reclaimed water providers interviewed under this study indicate a desire to maximize the use of reclaimed water where available.
- The City of Orlando Iron Bridge WRF and Poinciana Utilities WRF have identified significant amounts of reclaimed water for Year 2025 that did not have proposed reuse applications in Year 2004. This presents opportunities for interconnection with other reclaimed water providers to augment existing systems.
- Storage is an important component in the efficient management of a reclaimed water system. Aboveground storage tanks are sufficient to address short-term variations in demand; however, a means of storing reclaimed water for longer periods is needed. The best options for long-term storage are surface reservoirs, aquifer storage and recovery wells.

- Development of supplemental sources can increase reclaimed water use by extending supplies during low flow and/or high demand periods. Supplemental sources include groundwater, surface water and system interconnects with other utilities. Evaluations of Shingle and Boggy creeks show 10.0 MGD of potentially available surface water. Lakes within the Kissimmee Upper Chain of Lakes, in excess of 50.0 MGD may be available to supplement reclaimed water supplies during certain portions of the year.
- Acceptance of more risk of peak reuse shortfalls is a means of improving total reuse applied as potable replacement. A goal of 70 percent to 75 percent of total annual flow going to potable replacement should be considered reasonable. The duration of peak shortfalls can be minimized by use of supplemental sources and storage improvements. Management techniques will help regulate demand and improve annual percentage of use.
- Utilities should no longer promote reclaimed water as drought proof or unlimited sources of water. An outreach effort to prepare customers for system management during water shortages is encouraged. Management efforts might include pressure reductions, odd/even watering days, temporary removal of sites with backup supplies and seasonal rate adjustments. Changing the perception of reuse from an unlimited source to a limited source should provide for the introduction of drought management techniques.
- Aquifer recharge is a beneficial use of reclaimed water. The use of recharge basins is an effective means of recharging the Floridan Aquifer, but the rate of recharge is highly dependent on the location of the recharge basin. Those basins located in western Orange, western Osceola and areas along State Road 27 in eastern Polk have the highest recharge fractions.
- The use of recharge basins in the eastern and southern portions of the study area (low recharge areas) provides little benefit in mitigating the potential impact of future groundwater use.
- Within the study area, residential irrigation represented only about 4 percent (5.0 MGD) of the total reclaimed water use in Year 2001. By Year 2025, the growth in residential irrigation has the potential to increase this use to 37 percent or 96.0 MGD. For this reason, new developments should be required to use reclaimed water as part of the local ordinance. Local governments should consider reclaimed water for toilet flushing as part of this ordinance.
- Use of reclaimed water for irrigation is a beneficial means of offsetting future potable water demands. However, the use of reclaimed water for irrigation can be inefficient. Studies have shown that irrigation of residential landscaping is particularly inefficient, often requiring more than double the amount of potable water for the same use.

- Conservation efforts within the reclaimed water system can improve efficiency. Water conservation for residential systems could save as much as 45.0 MGD by Year 2025 if uses were brought in line with those found in the potable system. Savings in other reuse types are less dramatic, but could reasonably be combined to reduce irrigation demands by 20 percent (11.0 MGD) of the Year 2025 projected demand.
- A list of potential reuse recipients is provided as **Exhibit 3**. This listing was compiled from utility submissions and sites located as part of this study. These sites reflect a partial listing of potential reuse applications sites, but should be considered for alternative water supply funding.

7. IMPLEMENTATION STRATEGIES

The use of reclaimed water for irrigation and the promotion of aquifer recharge are important aspects of reuse in an integrated water supply plan. It is estimated that reclaimed water can help meet as much as 241.0 MGD of the projected water demands for central Florida by Year 2025. This estimate is predicated on the assumption that utilities will be able to meet the challenges required to collect, distribute and conserve the treated wastewater potentially made available. The State of Florida, the water management districts and the local communities all have a stake in promoting the efficient use of reclaimed water. The SFWMD's strategy for promoting reuse involves encouraging reuse conservation, assisting in the development of distribution systems and promoting the development of water storage and supplemental sources. These strategies should be implemented as follows.

7.1 Promote Water Conservation in Reuse Systems

Reclaimed water is an alternative water source to groundwater, and its efficient use is important. Every provider of public access quality reclaimed water has indicated a desire to use 100 percent of the reclaimed water likely to be made available by Year 2025. With the exception of utility rates, only a limited number of the current reclaimed water providers have proposed conservation measures that would promote conservation in the reuse system. While rate incentives are an effective tool for managing use, it has been demonstrated that reclaimed water use is still nearly twice that for potable water use in residential irrigation. The use of reclaimed water in agricultural, landscape and golf course irrigation systems is also thought to be higher than in systems supplied with potable water.

Like the transition of the mindset of reuse as a disposal issue to a source of irrigation, the mindset of reclaimed water as a limitless resource needs to transition to one that promotes reuse conservation on a level similar to that of potable water. To revise this mindset the following is recommended:

- The District should implement an evaluation to compare differences in the rates of reuse applications compared to potable water use. This should include an evaluation of all type of reuse. Based on the reasons for the difference, specific water conservation activities should be identified that would reduce the rate of reclaimed water consumption.
- The District should provide incentives for the implementation of water conservation activities proposed by local communities. The District currently operates the Water Savings Incentive Program (WaterSIP) for this purpose. The WaterSIP is used to promote the implementation of innovative water conservation projects by providing grants of up to $50,000. The District can use these grants to promote reclaimed water programs that expand service and conservation of reuse. A pilot project for installation of toilets using reclaimed water should be considered under this program.
- The District should develop a model reuse ordinance for local governments to use and adapt for use. The ordinance will follow the potable landscape ordinance and will include the elements of toilet flushing for new developments and guidelines for the development of rate structures to promote conservation. The District should sponsor rate development studies for reclaimed water systems.
- The District, in conjunction with the other water management districts and the FDEP should develop an outreach program that teaches the benefits of reclaimed water and promotes its efficient use on par with potable water conservation. Special focus on improvements in residential irrigation efficiency should be addressed.
- Local utilities should be required to provide plans for improving the efficiency of reclaimed water use as part of the 10-Year Water Supply Facilities Work Plan required under the comprehensive plan amendments and required by January 1 of 2006. These plans should address management techniques, such as rate structures, special watering days or hours, and incentives to regulate peak hour use, similar to the practices in use by the electric utility industry.
- The District should begin sponsoring mobile irrigation labs in Orange, Osceola and Polk counties. The labs should perform audits for agricultural and residential irrigation locations that include both potable and reclaimed water applications.

The perception by some members of the general public is that reclaimed water is a product to be disposed of and that overuse is acceptable. The sale of reclaimed water as being "drought proof" diminishes a utility's ability to manage systems during peak demands and perpetuates the public perception of an unlimited source. The FDEP and water management districts should begin an outreach campaign to educate consumers about conservation and management for all water sources, including reclaimed water.

7.2 Promote Construction of Reclaimed Water Distributions Systems

Collection of wastewater, treatment and distribution, are all critical components to expanding reuse applications. The District's past involvement has included sponsorship of expanding reuse lines or treatment plant upgrades. Funding for this has been provided primarily through the District's Alternative Water Supply Funding Program.

The District's Alternative Water Supply Funding Program has provided grants of more than $9.2 million dollars from Fiscal Year 2003 through Fiscal Year 2006. The Alternative Water Supply grants have been provided to supplement construction costs for alternative water supplies including reclaimed distribution systems. In the past, grants were given in amounts of up to $300,000. In 2005, the Florida Legislature approved significant increases of funding for alternative water supply construction projects. This funding is expected to significantly improve implementation of these programs.

- The District, in conjunction with the other water management districts and the FDEP, should provide incentives for development and implementation of area wide reuse plans. The water management districts should use regulatory authority to offer appropriate incentives (such as long-term permits) including financial assistance to support development of area-wide non-potable reuse plans and to expedite the implementation of area-wide reuse plans. The FDEP's implementation of the wastewater treatment facility permitting program should be consistent with the area-wide reuse plan.
- Aquifer recharge using reclaimed water should be enhanced. Recharging the aquifer through surface application of reclaimed water should be given priority consideration, especially in high recharge areas. During the wet season, when opportunities for more direct reuse are decreased, aquifer recharge in high recharge areas is the most efficient means for reclaimed water reuse.

7.3 Promote Development of Supplemental Sources to Reclaimed Water

Improving the efficient use of reclaimed water for irrigation depends heavily on the ability of the provider to meet peak demands. Short-term needs are generally met with aboveground storage or retention areas. Having sufficient aboveground or surface storage to meet seasonal peak demands would require large storage facilities and would likely be impractical in an urban setting. Finding alternative storage and supplemental surface and groundwater sources may assist in addressing these longer-term peak use periods.

- The District should design and implement a pilot program for regional reclaimed water storage. This pilot program should address reclaimed water injection and or aquifer storage and recovery. As part of this initiative, an outreach effort to educate the public on the benefits and dangers of reclaimed water injection should be considered.
- The District should evaluate local surface water features as a source of water to augment reclaimed water systems. In particular, Shingle, Boggy and Reedy creeks, as well as the Kissimmee Chain of Lakes should be assessed for potential to deliver supplies of potable replacement.

EXHIBIT 1: SUMMARY OF WASTEWATER UTILITY FACILITIES

Wastewater Treatment Facilities

The reuse of highly treated wastewater has long been identified as a valued resource for irrigation, aquifer recharge and other beneficial uses, which offset the demands on other water resources. The primary means of wastewater treatment is through wastewater treatment facilities and septic tanks. This section documents information on wastewater treatment facilities with FDEP-rated capacities of 0.1 MGD or greater, that have been incorporated into the *2005–2006 KB Water Supply Plan Update* (2005–2006 KB Plan Update).

MOST BENEFICIAL USE

Direct recharge to the aquifer through injection
Direct replacement of use that would otherwise use the Floridan Aquifer
Application of wastewater to areas of highest recharge to the Floridan Aquifer
Application of wastewater to areas of lower recharge or discharge to the Floridan
Discharge to surface water bodies

LEAST BENEFICIAL USE

Figure 11. Relative Scale of Beneficial Reuse of Reclaimed Water.

In 2001, the KB Planning Area had 22 domestic wastewater treatment facilities that exceed the 0.1 MGD treatment threshold. Most are located in urbanized areas, where potential reuse demand is relatively high. Seventeen of the facilities are municipally/publicly owned, and all the facilities use the activated sludge treatment process or modification thereof. The reclaimed water/effluent disposal methods consist of discharge to surface waters, groundwater recharge, urban irrigation reuse (golf courses, residential lawns, medians, parks, etc.) and agricultural irrigation.

Those facilities located within the Kissimmee Basin Planning Area had a total rated capacity of 108.0 MGD in Year 2001. The Year 2001 average daily flow for these facilities was approximately 70.0 MGD. Wastewater flows from these facilities are projected to increase to approximately 105.2 MGD by Year 2025. Future wastewater generation estimates are based on a ratio or percentage of the projected potable water use by the same utility. In certain instances, utility wastewater projections were deemed more reliable.

Some types of reuse are considered more beneficial than others. The *2000 Kissimmee Basin Water Supply Plan* (2000 KB Plan) identified categories of higher and lower beneficial reuse. **Figure 11** was used in the 2000 KB Plan to present the ranking of wastewater reuse options into these categories in an attempt to identify reclaimed water that could be used in a more beneficial way. Direct reuse, rapid infiltration basins, percolation ponds in high or moderate recharge areas, and direct injection are generally more beneficial than surface water discharges and percolation ponds located in low recharge areas. **Appendix E** provides a summary of wastewater reuse for facilities located within the Kissimmee Basin Planning Area.

EXHIBIT 2: RELATIVE DESIRABILITY OF REUSE ACTIVITIES

Table 7. Relative Desirability of Reuse Activities.

Desirability	Reuse Activity	Offset [a,c]	Recharge Fraction [b,c]
High	Indirect potable reuse	--	100
	Groundwater recharge – injection to potable groundwater	--	100
	Industrial uses	100	0
	Toilet flushing	100	0
	Rapid Infiltration Basins (where groundwater is used)	0	90
	Efficient agricultural irrigation where irrigation is needed	75	25
	Efficient landscape irrigation (golf courses, parks, etc.)	75	10
	Efficient residential irrigation	60	40
	Cooling towers	100	0
	Vehicle washing	100	0
	Commercial laundries	100	0
	Cleaning of roads, sidewalks & work areas	100	10
	Fire protection	100	10
	Construction dust control	100	0
	Mixing of pesticides	100	0
Moderate	Inefficient landscape irrigation (parks and other landscaped areas)	50	50
	Inefficient agricultural irrigation	50	50
	Surface water with direct connection to groundwater (canals of SE Florida)	0	75
	Wetlands restoration (when additional water is needed)	75	10
	Inefficient residential irrigation	25	50
	Flushing & testing of sewers and reclaimed water lines	50	0
	Rapid Infiltration Basins where groundwater is currently not used	0	25
Low	Aesthetic features (ponds, fountains, etc.)	75	10
	Sprayfields (irrigation of grass or other cover crop when irrigation would not normally be practiced)	0	50
	Wetlands (when additional water is not needed)	0	10

a. Percentage of reclaimed water that replaces potable quality water.
b. Percentage of reclaimed water that augments potable quality groundwater or augments Class I surface water.
c. Depending on local circumstances, the offset and recharge may not be of equal importance. Source: The Water Conservation Initiative (4,19).

EXHIBIT 3: POTENTIAL REUSE APPLICATION SITES

Table 8. Potential Reclaimed Water Application Locations.

ID	Acre	Daily_Dem, GPD	Appnum	Applicant
City of Apopka				
A-A-1	53.90	233840.30		
A-A-2	0.00	1.22	2-095-0021AUF	Florida Power Corp.
A-A-3	2.20	9545.86	2-095-0022AUFM	White Sand Nurseries, Inc.
A-A-4	4.03	17483.95	2-095-0024AUF	Baywood Nurseries Company, Inc.
A-A-5	26.14	113392.58	2-095-0025ANFM	Rodney C. Hogshead Jr.
A-A-6	6.30	27339.07	2-095-0030AN	Spring Hill Nursery, Inc.
A-A-7	6.69	29016.98	2-095-0033AUVF	John A. Ware
A-A-8	13.00	56395.59	2-095-0037AUF	Foliage Corporation of Florida
A-A-9	0.65	2826.15	2-095-0040AU	Jacobson's Plants, Inc.
A-A-10	29.25	126912.97	2-095-0047AUFM	Florida Ponkan Corp.
A-A-11	5.65	24524.62	2-095-0048AU	Florida Ponkan Corp.
A-A-12	6.62	28722.06	2-095-0056AUF	Hermann Engelmann Greenhouse, Inc.
A-A-13	28.06	121725.13	2-095-0059AU	Harmon Groves
A-A-14	3.49	15138.48	2-095-0084AUR	Hermann Engelmann Greenhouses, Inc.
A-A-15	115.98	503184.35	2-095-0087	State of Florida
A-A-16	4.10	17796.28	2-095-0094AN	John Talton
A-A-17	3.75	16254.59	2-095-0115AUR	Robert Mellen Jr.
A-A-18	26.21	113722.95	2-095-0117AN	W. R. "Chops" Hancock Jr.
A-A-19	11.32	49127.51	2-095-0124AU	George Mcclure
A-A-20	9.04	39237.30	2-095-0138AUFM	Sun Up Farms
A-A-21	38.93	168880.00	2-095-0141AUNMR	O.F. Nelson and Sons Nursery
A-A-22	2.45	10631.63	2-095-0145AU	Fernlea Nurseries
A-A-23	14.50	62910.87	2-095-0160ANFM	Raymond W. Hogshead
A-A-24	68.80	298487.91	2-095-0161AUM2R	Fred N. Dunn
A-A-25	35.50	154030.42	2-095-0163ANFM	Twyford Plant Laboratories
A-A-26	53.09	230316.59	2-095-0169ANFM	Dewar Nurseries, Inc.

Table 8. Potential Reclaimed Water Application Locations (Continued).

ID	Acre	Daily_Dem, GPD	Appnum	Applicant
A-A-27	17.55	76124.07	2-095-0170AN	Allied Foliage Producers, Inc.
A-A-28	58.90	255533.25	2-095-0180AUR	Roper Grovers Cooperative
A-A-29	0.42	1811.43	2-095-0203AU	Eloise Beach
A-A-30	180.35	782464.90	2-095-0205AURM	Richard W. Rogers
A-A-31	15.45	67047.54	2-095-0206AU	Zellwood Fruit Distributors
A-A-32	26.81	116333.39	2-095-0217AU	Growers Precooler, Inc.
A-A-33	6.94	30094.55	2-095-0220ANR	J. D. C. Plants, Inc.
A-A-34	1.44	6267.31	2-095-0225AUFMR	Errol Estate Property Owners" Association Inc
A-A-35	0.76	3287.54	2-095-0231ANRM	Zellwood Station Coop, Inc.
A-A-36	7.28	31599.05	2-095-0239AUF	William H. Mathews
A-A-37	3.56	15461.32	2-095-0250AURM	Coca-Cola Foods
A-A-38	1.01	4382.33	2-095-0257ANR	Consolidated Minerals, Inc.
A-A-39	5.21	22624.60	2-095-0258AUR	C. James & Shaula E. Crooker
A-A-40	50.11	217421.54	2-095-0268AU	Dennis Klepzig
A-A-41	0.13	549.80	2-095-0289AU	A Duda And Sons, Inc.
A-A-42	2.64	11460.53	2-095-0294AUF	All Gator Carrot Co., Inc
A-A-43	0.01	31.15	2-095-0310AUMG	Orange County Public Utilities
A-A-44	115.22	499873.47	2-095-0313AUF	Hickerson Flowers, Inc.
A-A-45	13.99	60685.43	2-095-0339AUSR	Lust & Long Precooler, Inc.
A-A-46	12.73	55248.28	2-095-0346ANFM	Driftwood Gardens, Inc.
A-A-47	30.47	132178.73	2-095-0347ANVM2R	Paul Lukas
A-A-48	37.05	160752.19	2-095-0353AUSMR	J.B. Nurseries, Inc.
A-A-49	28.28	122697.17	2-095-0357AUSR	Garry F. Connell
A-A-50	28.13	122044.92	2-095-0374ANV	William Ambs
A-A-51	0.77	3325.17	2-095-0393ANR	Chester Peckett
A-A-52	14.43	62590.52	2-095-0394ANR	International Foliage Corp.
A-A-53	18.65	80893.66	2-095-0396ANVF	John's, Inc.
A-A-54	0.32	1397.75	2-095-0446AUV	Welker Plants, Inc.
A-A-55	4.63	20066.11	2-095-0481AUV	Gary Cottle
A-A-56	15.42	66911.65	2-095-0502AUV	Hermann Engelmann Greenhouse
A-A-57	17.13	74336.85	2-095-0517AUV	Edwin S. Bradford
A-A-58	12.06	52313.37	2-095-0520ANV	Bill Dewar
A-A-59	20.49	88905.63	20-095-0002AR	Baywood Nurseries Co., Inc.
A-A-60	120.44	522541.16	20-095-0006AN	

Table 8. Potential Reclaimed Water Application Locations (Continued).

ID	Acre	Daily_Dem, GPD	Appnum	Applicant
A-A-61	184.64	801082.64	20-095-0012	
A-A-62	0.29	1267.92	20-095-0023AR	Robert E. Lee
A-A-63	8.09	35078.44	20-095-0028AGR	USDA Agricultural Research
A-A-64	2.91	12624.20	20-095-0030AF	Charles Brad
A-A-65	14.66	63589.73	20-095-0063AR	Tran Trex Foliage
A-A-66	8.16	35420.54		
A-R-1	0.05	128.81	2-095-0231ANRM	Zellwood Station Co-Op, Inc.
A-R-2	0.06	149.60	2-095-0115AUR	Robert Mellen Jr.
Orange County Utilities				
Or-A-1	3.75	16297.16	940606-6	Granite Construction Co.
Or-A-2	0.61	2651.36	2-069-0122AU	McKinnon Groves
Or-A-3	0.34	1485.31	2-069-0487AUV	Libbys Fresh Food Co., Inc.
Or-A-4	6.02	26164.87	2-095-0011AURF	Evans Partnership
Or-A-5	7.29	31678.91	2-095-0020ANFR	Huckleberry Community Assoc., Inc
Or-A-6	11.87	51550.31	2-095-0040AU	Jacobson's Plants, Inc.
Or-A-7	0.25	1080.00	2-095-0047AUFM	Florida Ponkan Corp.
Or-A-8	6.62	28760.57	2-095-0056AUF	Hermann Engelmann Greenhouse, Inc.
Or-A-9	31.83	138293.19	2-095-0086AUR	Hermann Engelmann
Or-A-10	0.49	2136.60	2-095-0087	State of Florida
Or-A-11	2.22	9653.91	2-095-0113ANF	Nelson & Co., Inc.
Or-A-12	19.22	83483.04	2-095-0123AN	Roper Growers Coop.
Or-A-13	4.54	19725.45	2-095-0126	
Or-A-14	4.00	17362.58	2-095-0138AUFM	Sun Up Farms
Or-A-15	1.51	6578.15	2-095-0142AU	Mary Handley
Or-A-16	37.34	162221.99	2-095-0145AU	Fernlea Nurseries
Or-A-17	15.18	65952.43	2-095-0160ANFM	Raymond W. Hogshead
Or-A-18	16.87	73304.11	2-095-0169ANFM	Dewar Nurseries, Inc.
Or-A-19	7.10	30857.13	2-095-0176AU	Roper Growers Coop.
Or-A-20	6.97	30269.61	2-095-0178AU	Roper Growers Coop.
Or-A-21	7.63	33156.30	2-095-0179AU	Roper Growers Coop.
Or-A-22	0.78	3391.03	2-095-0191AU	Stoneybrook Joint Venture
Or-A-23	1.36	5912.47	2-095-0228AU	Mill Caretakers, Inc.

Table 8. Potential Reclaimed Water Application Locations (Continued).

ID	Acre	Daily_Dem, GPD	Appnum	Applicant
Or-A-24	1.56	6757.34	2-095-0231ANRM	Zellwood Station Co-Op, Inc.
Or-A-25	0.88	3840.19	2-095-0232AURM	Razbuton, Inc.
Or-A-26	0.76	3297.19	2-095-0237AU	Patricia Knop
Or-A-27	3.56	15459.96	2-095-0240AUR	Mary H. Wines
Or-A-28	0.05	206.50	2-095-0248AU	Ralph C. Kazaros
Or-A-29	27.16	117997.93	2-095-0254AU	Patrick Fruit Corp.
Or-A-30	1.01	4388.14	2-095-0257ANR	Consolidated Minerals, Inc.
Or-A-31	0.57	2463.12	2-095-0259AUF	Walter Phillips
Or-A-32	0.00	4.84	2-095-0274ANGMR	Orange Cnty Research & Development Authority
Or-A-33	1.60	6958.58	2-095-0288AURM	J. F. Barrett & R. Solomon
Or-A-34	0.82	3557.65	2-095-0309AUR	Battaglia Fruit Co., Inc.
Or-A-35	0.01	31.20	2-095-0310AUMG	Orange County Public Utilities
Or-A-36	1.11	4813.30	2-095-0321AU	Joseph Caruso Sr.
Or-A-37	14.84	64465.64	2-095-0322AURM	Richard L Gonzalez
Or-A-38	26.32	114362.89	2-095-0345ANVFM	Spring Hill Nursery, Inc.
Or-A-39	6.23	27081.35	2-095-0348AN	George Mcclure
Or-A-40	10.73	46606.13	2-095-0371ANVRM	Lilly Lott
Or-A-41	5.44	23640.34	2-095-0375ANV	Joseph L. Stecher
Or-A-42	150.66	654542.28	2-095-0413AN	Professional Engineering Con.
Or-A-43	0.13	583.42	2-095-0414AN	Jerry J. Chicone
Or-A-44	0.97	4196.56	2-095-0440AN	Infinity Development
Or-A-45	0.22	974.68	2-095-0446AUV	Welker Plants, Inc.
Or-A-46	2.13	9270.52	2-095-0492AN	Riverbend Golf Group, Inc.
Or-A-47	3.87	16803.29	2-095-0512AUVG	Orange County
Or-A-48	0.17	757.55	20-095-0002AR	Baywood Nurseries Co., Inc.
Or-A-49	121.22	526642.93	20-095-0006AN	
Or-A-50	19.93	86576.22	20-095-0012	
Or-A-51	0.96	4177.35	20-095-0026AR	Steve Bekemeyer
Or-A-52	8.09	35125.36	20-095-0028AGR	Usda Agricultural Research
Or-A-53	80.12	348070.49	20-095-0042AR	South Apopka Citrus Fruit Co.

Table 8. Potential Reclaimed Water Application Locations (Continued).

ID	Acre	Daily_Dem, GPD	Appnum	Applicant
Or-A-54	11.65	50594.61		
Or-A-55	0.37	1623.49	2-069-0157AN	Certified Financial Services
Or-A-56	0.38	1635.85		
Or-A-57	0.19	807.10		
Or-A-58	0.94	4070.39		
Or-A-59	1.12	4857.93	48-00015-W	Sugar Loaf Grove
Or-A-60	1.37	5951.43	48-00016-W	WGCGA #48
Or-A-61	1.45	6296.15	48-00022-W	Grove
Or-A-62	1.26	5478.67	48-00024-W	Grove
Or-A-63	3.06	13276.87	48-00031-W	Avalon Grove #1
Or-A-64	1.36	5896.03	48-00035-W	Denmark Groves
Or-A-65	27.80	120758.41	48-00036-W	Kirby Smith Grove
Or-A-66	6.73	29225.44	48-00037-W	Hickory Nut Lake Orange Grove
Or-A-67	0.08	332.85	48-00054-W	Lake Hart Groves
Or-A-68	0.08	330.15	48-00061-W	Reedy Creek Improvement District
Or-A-69	0.80	3455.77	48-00067-W	McDowell Groves
Or-A-70	1.54	6690.06	48-00100-W	Stanford Groves
Or-A-71	0.86	3728.13	48-00194-W	Grove No. 115
Or-A-72	2.96	12841.00	48-00196-W	Hilltop Citrus Grove
Or-A-73	1.00	4326.71	48-00261-W	Water Conservation Ii
Or-A-74	15.70	68189.40	48-00286-W	Big Sand Lake Block
Or-A-75	0.59	2567.53	48-00394-W	Ivey Groves
Or-A-76	5.50	23894.70	48-00519-W	Porter Grove
Or-A-77	0.69	2989.82	48-00567-W	JOTOBO Investments
Or-A-78	140.66	611090.81	48-00574-W	Golden Gem Citrus
Or-A-79	5.09	22112.78	48-00617-W	Ford-Avalon And Ford-Veech Grove
Or-A-80	0.06	245.27	48-00007-W	Quadrangle
Or-A-81	1.26	5474.24	48-00245-W	Devil's Wash Basin Grove
Or-A-82	0.00	0.51	48-00121-W	Grand Cypress Resort
Or-A-83	0.00	0.07		
Or-A-84	0.00	3.18		
Or-A-85	0.74	3207.90		
Or-R-1	2.95	8019.02		

Table 8. Potential Reclaimed Water Application Locations (Continued).

ID	Acre	Daily_Dem, GPD	Appnum	Applicant
Or-R-2	4.51	12256.55		
Or-R-3	45.41	123286.19		
Or-R-4	6.29	17088.03		
Or-R-5	0.84	2291.89	48-00746-W	Project ABC Resort Hotel with Villas
Or-R-6	15.82	42958.41	48-00398-W	Martin Marietta Missile Systems
Or-R-7	118.08	320616.23		
Or-R-8	0.75	2042.59		
Or-R-9	18.69	50739.27	2-095-0020ANFR	Huckleberry Community Assoc., Inc.
Or-R-10	0.06	149.60	2-095-0115AUR	Robert Mellen Jr.
Or-R-11	46.25	125588.33	2-095-0231ANRM	Zellwood Station Coop, Inc.
Or-R-12	5.99	16274.46	2-095-0386	Links Corp, Inc.
Or-R-13	6.88	18685.81	2-095-0413AN	Professional Engineering Con.
Or-R-14	3.37	9152.05	2-095-0512AUVG	Orange County Magnolia Park
Or-R-15	15.57	42276.22	2-095-0524AN	Les Springs Golf Course
City of Orlando				
Ord-A-1	6.36	27620.89		
Ord-A-2	94.04	408552.56	2-095-0016ANM2R	Famlee Investment Company
Ord-R-1	137.73	373967.46		Famlee Investment Company
Ord-R-2	87.60	237868.56		Valencia Community College
Ord-R-3	0.01	14.23		
Ord-R-4	0.03	76.64		
Ord-R-5	0.00	1.19		
Ord-R-6	0.50	1356.78	48-00852-W	Monte Vista Apartments
Ord-R-7	49.86	135371.87	48-00063-W	Orlando International Airport
Ord-R-8	1.90	5164.53	48-00091-W	Naval Training Center
Ord-R-9	1.31	3569.82	48-00294-W	Tradeport Drive Improvements & Landscaping
Ord-R-10	66.51	180589.67	48-00852-W	
Ord-R-11	6.15	16701.24		

Table 8. Potential Reclaimed Water Application Locations (Continued).

ID	Acre	Daily_Dem, GPD	Appnum	Applicant
City of Ocoee				
O-A-1	48.75	211789.87		Pasture
O-A-2	0.14	593.50	2-095-0063AU	D.A.B.I., Inc.
O-A-3	1.36	5912.42	2-095-0228AU	Mill Caretakers, Inc.
O-A-4	3.55	15444.23	2-095-0263AURM	D. G. Cloughley
O-A-5	22.95	99701.80	2-095-0288AURM	J. F. Barrett & R. Solomon
O-A-6	1.26	5454.59	2-095-0411ANR	Margaret W. Mulvey
O-A-7	150.66	654541.99	2-095-0413AN	Professional Engineering Con.
O-A-8	4.94	21480.29	2-095-0492AN	Riverbend Golf Group, Inc.
O-A-9	0.46	2015.46	20-095-0042AR	South Apopka Citrus Fruit Co.
O-R-1	6.88	18685.78	2-095-0413AN	Lake Whitney, Ltd.
City of Winter Garden				
W-A-1	12.21	53065.70		Granite Construction Co.
W-A-2	1.60	6961.55	2-095-0051AUF	Roper Growers Coop
W-A-3	34.43	149595.43	2-095-0102AUR	Britt Farming Co. #1
W-A-4	0.06	253.34	2-095-0123AN	Roper Growers Coop
W-A-5	0.53	2302.09	2-095-0173AUR	Roper Growers Coop
W-A-6	8.54	37102.57	2-095-0175AURM	Roper Growers Coop
W-A-7	18.83	81822.42	2-095-0191AU	Stoneybrook Joint Venture
W-A-8	16.29	70784.66	2-095-0296AUFM	L. F. & Mary Ellen Roper Partnership
W-A-9	0.48	2080.47	2-095-0342AURM	Coca-Cola Foods
W-A-10	21.97	95442.45	2-095-0371ANVRM	Lilly Lott
W-A-11	96.55	419449.01	20-095-0026AR	Steve Bekemeyer
Toho Water Authority				
T-A-1	0.01	21.84		Pasture
T-A-2	3.18	13813.25		Pasture
T-A-3	0.15	662.45		Pasture
T-A-4	0.25	1097.43		Pasture
T-A-5	0.32	1391.56	49-00581-W	Frank Brown's Lakes
T-A-6	61.37	266632.12	49-00671-W	Cane Island Combustion Turbine Project

Table 8. Potential Reclaimed Water Application Locations (Continued).

ID	Acre	Daily_Dem, GPD	Appnum	Applicant
T-A-7	2.71	11771.29	49-00027-W	Citrus Grove
T-A-8	0.02	82.58	49-00052-W	WGCGA #143
T-A-9	0.00	2.82	49-00058-W	Attaway Groves
T-A-10	1.59	6926.29	49-00065-W	John Bronson Groves
T-A-11	0.04	187.30	49-00091-W	Chamberlin Grove
T-A-12	2.93	12737.32	49-00341-W	Steed Groves
T-A-13	0.12	525.62	49-00059-W	Citrus Farm
T-A-14	3.27	14205.62	49-00279-W	Overoaks
T-A-15	0.41	1765.25	49-00780-W	Remington
T-A-16	1.76	7643.86	49-00786-W	Hughes, James G.
T-A-17	0.11	458.64		Citrus Groves
T-A-18	0.01	56.09		
T-A-19	0.18	772.52		Woodland Pastures
T-A-20	8.89	38603.35		Urban Land in Transition w/o Positive Indicators of Intent
T-A-21	0.02	89.91		Fallow Crop Land
T-A-22	18.91	82146.04		
T-R-1	185.28	503,072.94		Community Recreational Facilities
City of St. Cloud				
S-A-1	0.15	662.41		Improved Pasture
S-A-2	23.67	102852.83	49-00067-W	Citrus Grove
Poinciana Utilities				
P-A-1	2.24	9724.44		Pasture
P-A-2	0.12	534.30	49-00127-W	Judge Grove
P-A-4	4.08	17710.44	49-00293-W	Floriturf Sod Farm
P-A-4	0.18	793.80		Pasture

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I

Evaluation of Surface Water Availability

Note: The Surface Water Evaluations were preliminary studies, completed prior to the conclusion of related assessments and management plans encompassing the Kissimmee River and Chain of Lakes System, and Lake Okeechobee.

The Kissimmee Chain of Lakes Long-Term Management Plan is currently being developed as part of a multiagency effort, which includes participation by other state agencies, local governments, environmental agencies and the public. The completed plan will recommend lake management options to balance the needs of the river and lakes system and help define water supply availability for consumptive uses.

The U.S. Army Corps of Engineers is in the process of modifying the Lake Okeechobee Regulation Schedule. Additionally, a recent engineering study assessing the condition of Lake Okeechobee's Herbert Hoover Dike revealed public safety issues related to high lake levels. Lowered lake levels would reduce the water supply available from Lake Okeechobee for use to supplement the Kissimmee Basin's water supplies during water shortage events.

A PRELIMINARY EVALUATION OF AVAILABLE SURFACE WATER IN EAST LAKE TOHOPEKALIGA AND LAKE TOHOPEKALIGA

Executive Summary

An analysis performed as part of the *2000 Kissimmee Basin Water Supply Plan* (2000 KB Plan) identified possible risks that may result from future groundwater withdrawals in central Florida. The 2000 KB Plan recommended developing alternative water sources that would reduce future dependence on the Floridan Aquifer in areas contributing to the projected resource harm. Surface water was identified as one of the possible alternative sources. Recommendation 3.1 of the

2000 KB Plan suggested performing a water availability study to evaluate the surface water systems in the Upper Kissimmee Basin.

The District conducted studies of East Lake Tohopekaliga (East Lake Toho), Lake Tohopekaliga (Lake Toho) and major tributaries including Boggy and Shingle creeks to evaluate surface water availability in the Upper Kissimmee Basin. This technical memorandum summarizes the purpose, analysis and results of the Lake Toho and East Lake Toho study and should be reviewed with the companion report, *A Preliminary Evaluation of Available Surface Water in Boggy and Shingle Creeks* (Cai 2005).

The purpose of this evaluation is to identify the potential availability of water from the upper basin surface water system, to identify environmental considerations to address in withdrawing water and to characterize the technical issues associated with such a withdrawal.

In conducting this evaluation, it was assumed that water above current flood control regulation schedules for Lake Tohopekaliga and East Lake Tohopekaliga is available for water supply uses without harm to in-lake resources. This study reviews a test case of withdrawing a maximum of 50 MGD from Lake Toho and East Lake Toho (separately) and then evaluates the potential affects on lake levels and downstream releases. In addition, a 100 MGD regulation schedule controlled scenario and a 50 MGD historical stage controlled scenario were simulated to compare the affects of increasing diversions and altering the withdrawal control method on lake levels and downstream discharges.

The withdrawal scenarios were simulated using two water balance models developed for the District. These models include the Upper Kissimmee Chain of Lakes Routing Model (UKISS Model) originally developed for the Headwater Revitalization Project and Lake Istokpoga Operation System Model (LIOS Model), a tool initially developed to review operational system changes on Lake Istokpoga. The later of these two was modified for use in this evaluation. Results of the modeling were evaluated based on in-lake changes and changes in downstream flow south of the S-65 Structure.

Results of this evaluation suggest that a reliability of 65 percent or less can be achieved, while withdrawing water from the lakes under the maximum diversion of 50 MGD scenario. The total diverted amount of water can vary greatly from year to year and could include extended periods of restricted withdrawals lasting several weeks. This withdrawal pattern is also expected to impact flow patterns below the S-65 Structure by increasing the number of no-flow events by 25 percent and the maximum duration event by 7 percent. Historic, staged based withdrawal scenarios showed an improvement in the withdrawal reliability curve over regulation-controlled scenarios, but still caused an increase of 16 percent in the number of no-flow days in downstream releases. Increasing the withdrawal rates to 100 MGD caused only slight changes in the reliability curve and downstream discharge flow values from those produced in the 50 MGD scenario.

This study did not try to find the optimum withdrawal scenario to maximize withdrawals, but characterized the magnitude of potential water supply availability from this surface water system. Future evaluations of water availability for the Kissimmee Chain of Lakes system should rely on modeling tools that allow for the simultaneous simulation of lake levels and system flow discharges. This will provide a more accurate solution, while allowing flexibility in solution development.

Results of the modeling effort suggest that storage will need to be addressed in any diversion system proposed for the lakes. Storage options include reservoirs, underground storage (aquifer storage and recovery) and storage within the chain of lakes themselves by altering the regulation schedules. Under a separate analysis, the District evaluated the reservoir storage needed to improve system reliability to over 90 percent. This evaluation estimates that a reservoir storage requirement of 9,000 acre-feet and a reduction of withdrawals to 25 MGD would produce a 95 percent reliable system.

A PRELIMINARY EVALUATION OF AVAILABLE SURFACE WATER IN BOGGY AND SHINGLE CREEKS

Executive Summary

Analyses performed as part of the *2000 Kissimmee Basin Water Supply Plan* (2000 KB Plan) identified possible risks that may result from future groundwater withdrawals in central Florida. The 2000 KB Plan recommended developing alternative water sources that would reduce future dependence on the Floridan Aquifer in areas of greatest projected drawdown. Surface water, reclaimed water, storm water and brackish groundwater were identified as possible alternative sources. Recommendation 3.1 of the KB Plan suggested performing research to evaluate the surface water systems in the Upper Kissimmee Basin.

The South Florida Water Management District (SFWMD or District) has conducted studies of East Lake Tohopekaliga (East Lake Toho), Lake Tohopekaliga (Lake Toho) and the major tributaries including Boggy and Shingle creeks, to evaluate surface water availability within the Upper Kissimmee Basin. This technical memorandum summarizes the purpose, analysis and results of the Boggy and Shingle creeks study and should be reviewed with the companion report, *A Preliminary Evaluation of Available Surface Water in Lake Tohopekaliga and East Lake Tohopekaliga* (Cai 2005).

Much of the storm water generated in southern Orange County and northern Osceola County drains towards one of three basins: Boggy Creek, Shingle Creek and Reedy Creek basins. This study represents a planning-level evaluation of the surface water resources from Boggy Creek and Shingle Creek basins to identify potential water supply availability. This investigation does not include an evaluation of the Reedy Creek Basin, as the environmental information in this basin was not available at the time of the study.

This study also identifies environmental concerns to address in developing these two surface water resources and characterizes the technical issues associated with potential withdrawal. The study does not try to identify withdrawal scenarios to maximize the quantity of water available from the system. Instead, the study evaluates system availability under historic flow conditions and the impacts these withdrawals may have on matters, such as storage, supply dependability and ecosystem restoration.

This study involved the collection of climatic and hydrologic data, identification of environmental issues, field reconnaissance of local wetland systems, tool

development and identification of engineering issues needed to improve withdrawals. To conduct this evaluation, the SFWMD made assumptions about the manner in which withdrawals might occur and the way environmental issues might be addressed.

Evaluating water availability in these creeks was done using statistical methods and a preexisting model, originally developed to evaluate management alternatives for the Kissimmee Chain of Lakes as part of the Kissimmee River Restoration. These tools were used to simulate 32 years of historic climatic and operational conditions. Two separate calculations evaluated environmental impacts, one for in-basin concerns and the other addressing downstream lake levels and restoration efforts. The results of this evaluation, while preliminary, suggest that significant volumes of water might be withdrawn from Boggy and Shingle creeks, while causing minor changes to the environmental health. This suggests the need for further investigation of these surface water resources.

Available surface water for withdrawal from Boggy and Shingle creeks is estimated at 2 and 6 million gallons per day (MGD) respectively. The evaluation also demonstrated however, that the withdrawal reliability was in question. The evaluation showed that over the 32-year demonstration period, the reliability of the withdrawals was at best 85 percent during the wet season and was reduced to 50 percent or less during the dry season. Restoring hydrologic conditions in these wetlands may lead to improved water availability in the creeks during the wet season. Water availability in Boggy and Shingle creeks during the dry season is limited by ecosystem health concerns in the downstream environment. Incorporating elements of storage is expected to improve system reliability. Evaluating alternative withdrawal options for the Kissimmee Chain of Lakes withdrawals may improve dry season reliability.

The results of this evaluation should be considered in combination with the sister study, *A Preliminary Evaluation of Surface Water Availability in East Lake Tohopekaliga and Lake Tohopekaliga* (Cai 2005). Withdrawals that might occur from these lakes may have an impact on the availability of supplies within Boggy and Shingle creeks.

The concerns identified in this study are not the only limiting resource matters to consider in making a final determination of water availability. Any system devised for withdrawing water from these surface water sources will need to review environmental, economic, navigational and water quality concerns within and downstream of the basin.

The water for Boggy and Shingle creeks, the Kissimmee Chain of Lakes, the Kissimmee River and their connection with Lake Okeechobee is a complex hydrologic system. Its management is a balance of many objectives. The SFWMD is developing a long-term management plan for the Kissimmee Chain of Lakes and its tributaries to arrive at a strategy to address these varied concerns. Recommended is a full evaluation of the surface water supply potential for the Upper Kissimmee Basin in union with efforts of the *Kissimmee Chain of Lakes Long-Term Management Plan* (SFWMD 2004), currently under development.

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J
Hydrogeologic Investigations of the Floridan Aquifer System

HYDROGEOLOGIC INVESTIGATION OF THE FLORIDAN AQUIFER SYSTEM, INTERCESSION CITY, OSCEOLA COUNTY, FLORIDA

Executive Summary

The *2000 Kissimmee Basin Water Supply Plan* (2000 KB Plan) was the first look at the long-term water use conditions for areas located north of Lake Okeechobee within the South Florida Water Management District (SFWMD or District).

The findings of the 2000 KB Plan suggest the groundwater supplies in Osceola County area may not be sufficient to meet the 2020 (1-in-10 drought year) water supply needs. The continued use of the Upper Floridan Aquifer (UFA) may affect wetlands, reduce spring flow and possibly be a factor in the formation of sinkholes in this area. However, these conclusions are predicated on a limited amount of geologic and hydrologic information in this region. In particular, information about the Lower Floridan Aquifer is very limited.

This report documents the results of three Floridan Aquifer wells constructed and tested under the direction of the SFWMD. The Intercession City site was selected to augment existing hydrogeologic data and to provide broad, spatial coverage within the Kissimmee Basin Planning Area.

The highest ranked recommendation of the 2000 KB Plan is to gather more hydrogeologic information on the Floridan Aquifer System (FAS) to better resolve the uncertainty of future water use affects. The wells will supply information needed to characterize the water supply potential of the FAS and for

use in development of a groundwater flow model, which will support planning and regulatory decisions.

The FAS test site is near Intercession City in northwest Osceola County on SFWMD-owned property known as the Upper Lakes Watershed Property (**Figure 1**). The wells are located in the northeast quadrant of Section 3 of Township 26 South, Range 28 East. Land surface was surveyed at 68.2 feet relative to the National Geodetic Vertical Datum (NGVD) of 1929.

The scope of the investigation consisted of constructing and testing three FAS wells. The first well identified as OSF-97 was drilled to a total depth of 2,480 feet below land surface (bls). The contractor built a telescoping type well in various stages, completing it into three distinct hydrogeologic zones within the FAS. A single-zone monitor well identified as OSF-100 was constructed into the uppermost portion of the FAS. A dual-zone production well identified as IC_PW located 340 feet north of the FAS monitor wells was constructed to facilitate aquifer testing of the upper and lower portion of the FAS.

The SFWMD provided oversight during all well drilling, construction and testing. The Diversified Drilling Corporation (DDC), a Tampa based corporation, was responsible for all drilling, well construction and testing services at the Intercession City site under SFWMD Contract C-12356. This project was completed on schedule, costing $720,000.

The main findings of the exploratory drilling and testing program at this site are as follows:

- The top of the FAS as defined by the Southeastern Geological Society AdHoc Committee on Florida Hydrostratigraphic Unit Definition (1986) was identified at a depth of approximately 110 feet below land surface.
- Lithologic and geophysical logs, specific capacity and aquifer performance test results indicate moderate production capacity in Zone A of the UFA, good production capacity in Zone B of the UFA and excellent production capacity in the Lower Floridan Aquifer (LFA).
- Water quality data from packer tests and completed monitor zones indicate that chloride and total dissolved solids in the UFA waters meet potable drinking water standards.
- The base of the Underground Source of Drinking Water, those waters having TDS concentrations less than 10,000 mg/L, occurs at an approximate depth of 2,250 feet bls.
- Zone A of the UFA from 110 to 260 feet bls yielded a transmissivity of 115,000 gallons per day per foot of aquifer (gpd/ft), storage coefficient of 2.2×10^{-5}, an r/B value of 0.12 and a leakance value of 1.43×10^{-2} gpd/ft^3.

- Zone B of the UFA 360 to 860 feet bls yielded a transmissivity of 510,000 gpd/ft, storage coefficient of 6.1×10^{-5}, an r/B value of 0.07 and a leakance value of 2.16×10^{-2} gpd/ft^{3}.
- A productive horizon in LFA from 1,210 to 1,500 feet bls yielded a transmissivity of 1,500,000 gpd/ft storage coefficient of 1.2×10^{-5}, an r/B value of 0.007 and a leakance value of 6.36×10^{-4} gpd/ft^{3}.
- The average measured hydraulic heads for the FAS monitoring intervals are as follows:
- 66.58 feet above mean sea level for the 370 to 860 feet bls monitor interval,
- 54.13 feet above mean sea level for the 1,220 to 1,490 feet bls monitor interval,
- 53.00 feet above mean sea level for the 2,000 to 2097 feet bls monitor interval.
- Water levels in the FAS respond to external stresses, such as tidal loading and barometric pressure variations.

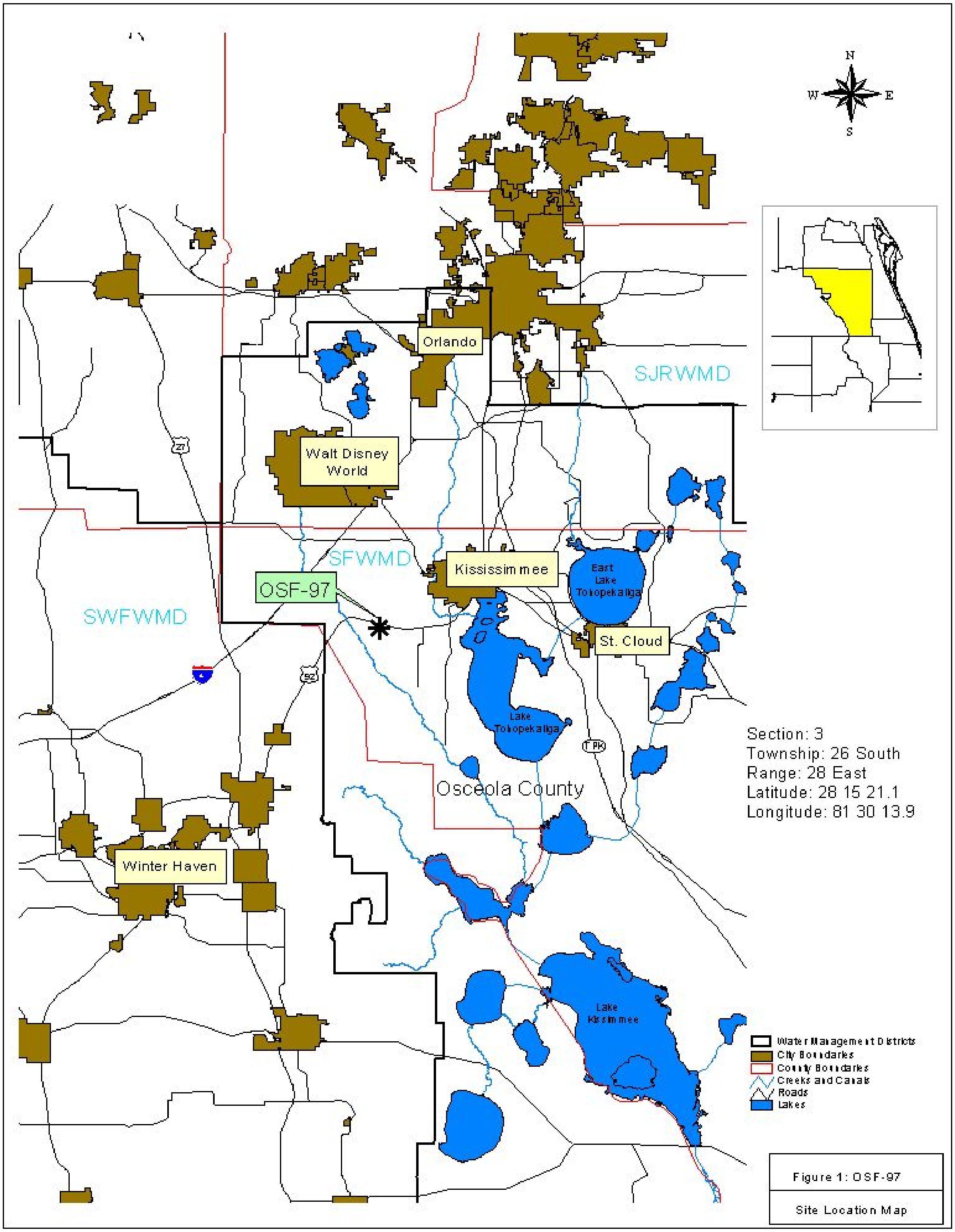

Figure 1. Intercession City FAS Test Well Location Map.

HYDROGEOLOGIC INVESTIGATION OF THE FLORIDAN AQUIFER SYSTEM, REEDY CREEK IMPROVEMENT DISTRICT, ORANGE COUNTY, FLORIDA

Executive Summary

The *2000 Kissimmee Basin Water Supply Plan* (2000 KB Plan) was the first look at the long-term water use conditions for areas located north of Lake Okeechobee within the South Florida Water Management District (SFWMD or District).

The findings of the 2000 KB Plan suggest that the groundwater supplies in Osceola County area may not be sufficient to meet the 2020 (1-in-10 drought year) water supply needs. The continued use of the Upper Floridan Aquifer (UFA) may affect wetlands, reduce spring flow and possibly be a factor in the formation of sinkholes in this area. However, these conclusions are predicated on a limited amount of geologic and hydrologic information in this region. In particular, information regarding the Lower Floridan Aquifer (LFA) is very limited.

The highest ranked recommendation of the 2000 KB Plan is to gather additional hydrogeologic information on the Floridan Aquifer System (FAS) to better resolve the uncertainty of future water use affects. Towards that end, three FAS exploratory sites were completed in the Kissimmee Basin Planning Area over the past five years. This report summarizes results from one of those sites located at the Reedy Creek Improvement District (RCID). This well will supply information needed to characterize the water supply potential of the LFA and for use in the development of a groundwater flow model, which will support future planning and regulatory decisions.

The FAS test site described in this report is located in southwest Orange County on RCID property (**Figure 2**). The test/monitor well is located in the southeast quadrant of Section 23 of Township 24 South, Range 27 East. The geographic coordinates of the RCID test/monitor well are 28° 22’43.7” N latitude and 81° 35’ 15.9” W longitude relative to the North American Datum (NAD) of 1983. Land surface was surveyed at 68.2 feet relative to the National Geodetic Vertical Datum (NGVD) of 1929. The RCID site was selected to augment existing hydrogeologic data and to provide broad, spatial coverage within the Kissimmee Basin Planning Area.

The scope of the investigation consisted of constructing and testing a LFA well, constructed to Florida Department of Environmental Class V, Group 8 well

standards. The well identified as ORF-60 was drilled to a total depth of 2,100 feet below land surface (bls). The contractor constructed a telescoping type well in various stages, completing it into a distinct hydrogeologic zone within the LFA from 1,160 to 1,280 feet bls.

The SFWMD provided oversight during all well drilling, construction and testing operations. The Diversified Drilling Corporation (DDC) was responsible for all drilling, well construction and testing services at the RCID site. The cost of this project ($375,000) was mutually shared by RCID, SFWMD and Orange County Utilities.

The main findings of the exploratory drilling and testing program at this site are as follows:

- The top of the FAS as defined by the Southeastern Geological Society AdHoc Committee on Florida Hydrostratigraphic Unit Definition (1986) was identified at a depth of approximately 80 feet below land surface (bls).
- A 10-inch inner diameter exploratory well was successfully constructed and tested at the RCID site in accordance with FDEP Class V, Group 8, well standards.
- Lithologic and geophysical logs, specific capacity and aquifer performance test results indicate moderate production capacity in Zone A of the UFA (80 to 250 feet bls) and very good production capacity in Zone B of the UFA (300 to 740 feet bls).
- Water quality data from 220 to 715 feet bls indicate that chloride and total dissolved solids in the UFA waters meet potable drinking water standards with chloride and total dissolved solids concentrations of five and 134 milligrams per liter, respectively.
- Lithologic information and geophysical logs obtained from OSF-60 indicates that low porosity/permeability, poorly indurated grainstones and moderately to well indurated, wackestones and crystalline dolostones occur from 740 to 1,160 feet bls, These low permeable sediments act as a confining unit that effectively isolates the UFA from the LFA.
- Lithologic and geophysical logs and specific capacity test results indicate very good production capacity of the LFA "Zone A" from 1,170 to 1,280 feet bls. This zone yielded a specific capacity value of 116 gpm/foot of drawdown at pump rate of 2,210 gpm with a calculated transmissivity of 232,000 gpd/ft.
- Lithologic data, geophysical logs and packer test results indicate good production capacity of the LFA "Zone B" from 1,860 to 1,970 feet bls. This zone yielded a specific capacity value of 116 gpm/foot of drawdown with chloride and total dissolved solids concentrations of seven and 148 milligrams per liter (mg/L), respectively.

- Composite water quality sampling of ORF-60 (1,170 to 1,280 feet bls) indicate that chloride and total dissolved solids meet potable drinking water standards with chloride and total dissolved solids concentrations of eight and a 160 milligrams per liter, respectively.
- Lithologic data and production-type logs (e.g. flow, temperature logs) indicate very good production from flow zones between 1,170 and 1,195 feet bls and 1,215 to 1,270 feet bls. Below 1,270 feet bls, the productive capacity is limited (as indicated by the fluid-type logs) suggesting lower permeable—semi-confining units near the base of the monitor zone.
- The base of the Underground Source of Drinking Water, those waters having TDS concentrations less than 10,000 mg/L, was not encountered at the total depth of 2,100 feet bls.

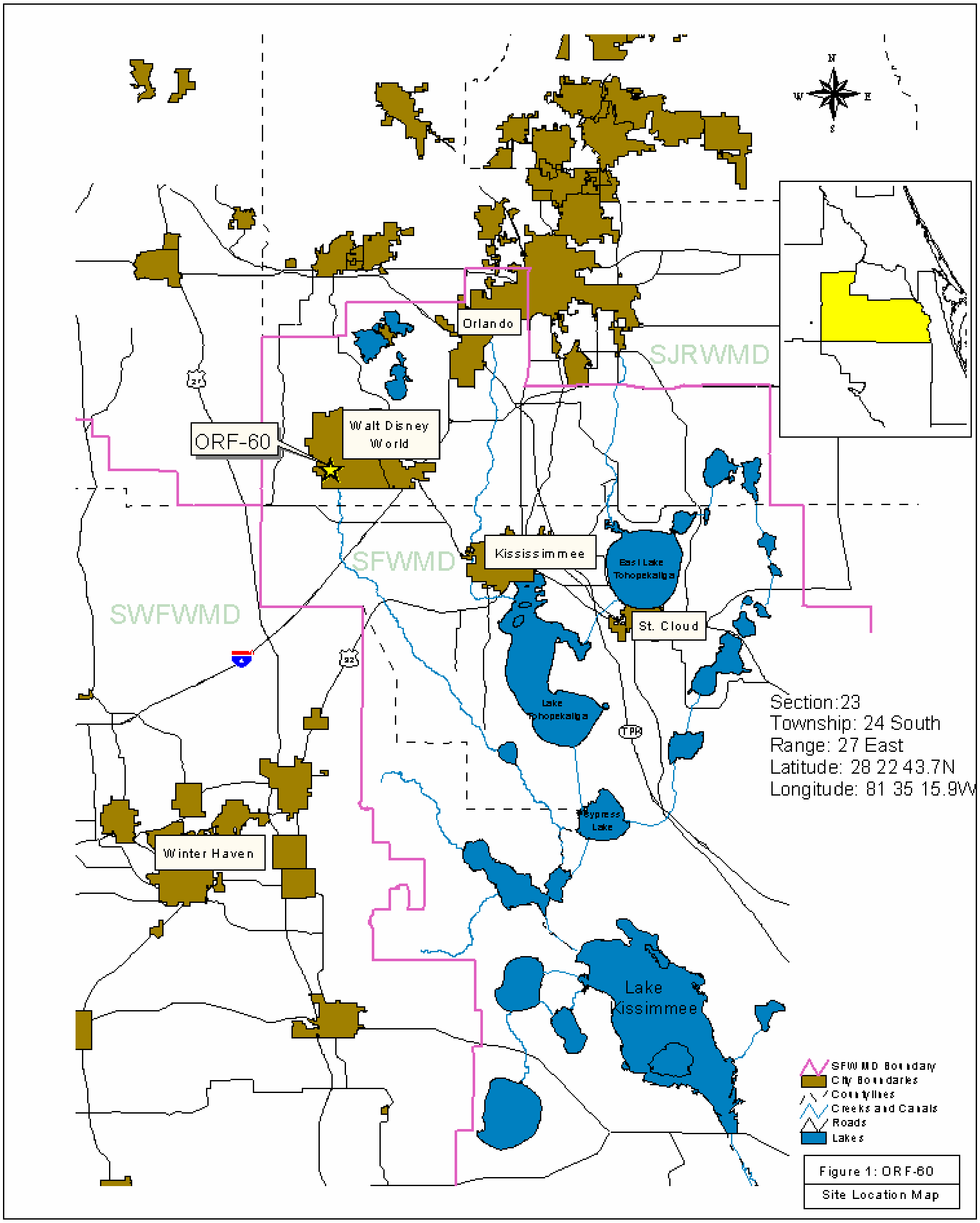

Figure 2. Reedy Creek Improvement District FAS Test Well Location Map.

HYDROGEOLOGIC INVESTIGATION OF THE FLORIDAN AQUIFER SYSTEM, R.D. KEENE COUNTY PARK, ORANGE COUNTY, FLORIDA

Executive Summary

The Kissimmee Basin Planning Area covers approximately 3,500 square miles, includes portions of Orange, Osceola, Polk, Highlands, Okeechobee and Glades counties and shares common boundaries with the St. Johns River Water Management District and the Southwest Florida Water Management District. The *2000 Kissimmee Basin Water Supply Plan* (2000 KB Plan) examined the long-term water use conditions for areas located north of Lake Okeechobee within the South Florida Water Management District (SFWMD or District).

The findings of the 2000 KB Plan suggest that the groundwater supplies in portions of Orange, Osceola and Polk counties may not be sufficient to meet the 2020 (1-in-10 drought year) water supply needs. In the Orange, Osceola and Polk County area, the continued use of the Upper Florida Aquifer (UFA) has been projected to contribute to possible harm to wetlands, reduction in spring flow and may be a factor in the formation of sinkholes. These conclusions however, were predicated on a limited amount of geologic and hydrologic information in the region. In particular, information regarding the interactions between the Surficial Aquifer and UFA is very limited.

A priority recommendation in the 2000 KB Plan was to gather additional hydrologic information to better address the uncertainty of the future water use of the UFA and their impact to wetlands and surface water. Towards that end, three Floridan Aquifer System (FAS) exploratory sites were completed in the Kissimmee Basin Planning Area over the past five years. This report summarizes results from one of those sites located at the R.D. Keene County Park in Orange County.

The objective of this work was to construct and test a series of wells that will support the KB Plan and its recommendations. Data collected from the testing and monitoring of the wells at this site will be instrumental in revising the current groundwater model and evaluation of wetland impact constraints. The R.D. Keene site is presently part of the SFWMD's long-term water level monitoring network.

The test site described in this report is located in western Orange County within the R.D. Keene County Park (**Figure 3**). Specifically, the test site is located near

the Town of Windermere in the northeast quadrant of Section 20, Range 28 East and Township 23 South. Land surface elevation was surveyed at 106.1 feet relative to the National Geodetic Vertical Datum (NGVD) of 1929.

Site preparation and equipment mobilization at the project site began February 20, 2003. The contractor constructed two UFA wells, and three shallow (32 to 92 feet bls) monitor wells to determine the degree of connection between the Surficial Aquifer System (SAS) and the UFA. The UFA wells consisted of one 14-inch diameter test- production well and one 6-inch diameter observation well (identified as ORF-61). In addition, two 2-inch diameter PVC monitor wells were constructed; one completed into the Hawthorn Group (upper confining unit and identified as ORH-1) and one into the SAS (identified as ORS-3) with a corresponding 6-inch diameter test-production well completed in the SAS.

The SFWMD provided technical guidance and oversight of all well construction and testing operations. The Diversified Drilling Corporation (DDC) was responsible for well construction and testing services associated with this project. Daily data collection activities and construction oversight were facilitated by Universal Engineering Sciences (UES). This project was completed on June 10, 2003 at a cost of $225,000.

The main findings of the exploratory drilling and testing program at this site are as follows:

The top of the FAS was identified at 106 feet below land surface as defined as the first occurrence of vertically persistent, permeable and consolidated, carbonate unit (Tibbals 1990).

- Lithologic data, geophysical logs and aquifer performance test results indicate moderate to good production capacity in UFA.
- Water quality data from the completed monitor wells indicate that chloride and total dissolved solids concentrations in the Surficial Aquifer and UFA meet potable drinking water standards.
- The SAS hydraulic test results yielded a transmissivity of 170 gallons per day per foot of aquifer (gpd/ft) and a dimensionless storativity value of 5.75×10^{-2}.
- The Hawthorn Group (intermediate confining unit) yielded a hydraulic conductivity of 0.038 ft/day.
- Hydraulic testing of the UFA, which included the both Zones A & B yielded a transmissivity of 300,000 gpd/ft, a storage coefficient of 2.40×10^{-3}, a dimensionless r/B value of 0.04 with a calculated leakance value of 7.50×10^{-2} gpd/ft^3.
- Hydraulic test results indicate moderate connectivity between SAS and UFA.

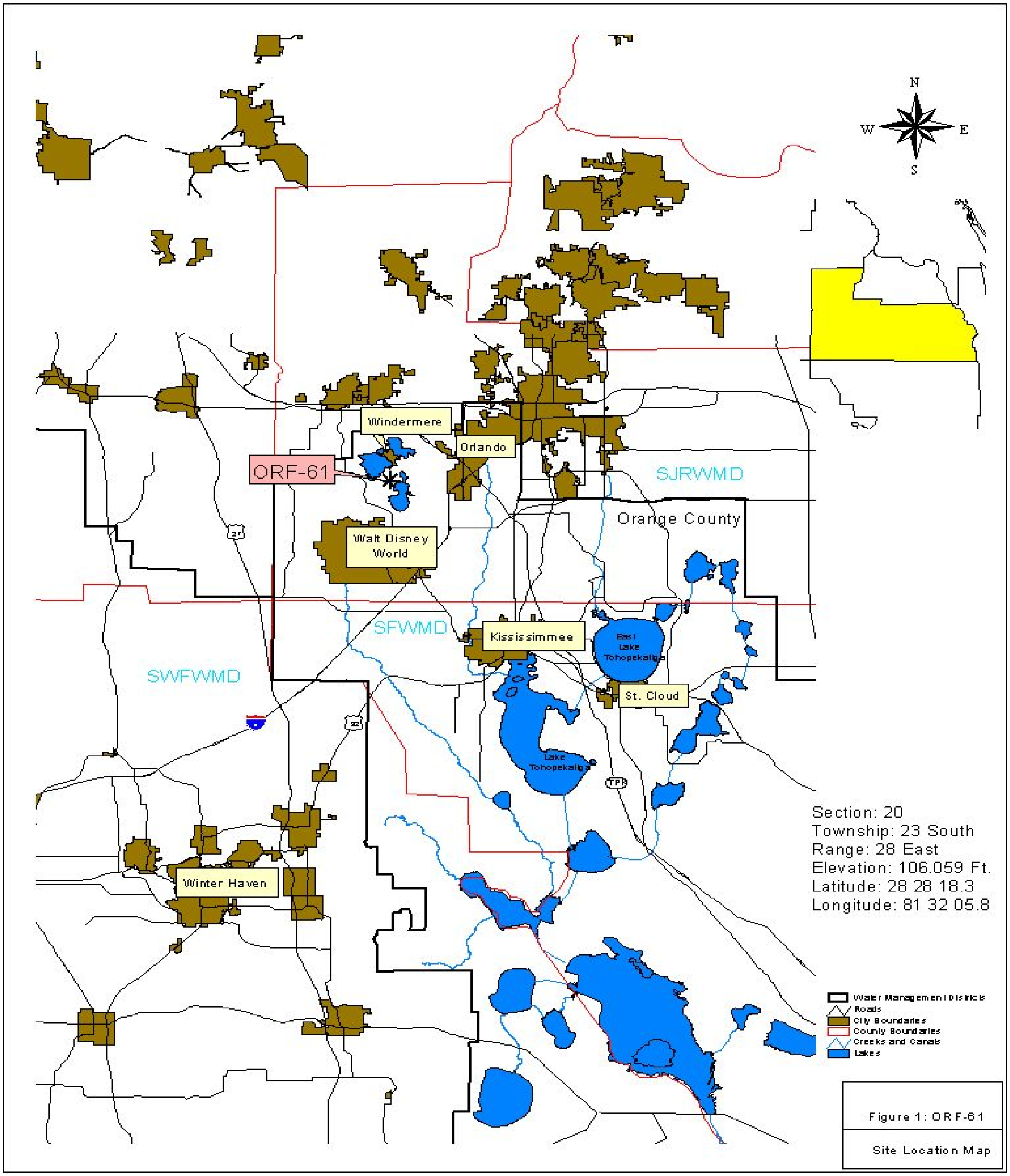

Figure 3. R.D. Keene County Park FAS Test Well Location Map.

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K

Groundwater Quality Conditions

This appendix was prepared as of September 2004.

FLORIDAN AQUIFER SYSTEM

The Floridan Aquifer System (FAS) is made up of the Upper Floridan Aquifer (UFA), a middle confining unit and the Lower Floridan Aquifer (LFA), as shown in **Figure 1**. From a groundwater use perspective the UFA provides most of the freshwater needs of the Kissimmee Basin. The upper portion of the LFA is increasingly used as a source, particularly for public water supply needs in Orange County (O'Reilly *et al*. 2002).

The recharge areas for both the UFA and LFA are in the Lake Wales Ridge Area of Polk County in the southwestern portion of the planning area. Movement of groundwater in the FAS is generally from southwest to northeast (O'Reilly *et al*. 2002). Water quality in the UFA generally meets potable standards in most of the Kissimmee Basin (KB) Planning Area, except for the southeastern portion, which becomes more saline. Water quality in the LFA can vary depending on several factors, such as initial chemical composition and solubility of the aquifer material and the presence of connate water from historic marine inundations. Each of these factors contributes to the degree of mineralization of the water. Higher mineralization translates into lower quality.

The maps in **Figure 2** through **Figure 5** show chloride ion and total dissolved solids (TDS) concentrations within the UFA and the LFA compiled from data obtained over a 15-year period. **Table 1** and **Table 3** list the locations and depths of the wells used to create the figures.

The FAS groundwater is least mineralized in recharge areas along the western part of the basin. Along parts of the Wekiva and St. Johns Rivers, and in much of the northeastern and southeastern parts of the Kissimmee Basin, the FAS groundwater is very mineralized (O'Reilly *et al*. 2002). The areas of increased mineralization could be a result of the factors previously mentioned, or could be due to saline upwelling.

The lowest chloride concentrations occur in the central and western parts of the basin for both the UFA and LFA (**Figure 2** and **Figure 3**). The highest chloride concentrations appear in wells found in the northeastern and southeastern basin. Chloride concentrations are known to exceed 1,000 milligrams per liter (mg/L) along the St. Johns River and portions of eastern Orange County (O'Reilly *et al*. 2002).

A comparison of current chloride concentrations in the UFA to those found in the 1960s shows only minor changes for most of the Orange County area; however, concentrations appear to have increased in the southeast near the Cocoa wellfield, most likely due to upwelling of deeper saline water in response to wellfield pumping (Adamski 2003). Chloride data in proximal wells, or even in the same well, can vary over time for many reasons. Lowered aquifer heads may cause upcoming or lateral intrusion of more saline water.

Total dissolved solid concentrations also tend to be within drinking water standards (500 mg/L) in the UFA in all except for the extreme southeast portion of the planning area. **Figure 3** shows the distribution of TDS concentrations in the UFA within the planning area.

Figure 4 and **Figure 5** show spatial chlorides and TDS concentrations in the LFA. These contours are based on a very limited amount of data. **Figure 5** shows that TDS in the LFA exceeds the drinking water standard of 500 mg/L for most of the KB Planning Area except in the extreme northwest Lake County and central Highlands County. This may simply be an artifact of the lack of even spatial coverage of LFA well data currently available.

Recent U.S. Geological Survey (USGS) studies categorize the groundwater quality types occurring in the Kissimmee Basin. In most of Orange County, groundwater in the UFA and LFA is of a calcium or calcium-magnesium bicarbonate type. Water from wells near the Cocoa wellfield in southeast Orange County is of a sodium-chloride type (Adamski 2003). In northwest Osceola County, sodium-chloride water occurs where chloride concentrations exceed 250 mg/L (Schiner 1993).

A study including all of Orange County and parts of Osceola and eastern Polk counties found three main types of groundwater in the LFA (O'Reilly *et al*. 2002):

1. The inland areas have water enriched in calcium, magnesium and bicarbonate ions.

2. A second type of LFA water is enriched in calcium, magnesium and sulfate, probably due to dissolution of gypsum in deep parts of the aquifer.

3. Sodium-chloride type water occurs in the eastern parts of the basin due to mixing of relict seawater, or upwelling of deep saline water.

Figure 6 illustrates the sodium-chloride type water east of the planning area containing chloride concentrations greater that 250 mg/L. The estimated position of the 250 mg/L isochlor is less than 200 feet below sea level in much of the eastern part of the basin. The 250 mg/L isochlor increases with depth towards the west. The water quality within the center of the KB Planning Area shows that chloride concentrations are lower than 250 mg/L for the upper portion of the LFA. The altitude of the 250 mg/L isochlor exceeds 2,000 feet below sea level in the southwest part of the basin. LFA water in the southwestern part of the basin is not considered fresh (below 250 mg/L), even though chloride concentrations are low. Limited data suggest the water may be of a calcium-sulfate type and mineralized due to high concentrations of sulfate (O'Reilly 2002).

SURFICIAL AQUIFER SYSTEM

The Surficial Aquifer System (SAS) is predominantly unconsolidated quartz sand with varying amounts of shell, limestone and clay from the late Miocene to Holocene age (**Figure 1**). The SAS is an unconfined aquifer with the upper boundary being defined by the water table. The thickness of the SAS varies from 30 feet to 225 feet in the KB Planning Area.

Water quality in the SAS is highly variable depending on aquifer materials, interaction with the UFA and effects of land use. In general, water quality is good (non-mineralized) due to direct recharge by precipitation. However, varying water types, such as calcium-bicarbonate, calcium sulfate and sodium chloride, occur within the Kissimmee Basin and are a good indicator of the geochemical evolution and nature of the origin of these waters. The most common water quality problem with the SAS is high concentrations of iron that cause staining.

In the northern part of the basin, mainly Orange and Osceola counties, the water type is calcium bicarbonate and tends to vary, moving toward the lower parts of the basin. Water quality in the SAS generally meets State of Florida secondary drinking water standards, except for iron concentrations. Chloride and sulfate concentrations are significantly less than the 250 mg/L limit (State of Florida secondary drinking water standards) at most locations. As previously noted, brackish water from the FAS introduced into the SAS by irrigation, upward leakance and leaking well casings could result in local chloride and sulfate concentrations greater than the 250 mg/L standard.

A general water quality assessment was performed on a selected set of data points that were collected from the South Florida Water Management District's (SFWMD or District) database and from USGS publications. The data represent the period of 1998 to 2003. These data are provided in **Table 4**.

The SAS along the Kissimmee River valley and adjacent parts of the Lake Wales Ridge are shown to have lower alkalinities than in the rest of the Kissimmee Basin. The alkalinity increases when moving toward the Atlantic coast. Concentrations of chlorides and TDS were generally low in SAS wells. **Figure 7** and **Figure 8** show the chlorides and TDS concentrations distributed within the KB Planning Area. Again, these concentrations can vary significantly due to local conditions, but concentrations tend to be higher in areas along the rivers and most likely represent upwelling and discharge of deeper waters from the UFA (Adamski and German 2003 unpublished). The average pH in SAS water ranges from 6.0 to 7.0 within most of the Kissimmee Basin, with some lower values found near the lower lying wetland areas. High chloride concentrations in the SAS in the eastern portion of the Kissimmee Basin correspond with locations where the potentiometric surface of the UFA is higher than the land surface. Here, high chloride water from the UFA may leak upward into the SAS (Adamski and German 2003).

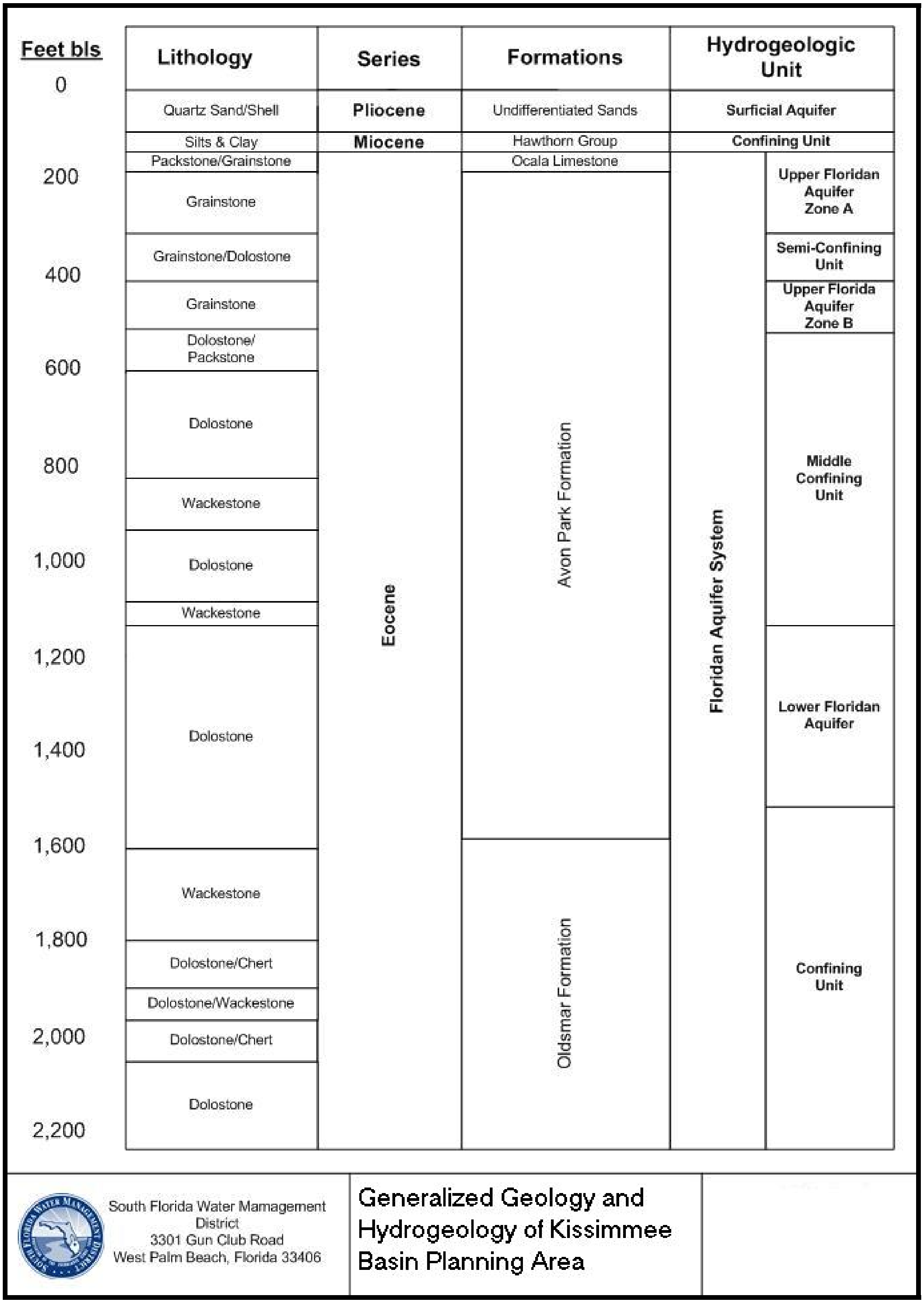

Figure 1. Generalized Geology and Hydrogeology of the Kissimmee Basin Planning Area.

Nutrient concentrations in the sampled SAS wells are low for those wells found in the northern portion of the KB Planning Area (Adamski and German 2003 unpublished). Nutrients can increase in localized areas resulting in contamination from land use. Phosphorus concentrations greater than 1.0 mg/L in monitoring wells around the Orlando area suggest possible heavy use of fertilizers from past and present land use. Concentrations of phosphorus greater than 0.1 mg/L in the SAS can stimulate algal growth in lakes, as groundwater from the SAS discharges into lakes and streams. This is evident in some of the lake water quality data collected throughout the basin.

SUMMARY

Surficial Aquifer

Water quality in the SAS is predominantly calcium-bicarbonate and to some extent sodium-chloride with low mineralization due to direct recharge by precipitation. Water quality data provided in **Table 4** indicates the shallow aquifer water meets potable drinking water standards of the State of Florida, with the exception of iron.

Upper Floridan Aquifer

Water quality in the UFA within the KB Planning Area is generally of potable quality, except for the extreme southern portions of the basin. The chloride and TDS trends show that most of the KB Planning Area is within the 250 mg/L isochlor and 500 mg/L contour for TDS, except for the southeastern corner of the planning area. **Table 1** provides the water quality data from select wells. The water found in the UFA is usually characterized as calcium-bicarbonate, while the southern portion of the basin is characterized as calcium sulfate to the west and sodium chloride to the south. Most of the sodium-chloride groundwater within the UFA is a result of remnant connate water trapped in the aquifer due to prior marine deposition. Within the KB Planning Area, pH ranges from 7.0 to 8.0 in the Floridan Aquifer.

Lower Floridan Aquifer

Water quality in the LFA is influenced by many factors. These factors include the initial chemical composition and solubility of the aquifer material, and the length of time the water remains in contact with that aquifer material and connate water. The most important parameters characterizing water quality in the Lower Floridan Aquifer are chlorides, TDS and sulfates. Water in the LFA generally decreases in quality with increasing depth. The water quality within the LFA can be a function of the marine depositional environment. LFA water in the northern portion of the Kissimmee Basin is defined as the calcium bicarbonate type and is generally of potable quality in upper portions of the aquifer. The quality appears to degrade to sodium chloride in the south and towards the coastlines (east and west). Poor water quality of calcium-sulfate concentration exists within the Kissimmee Basin in areas of Polk and Highlands counties and in some Floridan Aquifer wells that penetrate deep into the lower portion of the aquifer, rich in calcium sulfate evaporates.

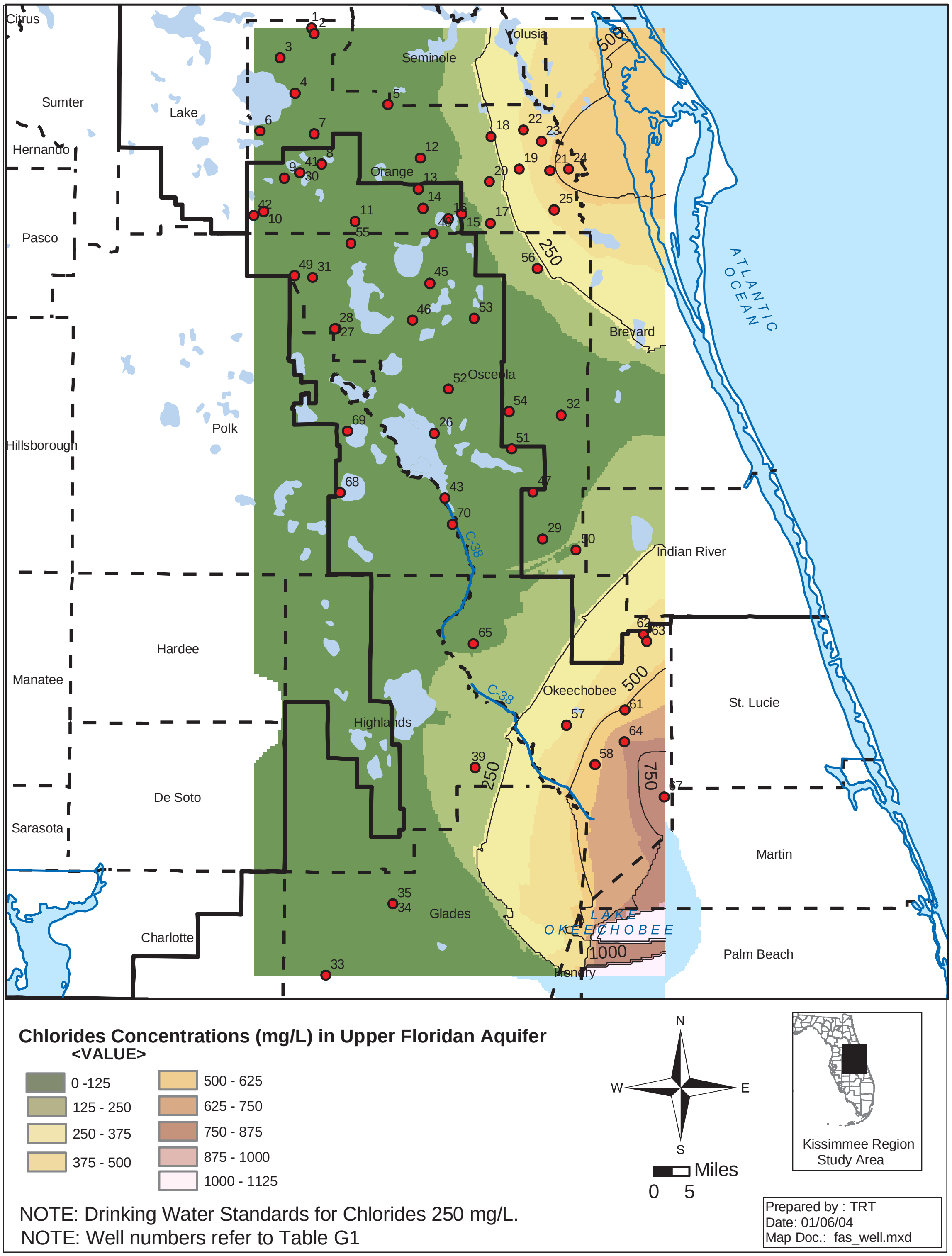

Figure 2. Chloride Concentrations in the Upper Floridan Aquifer.

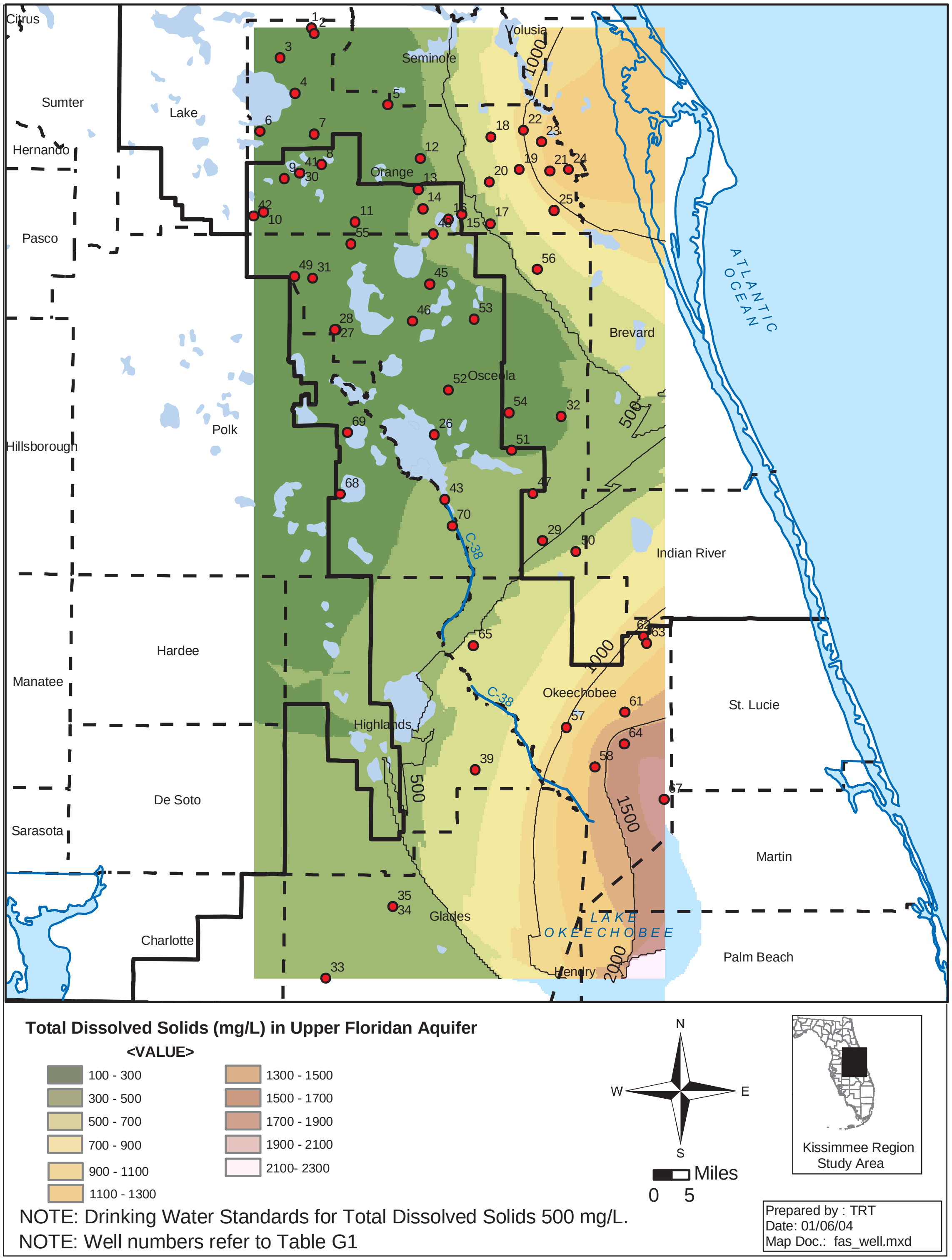

Figure 3. Total Dissolved Solids Concentrations in the Upper Floridan Aquifer.

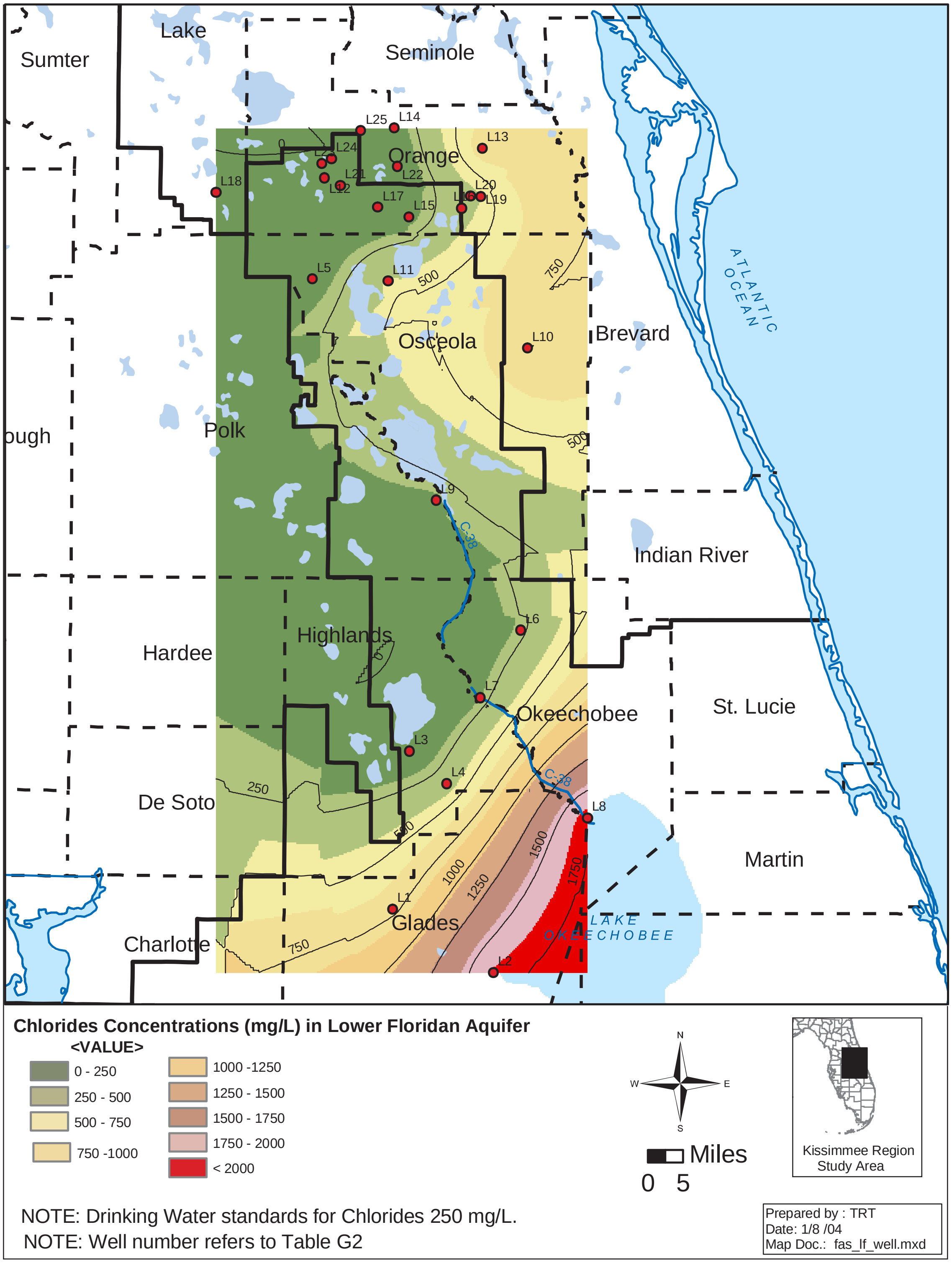

Figure 4. Chloride Concentrations in the Lower Floridan Aquifer.

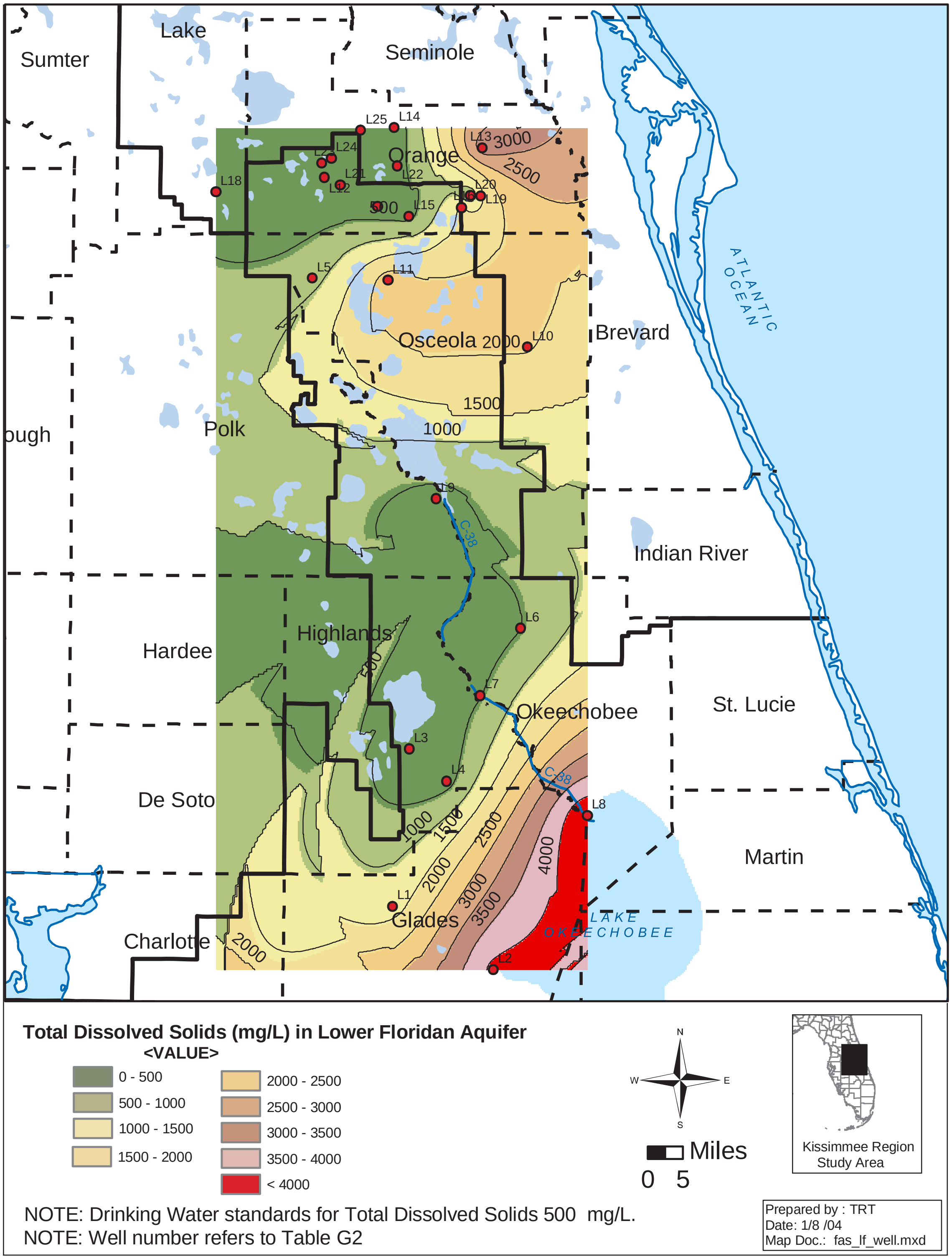

Figure 5. Total Dissolved Solids Concentrations in the Lower Floridan Aquifer.

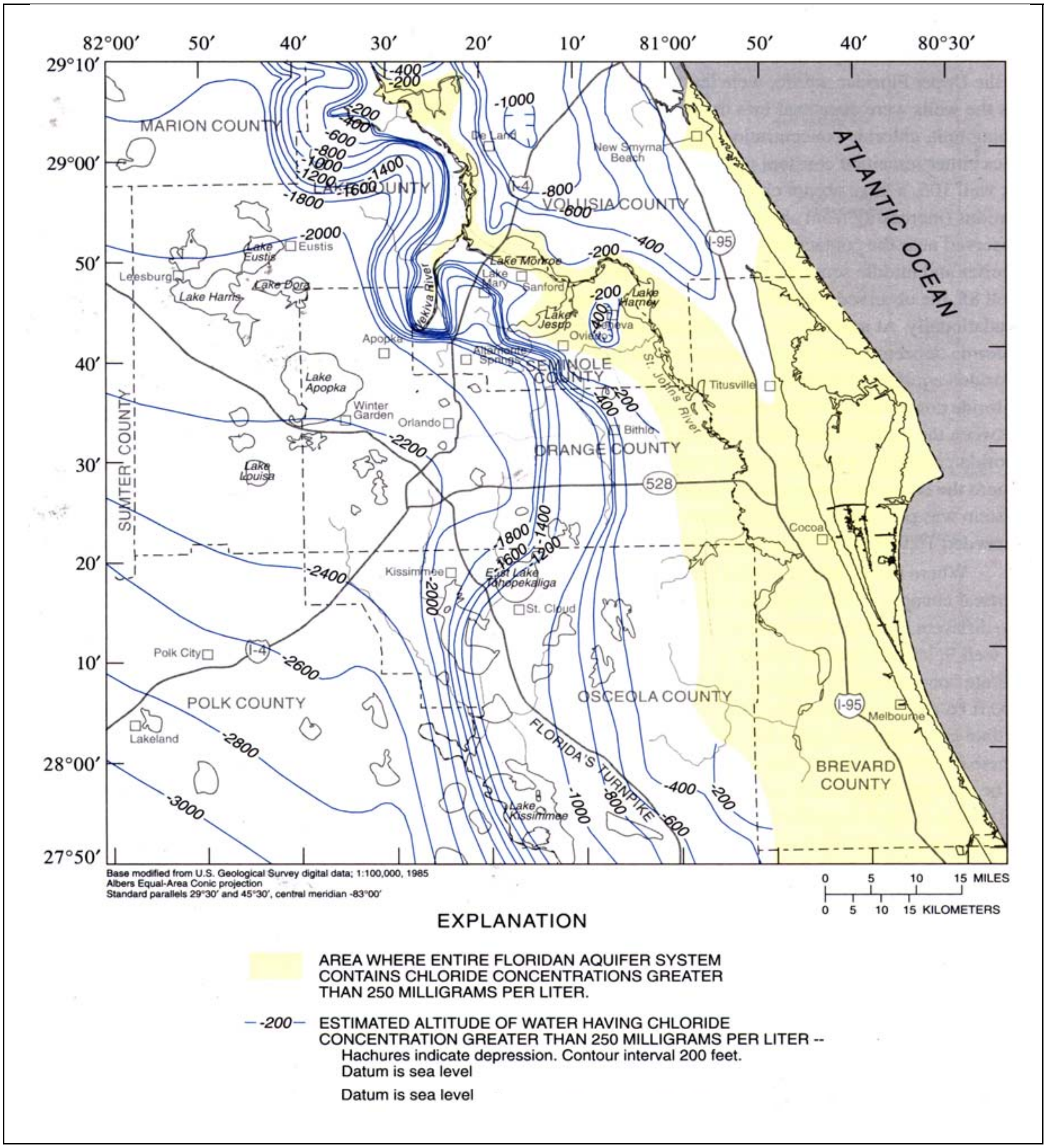

Figure 6. Estimated Altitude of Water in the Floridan Aquifer System Having Chloride Concentrations Greater Than 250 Milligrams Per Liter (McGurk *et al*. 1998).

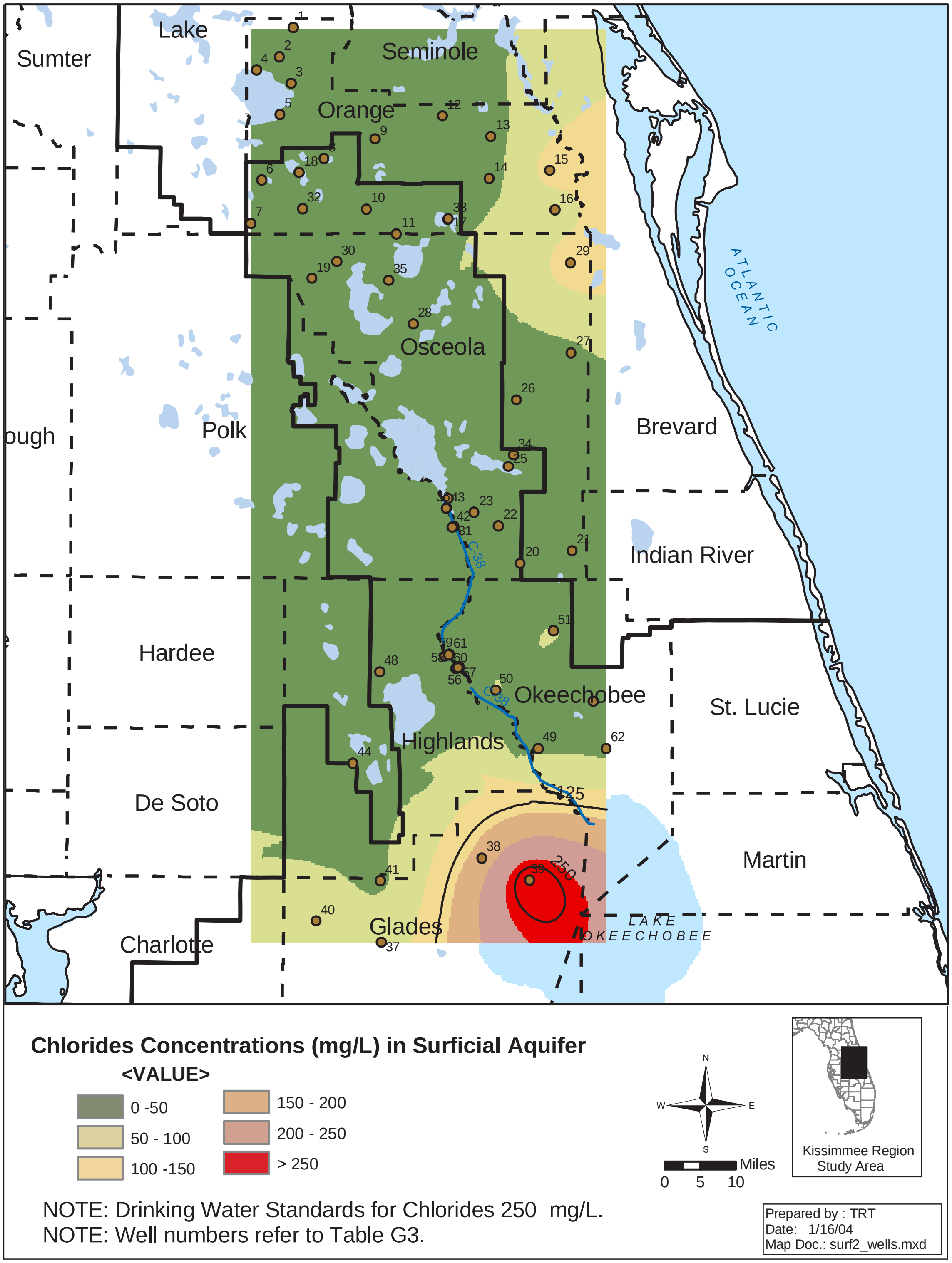

Figure 7. Chloride Concentrations in the Surficial Aquifer.

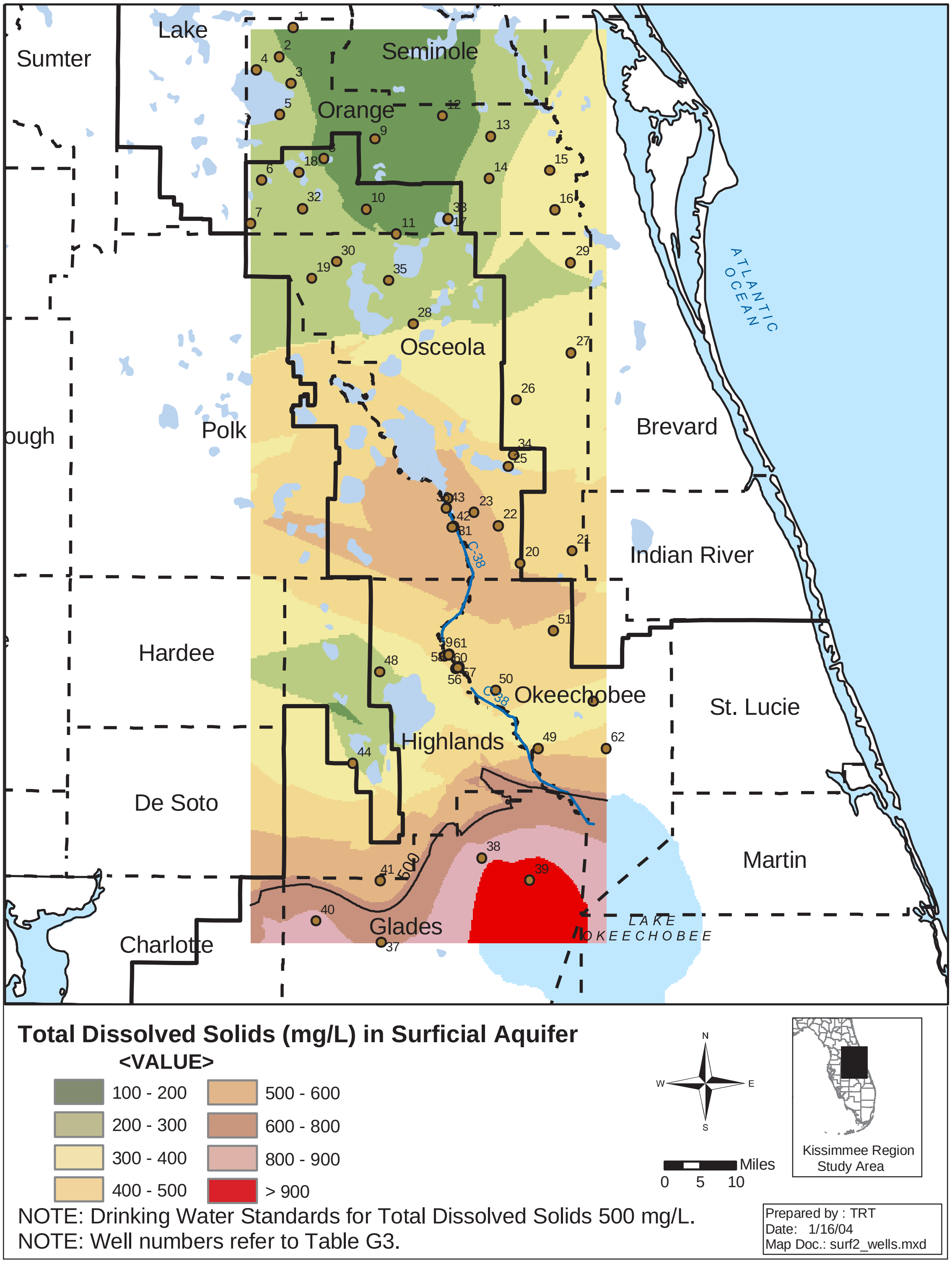

Figure 8. Total Dissolved Solids Concentrations in the Surficial Aquifer.

Table 1. FAS TDS and Chloride Data from Selected Upper Floridan Aquifer Wells 1988–2003.

Site #	Well Name	Total Dissolved Solids (mg/L)	Chlorides (mg/L)	Open Interval or Total Depth	Source	County
1	284612081303401	273.0	7.7		USGS	Orange
2	284529081301001	119.0	7.3	365	USGS	Orange
3	284230081345301	141.0	8.6	--	USGS	Orange
4	283809081324801	196.0	--	--	USGS	Orange
5	283646081195401	146.0	11.0	--	USGS	Orange
6	283325081374001	204.0	16.0	--	USGS	Orange
7	283307081300801	45.0	9.0	--	USGS	Orange
8	282924081290401	168.0	13.0	--	USGS	Orange
9	282738081341401	150.0	5.9	--	USGS	Orange
10	282331081370801	346.0	90.0	--	USGS	Orange
11	282219081242501	255.0	14.0	--	USGS	Orange
12	283011081152301	167.0	11.0	--	USGS	Orange
13	282623081153801	273.0	17.0	248-1004	USGS	Orange
14	282400081150201	471.0	156.0	--	USGS	Orange
15	282315081093601	353.0	34.0	--	USGS	Orange
16	282241081112801	411.0	38.0	--	USGS	Orange
17	282208081053501	500.0	82.0	--	USGS	Orange
18	283249081053201	320.0	56.0	151-492	USGS	Orange
19	282847081013701	495.0	110.0	252-495	USGS	Orange
20	282716081054501	520.0	96.0	506	USGS	Orange
21	282838080572401	1490.0	640.0	--	USGS	Orange
22	283338081010201	1242.0	550.0	--	USGS	Orange
23	283214080583501	1420.0	560.0	200	USGS	Orange
24	282848080544501	2290.0	1100.0	--	USGS	Orange
25	282348080564701	740.0	330.0	245-381	USGS	Orange
26	275609081132001	--	14.0	288-400	USGS	Osceola
27	280905081270101	--	6.0	134-398	USGS	Osceola
28	280905081270102	--	300.0	322-1097	USGS	Osceola
29	274307080582401	--	54.0	218-767	USGS	Osceola
30	ORF-61	153.0	10.4	--	SFWMD	Orange
31	OSF-97	350.0	4.7	--	SFWMD	Osceola
32	275826080554701	500.0	77.0	--	USGS	Osceola
33	RTA-007	504.9	112.3	410	DBHYDRO	Glades
34	GL-5A	310.0	44.5	550	DBHYDRO	Glades
35	GL-5B	285.0	25.4	928	DBHYDRO	Glades
39	HIF-0006	423.1	70.5	520	DBHYDRO	Highlands
41	ORF-61	152.7	10.4	650	DBHYDRO	Orange
42	OR-0004	161.0	6.7	83	DBHYDRO	Orange
43	OSF-0052	836.9	357.8	880	DBHYDRO	Osceola
45	OSF-12	242.0	9.5	400	DBHYDRO	Osceola
46	OSF-18	219.0	31.5	500	DBHYDRO	Osceola

Table 2. FAS TDS and Chloride Data from Selected Upper Floridan Aquifer Wells 1988–2003. (Continued).

Site #	Well Name	Total Dissolved Solids (mg/L)	Chlorides (mg/L)	Open Interval or Total Depth	Source	County
47	OSF-21	436.0	134.2	877	DBHYDRO	Osceola
48	OSF-27	593.0	77.8	470	DBHYDRO	Osceola
49	OSF-5	145.0	4.1	231	DBHYDRO	Osceola
51	OSF-62	321.0	77.9	630	DBHYDRO	Osceola
52	OSF-66	122.0	14.1	670	DBHYDRO	Osceola
53	OSF-68	212.0	10.6	500	DBHYDRO	Osceola
54	OSF-84	193.0	8.7	405	DBHYDRO	Osceola
55	OSF-9	133.0	5.5	1195	DBHYDRO	Osceola
56	OSF-92	286.0	198.3	377	DBHYDRO	Osceola
57	OKF-17	527.0	97.2	986	DBHYDRO	Okeechobee
58	OKF-23	953.0	327.3	925	DBHYDRO	Okeechobee
61	OKF-7	224.0	16.8	963	DBHYDRO	Okeechobee
62	OKF-71	1430.0	575.5	855	DBHYDRO	Okeechobee
63	OKF-72	698.0	305.2	800	DBHYDRO	Okeechobee
64	OKF-74	3950.0	1776.8	725	DBHYDRO	Okeechobee
65	OKF-81	410.0	82.4	782	DBHYDRO	Okeechobee
68	POF-0008	90.9	8.3	199	DBHYDRO	Polk
67	OKF-0003	2284.1	1070.4	433	DBHYDRO	Okeechobee
74	Southwest #3 (P-2)	125.0	8.1	1455	USGS	Orange
69	POF-0015	101.0	5.4	575	DBHYDRO	Polk
70	KREFFD	314.0	4.3	120	DBHYDRO	Osceola

Table 3. FAS TDS and Chloride Data from Selected Lower Floridan Aquifer Well 1988–2003.

Site #	Well Name	Total Dissolved Solids (mg/L)	Chlorides (mg/L)	Open Interval or Total Depth	Source	County
L1	GL-5C	1263.0	540.4	1390-1350	DBHYDRO	Glades
L2	GLF-6	4140.6	1938.4	2023	DBHYDRO	Glades
L3	HIF-14_G	174.1	30.1	1500	DBHYDRO	Highlands
L4	HIF-0037	314.9	118.3	1450	DBHYDRO	Highlands
L5	OSF-97	820.7	16.4	2480	DBHYDRO	Osceola
L6	OKF-34	491.0	103.5	1143	DBHYDRO	Okeechobee
L7	OKF-42	472.0	56.5	1152	DBHYDRO	Okeechobee
L8	OKF-100	12910.7	6340.7	2043	DBHYDRO	Okeechobee
L9	POF-21	359.0	87.9	1035	DBHYDRO	Polk
L10	Bull Creek OS-0025	2040.0	930.0	1483-1473	USGS	Osceola
L11	OSF-0081	2280.0	730.0	2210	USGS	Osceola
L12	Southwest #3 (P-2)	125.0	8.1	1455-1003	USGS	Orange
L13	OR-0618	3280.0	1200.0	1280-1140	USGS	Orange
L14	Navy #1	160.0	9.7	1370-1080	USGS	Orange
L15	Southeast #2	360.0	17.0	1441-1045	USGS	Orange
L16	Cocoa	1590.0	370.0	1205-1098	USGS	Orange
L17	Orange Test Well	258.0	15.0	1424-1098	USGS	Orange
L18	Lk Louisa State Pk	210.0	8.3	1410-1295	USGS	Lake
L19	Cocoa (OR-0613)	1460.0	390.0	1500-1428	USGS	Orange
L20	Cocoa C Zone 3	533.0	81.0	1224-1218	USGS	Orange
L21	Sand Lake	185.0	3.0	2030-2005	USGS	Orange
L22	Orange Conway #4	--	9.8	1400-1100	USGS	Orange
L23	Hidden Springs #4	156.0	8.5	1401-1250	USGS	Orange
L24	Kirkman #3	149.0	8.3	1400-943	USGS	Orange
L25	Lake Adair 9	97.0	8.7	1281-601	USGS	Orange

Table 4. SAS TDS and Chloride Data from Selected Surficial Aquifer Wells 1988–2003.

Site #	Well Name	Total Dissolved Solids (mg/L)	Chlorides (mg/L)	Open Interval or Total Depth	Source	County
1	284604081330301	103	17.0	75	USGS	Orange
2	284230081345302	51	5.3	40	USGS	Orange
3	283914081331702	185	5.0		USGS	Orange
4	284051081380701	451	23.0		USGS	Orange
5	283524081344701	313	34.0		USGS	Orange
6	282722081371701	224	7.6		USGS	Orange
7	282202081384602	138	8.1	38	USGS	Orange
8	283003081283801	76	7.0	54	USGS	Orange
9	283228081213501	98	36.0	25	USGS	Orange
10	282352081224401	70	20.0	29	USGS	Orange
11	282051081183402	96	31.0		USGS	Orange
12	283517081121501	26	5.7	15	USGS	Orange
13	283249081053203	88	12.0	15	USGS	Orange
14	282739081054502	316	12.0	30	USGS	Orange
15	282838080572402	629	180.0	17	USGS	Orange
16	282348080564301	277	9.2	30	USGS	Orange
17	282241081112802	105	38.0	29	USGS	Orange
18	ORS-3	180	9.9	32-52	SFWMD	Orange
19	IC_SAS	300	14.1	15-20	SFWMD	Osceola
20	274032081012701		2.4	9	USGS	Osceola
21	274204080542901		9.8	100	USGS	Osceola
22	274509081042901		30.0	7	USGS	Osceola
23	274646081074801		15.0	23	USGS	Osceola
24	274827081112302		57.0	N/A	USGS	Osceola
25	275222081030702		29.0	28	USGS	Osceola
26	280033081015802		7.1	130	USGS	Osceola
27	280619080542602		20.0	16	USGS	Osceola
28	280950081161501		13.0	65	USGS	Osceola
29	281722080543001		170.0	19	USGS	Osceola
30	281724081265301		29.0	8	USGS	Osceola
31	KRENNM1	446	8.3	37	SFWMD	Osceola
32	OR-0003	352	60.3	18	DBHYDRO	Orange
33	OR-0010	123	46.2	29	DBHYDRO	Orange
34	WELL#41S	30	11.6	28	DBHYDRO	Osceola
35	WELL#45S	400	23.0	26	DBHYDRO	Osceola
36	KRFNNS	500	3.5	21	DBHYDRO	Osceola
37	GLWQ-01	378	28.7	54	DBHYDRO	Glades
38	GLWQ-04	825	152.4	75	DBHYDRO	Glades
39	GLWQ-06	1145	370.1	46	DBHYDRO	Glades
40	GLWQ-08	992	120.4	85	DBHYDRO	Glades
41	GLWQ-09	89	11.2	33	DBHYDRO	Glades

Table 3. SAS TDS and Chloride Data from Selected Surficial Aquifer Wells 1988–2003 (Continued).

Site #	Well Name	Total Dissolved Solids (mg/L)	Chlorides (mg/L)	Open Interval or Total Depth	Source	County
42	KREFFS	400	3.4	21	DBHYDRO	Polk
43	KRFFFS	860	18.0	21	DBHYDRO	Polk
44	HI-0440A	71	7.2	23	DBHYDRO	Highlands
46	KRBNNS	360	18.0	30	DBHYDRO	Highlands
47	KRDNNS1	450	24.0	25	DBHYDRO	Highlands
48	MR-0158	59.1	4.5	10	DBHYDRO	Highlands
49	OKS-83S1	103	12.1	20	DBHYDRO	Okeechobee
50	OKS-84	482	64.3	178	DBHYDRO	Okeechobee
51	OKS-96M1	480	70.0	51	DBHYDRO	Okeechobee
52	OKS90DP1	327	10.8	93	DBHYDRO	Okeechobee
53	OKS90S01	118	18.8	21	DBHYDRO	Okeechobee
54	KRAFFM	330	36.0	40	DBHYDRO	Okeechobee
55	KRAFFS	1500	25.0	23	DBHYDRO	Okeechobee
56	KRANNM	350	53.0	49	DBHYDRO	Okeechobee
57	KRANNS	740	15.0	24	DBHYDRO	Okeechobee
58	KRCFFM	370	28.0	42	DBHYDRO	Okeechobee
59	KRCFFS	450	33.0	25	DBHYDRO	Okeechobee
60	KRCNNM	330	35.0	43	DBHYDRO	Okeechobee
61	KRCNNS	420	33.0	20	DBHYDRO	Okeechobee
62	GRW1	223	13.7	17	DBHYDRO	Okeechobee

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L
Conservation

OVERVIEW

The *2000 Kissimmee Basin Water Supply Plan* (2000 KB Plan) recommended plumbing retrofits for both interior plumbing fixtures and rain sensors for automatic landscape irrigation systems; efficiencies for public water supply utilities; continuation/expansion of the Mobile Irrigation Laboratory (MIL) Program; and, voluntary conversion of agricultural seepage irrigation systems to microirrigation in the Kissimmee Basin (KB) Planning Area. Based on consensus from stakeholders and the analysis associated with this plan update, it was concluded that the 2000 KB Plan recommendations remain valid.

Water conservation options were selected from the *Florida Water Conservation Initiative's* (FDEP 2002) list of potential conservation measures. These are the methods best suited to the scope of the regional water supply plan. An analysis of potential water conservation savings was performed, and options with the greatest potential water savings were identified based on relevant information assembled from laws and ordinances, as well as rules established by the South Florida Water Management District (SFWMD or District). Age of housing stock and the number of hospitality rooms and restaurants in the KB Planning Area were also considered and analyzed. Funding mechanisms for the recommended alternatives are also discussed in this appendix.

AGRICULTURAL IRRIGATION CONSERVATION

Citrus is the dominant crop in the KB Planning Area. According to the District's 2004 Consumptive Use Permit data, over 58 percent of the citrus acreage in the planning area is now using low-volume technology or microirrigation, with the remaining acreage utilizing conventional irrigation methods such as overhead or crown flooding. Conversion of citrus acreage using flood irrigation could result in significant water savings if converted to microirrigation.

Agricultural Best Management Practices

The Best Management Practices (BMP) Programs authorized by Section 403.067, Florida Statutes (F.S.), was developed to help farmers improve water quality. The BMP programs are voluntary and were developed in cooperation with specific agricultural commodity groups. The commodity groups that presently have BMP programs in place or under development are Cattle, Citrus (Indian River area and Ridge area), Green Industries (landscape, nurseries and golf courses), Horses, Silvaculture (forestry) and Vegetables.

Section 403.021, F.S., mandates the involvement of the SFWMD in the BMP Program. Administered by the Florida Department of Agriculture and Consumer Services (FDACS), the BMP Program involves several state, federal and local agencies. The Florida Department of Environmental Protection (FDEP) sets allowable pollution limits called Total Maximum Daily Loads (TMDLs) for nutrients. Resource Conservation and Development corporations and Soil and Water Conservation districts provide local support for BMP programs. The Institute of Food and Agricultural Sciences (IFAS), University of Florida, evaluates individual grove owners' BMPs compliance and has written the Water Quality/Quantity BMPs for Indian River Area Citrus Groves. In addition, the IFAS provided technical expertise to establish nitrogen fertilization rates for the Ridge Citrus BMP Manual. The United States Department of Agriculture–Natural Resources Conservation Service (USDA–NRCS) provides technical assistance and some additional cost-sharing for the program.

The statewide BMP Program is authorized by Section 403.067, F.S. and the specific authority for the Ridge Citrus BMP Program in Rule 5E-1.023, Florida Administrative Code (F.A.C.). Section 576.045, F.S, mandates the SFWMD's involvement in the BMP Program. The Ridge Citrus area is located in Orange and Osceola counties, as well as in the portion of Highlands County in the Southwest Florida Water Management District (SWFWMD). An example of BMPs for the Ridge Citrus area is a recommendation for microirrigation conversion. There has been a moderate level of enrollment in the voluntary program in the KB Planning Area. **Table 1** shows the percentage of citrus acres enrolled in the program by county and within the planning area.

One of the major incentives to join the BMP Program is a cost-sharing arrangement with the FDACS on implementation costs. The SFWMD provides financial and technical assistance for the program startup.

Table 1. Percentage of Citrus Acreage in the Ridge Citrus BMP Program in the Kissimmee Basin Planning Area.

County	Area	Potential Acres[a]	Enrolled Acres	Percentage Enrolled
Glades[b]		0	0	
Highlands[c]	County	42,638	38,994	91%
	KB Area	0	0	
Okeechobee[b]		0	0	
Orange[d]	County	8,095	1,264	16%
	KB Area	4,497	702	16%
Osceola[d]	County	15,273	3,713	24%
	KB Area	14,128	3,435	24%
Polk[d]	County	101,484	45,704	45%
	KB Area	2,537	1,143	45%
Totals	County	167,490	89,676	54%
	KB Area	21,162	5,280	25%

Source: FDACS Notice of Intents Status Reports 2/18/2003

a. Potential Acreage represents Citrus on soil series identified in Rule 5E-1.023, F.A.C.
b. Glades and Okeechobee Counties are not part of the Ridge Area.
c. Excludes Highlands County KB Planning Area because soils defined in footnote "a" are in SWFWMD.
d. The ratio of county to KB Planning Area for Orange, Osceola and Polk counties are defined in the Districtwide Water Supply Assessment (SFWMD 1998).

Agricultural Mobile Irrigation Lab Program

The Mobile Irrigation Lab (MIL) Program began in south Florida in 1989 with an agricultural lab in the SFWMD's Lower West Coast (LWC) Planning Area. The mission of the labs is to educate and demonstrate to agricultural and urban water users how to irrigate efficiently. Currently, there are 15 operational labs throughout the District. Twelve counties are served by the labs. Ten MILs are District-funded and five are funded by other sources. Four of these MILs provide agricultural evaluations. Funding is a multiagency partnership between federal, state and local governments. The agencies currently funding MILs are the USDA-NRCS, the SFWMD and the Big Cypress Basin Board, and various county and local governments. Districtwide, each urban MIL saves an average of 0.41 million gallons per day (MGD), or 410,000 gallons per day.

In the KB Planning Area, one agricultural lab provides evaluations in Okeechobee County. Mobile irrigation labs for Orange and Osceola counties began activities in 2006.

URBAN WATER CONSERVATION

Utilities in the KB Planning Area have promoted water conservation through traditional methods, such as public outreach and customer information. The utilities in this region have implemented the Consumptive Use Permit (CUP) Program water conservation requirements, resulting in implementation of water conservation programs and adopted conservation ordinances.

A survey of the current conservation efforts employed by the major utility providers was conducted. The approach to evaluating the best conservation measures for the KB Planning Area was a repetitive one. The evaluation process entailed identifying characteristics of the planning area, such as age of housing stock, that would likely determine the type or respective age of technology of indoor plumbing devices, and characterizing use patterns by service area and per capita trends (**Table 2**).

Table 2. Examples of How Alternatives are Evaluated.

Planning Area Characteristic	Best Opportunity	Conservation Measure
Indoor - older housing with inefficient indoor plumbing fixtures	Retrofits	Plumbing (e.g., toilets, showerheads, etc.)
Outdoor - irrigation systems that do not respond to rainfall	Retrofits	Rain shut-off switches
New development	Local ordinances/ codes/regulatory measures	Varies from code enforcement to landscape technology, such as Xeriscape™

Indoor Water Use

Two significant changes occurred in plumbing standards in 1983 and 1994, which affected residential water use. In 1983, Chapter 553, F.S., was modified, lowering the maximum allowable flow rates for water fixtures in new construction to a maximum use of 3.5 gallons per flush for toilets and a flow rate of 3.0 gallons per minute (GPM) for showerheads. Prior to this state legislation, the typical volume of water for toilet flushing was 6.0 gallons and showerhead flow was 6.0 GPM.

In 1994, new plumbing standards for water use were implemented under the Federal Energy Policy Act of 1992, setting national plumbing code standards of 1.6 gallons per flush for toilets, 2.5 GPM for showerheads and 2.0 GPM for faucets.

Methodology

In order to determine the urban areas with the greatest potential for retrofits in the KB Planning Area, a housing stock analysis was performed using age of housing as a determinate of the age and water use characteristics of plumbing fixtures. County property assessors' parcel data for Glades, Highlands, Okeechobee, Orange, Osceola and Polk counties provided the number and age of residential units. The age of the residential units was compared to the years when the plumbing code changed as described previously (pre-1984, 1984–1994, 1994–2000).

Table 3 shows the number of units and percentages of housing in each group for the counties in the planning area.

Table 3. Age of Housing Stock in Kissimmee Basin Counties (Indoor Retrofit).

County	Housing Stock			
	Pre 1984	**1985-1994**	**Post 1994**	**Total**
Glades	763 71%	264 24%	52 5%	1,079
Highlands[a,c]	384 NA	384 NA	232 NA	1,000
Okeechobee	4,312 36%	5,306 45%	2,234 19%	11,852
Orange	21,025 41%	19,060 38%	10,580 21%	50,665
Osceola	20,875 36%	22,234 38%	15,485 26%	58,594
Polk[c]	1465 NA	1462 NA	884 NA	3,811
Subtotal[b]	46,975 38%	46,864 38%	28,351 23%	122,190
Total	48,825	48,709	29,467	127,001

NA = Information not available at this time.

a. Based on analysis of USGS Digital Orthographic Quarter Quad images: dq2811ne, dq2811nw, dq2811se, dq2811sw.
b. Includes Glades, Okeechobee, Orange and Osceola counties.
c. Highlands and Polk county percentages based on basinwide average.

Costs and Savings

Utilities that would benefit most from plumbing fixture retrofits are those with significant housing in the pre-1984 age category, and therefore have the most potential for indoor water savings.

Although Glades County has the highest percentage of housing stock pre-1984, its small number of homes relative to Orange and Osceola counties yields a less significant impact for potential water savings. In Orange County, three of seven utilities had a majority of housing stock pre-1984. In Osceola County, three of 10 utilities had a majority of housing stock in their service areas that was pre-1984. For the remaining utilities, the majority of housing stock in their service areas was pre-1994.

Water savings derived from retrofitting pre-1984 housing to current standards is an estimated 4.4 gallons per flush for toilets, and 3.5 GPM for showerheads. Toilets are estimated to be flushed five times a day, while 10 minutes per shower is a standard estimate. According to the 2000 U.S. Census, the number of persons-per-household was 2.51 in Glades County; 2.30 in Highlands County; 2.69 in Okeechobee County; 2.61 in Orange County; 2.79 in Osceola County; and, 2.52 in Polk County.

Annual savings from retrofitting one unit from the pre-1984 technology to current standards would be 32,000 gallons for each retrofitted showerhead and 20,075 gallons for each retrofitted toilet.

For the purposes of this approach, it is assumed that a retrofit program would include 75 percent of the pre-1984 housing stock. This percentage is typically used as an estimate of expected coverage in an urban retrofit program, as some retrofits have already been done, some units are vacant or on the market, or for other reasons will not be part of the program. Using the county housing age data in **Table 3**, and assuming the 75 percent retrofit, the total potential annual savings of a showerhead retrofit is 0.30 MGD for Okeechobee County; 1.40 MGD for Orange County; 1.50 MGD for Osceola County; and, 0.20 MGD for the remaining counties, for total potential savings of 3.40 MGD for the planning area.

Similarly, using the housing age data in **Table 3**, and assuming the 75 percent retrofit, total annual savings of a toilet retrofit is 0.20 MGD for Okeechobee County; 0.90 MGD for Orange County; 1.00 MGD for Osceola County; and, 0.10 MGD for the remaining counties, for a total potential savings of 2.20 MGD for the planning area.

Total annual savings for both toilet and showerhead retrofits are 0.50 MGD for Okeechobee County; 2.40 MGD for Orange County; 2.50 MGD for Osceola County; and, 0.30 MGD for the remaining counties, for a total potential savings of 5.70 MGD. This estimate assumes one retrofit of each device per housing unit.

Whenever indoor water use is reduced, there is also a reduction in wastewater. Wastewater flows have been estimated to be as much as 50 percent of residential water use. Impacts to wastewater treatment facilities and the need for expansion and disposal can be reduced if water use is reduced.

Table 6 shows the estimated savings that could be accrued in the KB Planning Area if the three retrofit measures are implemented, as well as the costs and assumptions used in the calculations. Costs for retrofits are $200 per toilet retrofit and $20 per showerhead, as described in the *Consolidated Water Supply Plan Support Document* (SFWMD 2006). Water conservation cost-efficiency is expressed in 1,000 gallons of water saved annually. Toilet retrofits cost $.25 per 1,000 gallons of water saved, and showerhead retrofits cost $.06 per 1,000 gallons of water saved.

Urban Landscape Irrigation

Methodology

Rain sensor cut-off devices are an effective means of reducing wasteful irrigation in automatic systems when local rainfall has met the immediate irrigation requirement. To determine housing with the greatest potential for outdoor retrofits, age of the housing unit was compared to the law related to rain sensor changes (pre-1992 and post-1992). The percentages of units constructed in the two time periods are described for each county. Data for **Table 4** were obtained from county property assessors' parcel data as previously described.

For this evaluation, water savings derived from installing rain sensors for housing stock built prior to 1992 is estimated. Based on the county housing age data in **Table 4**, and assuming 75 percent of the housing units are retrofitted, a total savings of 4.90 MGD was estimated for the KB Planning Area (0.50 MGD for Okeechobee County; 2.00 MGD for Orange County; 2.20 MGD for Osceola County; and, 0.20 MGD for the remaining counties).

Installing rain sensors in irrigation systems of housing units constructed prior to the 1991 Xeriscape™ landscaping law would result in the greatest savings. For those systems using reclaimed water, additional efficiencies can be realized using metering.

Costs and Savings

Rain sensors can provide a significant reduction in water use for nominal cost. The cost is estimated to average $68 per rain sensor, including installation, and can save 12,700 gallons per year. This equates to a cost of $1.07 per 1,000 gallons. The useful life of a rain sensor is estimated to be five years. Areas benefiting the most from a rain sensor retrofit program would be pre-1992 housing units with in-ground irrigation systems.

Urban Mobile Irrigation Labs

In the KB Planning Area, irrigation audits (evaluations) are purchased from a MIL sponsored by the St. Johns River Water Management District (SJRWMD). These evaluations are done in Osceola County. Mobile irrigation lab personnel evaluate the effectiveness of irrigation systems and then make recommendations as to how the systems can be made more efficient. The result is savings in water, energy, time and money for the user.

The cost of operating and maintaining an urban lab is approximately $57,000 per year. Districtwide, each urban MIL saves an average of 0.08 MGD or 80,0000 gallons per day. State and local funding are usually available for these labs.

Table 4. Age of Housing Stock in the Kissimmee Basin (Rain Sensor).

County	Housing Stock		
	Pre 1992	Post 1992	Total
Glades	996 92%	83 8%	1,079
Highlands[a,c]	700 NA	300 NA	1,000
Okeechobee	8,799 74%	3,053 26%	11,852
Orange	36,549 72%	14,116 28%	50,665
Osceola	39,174 67%	19,420 33%	58,594
Polk[c]	2667 NA	1144 NA	3,811
Subtotal[b]	85,518 70%	36,672 30%	122,190
Total	88,885	38,116	127,001

NA = Information not available at this time.

a. Based on analysis of USGS Digital Orthographic Quarter Quad images: dq2811ne, dq2811nw, dq2811se, dq2811sw.
b. Includes Glades, Okeechobee, Orange and Osceola counties.
c. Highlands and Polk county percentages based on basinwide average.

Restaurant and Hospitality

Restaurant - Water Savings

Orange County has 1,328 seated restaurants in the KB Planning Area, Osceola County has 541 seated restaurants, and Okeechobee County has 64 seated restaurants. Although figures for seated restaurants in Glades, Highlands and Polk counties that lie within the KB Planning Area are not available, the sum is considerably smaller relative to Orange and Osceola counties (78 percent of the KB Planning Area's restaurants are located in Orange and Osceola counties).

In restaurant dishwashing systems, dishes, pots and pans are pre-rinsed prior to washing. The estimation of potential water savings is based on the assumption that a low-volume rinse valve installed on a pre-rinse sprayer will save 77,047 gallons of water per year (211 gallons per day) and can be installed in 50 percent of the seated restaurants in Orange and Osceola counties.

The savings are 51 MGY (0.14 MGD) for Orange County and 21 MGY (0.06 MGD) for Osceola County, totaling 72 MGY (0.20 MGD).

Restaurant - Retrofit Cost

Costs for restaurant rinse valve retrofits are estimated at $80 per retrofit. Water conservation cost efficiency is expressed in 1,000 gallons of water saved annually. Rinse valve retrofits cost $.21 per 1,000 gallons of water saved. Whenever indoor water use is reduced, there is also a reduction in wastewater. Impacts to wastewater treatment facilities and the need for expansion and disposal of these facilities can be reduced if water use is reduced.

Hotel - Water Savings

The estimation of potential water savings is based on the assumption that low-volume shower and faucet retrofit kits are installed in each hotel, motel, or rental condominium room. Each kit will save 71 gallons of water per day, per room, and can be installed in 50 percent of the rooms in Orange and Osceola counties.

In 2002, Orange County had 690 hotels, motels and rental condominiums with a total of 85,939 rooms. Osceola County had 3,851 hotels, motels and rental condominiums for a total of 38,061 rooms.

The savings are 3.06 MGD for Orange County and 1.36 MGD for Osceola County, totaling 4.42 MGD.

Hotel - Retrofit Cost

Costs for hotel retrofits are $20 per retrofit. Water conservation cost efficiency is expressed in 1,000 gallons of water saved annually. Showerhead and faucet retrofits cost $.08 per 1,000 gallons of water saved. The total costs of implementing the hotel retrofit programs for showerheads and faucets is $1,102,750 for Orange and Osceola counties in order to achieve the savings presented above.

CONSERVATION MEASURES

Table 5 provides a general list of recommended conservation measures that would be effective in different types of utility service areas based on the population growth rate, housing stock, and potential for growth.

The SFWMD actively engages in devising programs for retrofits, and has dedicated outreach specialists and intergovernmental representatives to assist utilities, local governments and water users to achieve the goals of this plan update. The District's Water Savings Incentive Program (WaterSIP) is tailored to assist the community to partially fund projects, such as large-scale retrofits, as recommended by this plan update. Through the WaterSIP, the SFWMD will continue to provide matching funds up to $50,000 to water providers for water-saving technologies.

Table 5. Utility Characteristics and Conservation Methods.

Type of Utility	Characteristics of Utilities	Utility Specific Recommendations
Large Growth Potential	Considerable existing housing stock of intermediate to old age, significant land available for new development	Indoor retrofits, Xeriscape™ ordinance, irrigation hours ordinance, outreach and education
Moderate Growth Potential	Existing housing stock intermediate in age, moderate potential for development - limited by boundaries of other utility service areas and natural areas	Indoor retrofits, Xeriscape™ ordinance, irrigation hours ordinance, promote Mobile Irrigation Lab, outreach & education
Limited Growth Potential	Housing stock is older, service area is near build out, very limited potential for growth	Indoor retrofits, rain sensor installation, promote Mobile Irrigation Lab, outreach & education

The SFWMD will also provide increased technical assistance, as well as outreach and education efforts in the KB Planning Area. These efforts include annual conservation workshops held at the service center to showcase the District's funding programs for conservation and alternative water supplies; funding support for annual WaterFest events; support of Florida Yards and Neighborhoods; and, MIL educational efforts. Savings may vary from year to year as programs are implemented.

Table 6 and **Table 7** show the estimated savings that could be realized in the KB Planning Area if retrofit measures are implemented, as well as the costs and assumptions used in the calculations.

Table 6. Savings Achieved by Implementing the Recommended Measures for Conservation in the KB Planning Area.

Housing Stock Characteristic	Conservation Measure	Water Savings per Retrofit Device	Cost per Device	Cost per 1,000 gallons	Planning Area Savings Based on Retrofit of 75% of Characteristic Housing Stock	Estimated Total Cost of Program to Achieve Savings
Housing Built Before 1984	Showerhead Retrofit	3.5 gallons per minute	$20	$.06/ 1,000	3.4 MGD	$732,368
Housing Built Before 1984	Toilet Retrofit	4.4 gallons per flush	$200	$.25/ 1,000	2.2 MGD	$7,323,683
Pre-1992 Outdoor Irrigation Systems Without Rain Sensors	Rain Sensor Installation	74 gallons per day	$68	$1.07/ 1,000	4.9 MGD	$4,533,141
				Totals	10.5 MGD	12,589,192

Table 7. Savings Achieved by Implementing the Recommended Hospitality Industry Measures for Conservation in the KB Planning Area.

Housing Stock Characteristic	Conservation Measure	Water Savings per Retrofit Device	Cost per Device	Cost per 1,000 gallons	Planning Area Savings Based on 50% Retrofit Rate	Estimated Total Cost of Program to Achieve Savings
Restaurants 50% Retrofit Rate	Low Volume Spray Valve	211gallons per day	$80	$.21/ 1,000	0.3 MGD	$201,084
Hotel/Motel 50% Retrofit Rate*	Showerhead and Faucet Retrofit	71 gallons per day	$20	$.08/ 1,000	4.4 MGD	$1,102,750
				Totals	4.7 MGD	$1,303,834

The estimated amount of water that could potentially be conserved in the KB Planning Area is 15.20 MGD for urban use within the 20-year planning horizon as a result of retrofit conservation measures. Achieving this savings, however, is highly dependent on cooperating utilities.

CONSERVATION – IMPLEMENTATION STRATEGIES

The following are potential strategies for water conservation that were developed in cooperation with the public:

- Landscape irrigation water conservation has the potential for significant water savings, and has the potential to reduce Surficial Aquifer System resource issues. This may be accomplished by expanding MIL activity in the planning area, and may involve local government funding partnerships to increase lab services, especially in newer urban communities.
- Local governments should consider developing ordinances to address water-conserving landscape installation for new construction to maximize water savings in initial design and operation of both residential and commercial sites.
- Implement cost-effective indoor and outdoor retrofits in the KB Planning Area based on the preceding analyses.
- Complete water conservation rulemaking for Chapter 40E-2, F.A.C., and the *Basis of Review for Water Use Permit Applications*, emphasizing goal-based conservation programs for public water suppliers and major water users.
- Fund projects through the WaterSIP, including public/private partnerships, which further the preceding recommendations.
- Expand outreach and education through funding, public/private partnerships, the media, professional organizations and users.

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Cost Estimating and Economic Criteria

This appendix contains information on the origination of several of the cost estimations for the water source options and treatment technologies presented in this plan.

A memorandum (**Exhibit 1**) summarizes the approach on the origination and updated cost information presented in the *2005–2006 Kissimmee Basin Water Supply Plan Update* (2005–2006 KB Plan Update). The approach discussed in this memorandum is supported by the Florida Department of Environmental Protection (FDEP) and the water management districts. The cost information provides a consistent set of definitions and criteria for the development of comparable planning level, life cycle, cost estimates for water supply and wastewater treatment alternatives.

Exhibit 1. Cost Estimating and Economic Criteria for 2005 District Water Supply Plan.

TECHNICAL MEMORANDUM CH2MHILL

Cost Estimating and Economic Criteria for 2005 District Water Supply Plan

PREPARED FOR:	Beth Wilder/SJRWMD
PREPARED BY:	Ron Wycoff/ CH2M HILL Mandy Parks/ CH2M HILL
COPIES:	Barbara Vergara/ SJRWMD Jerry Salsano/TAURANT
DATE:	June 16, 2004

Purpose

This technical memorandum (TM) provides cost definitions and cost estimating and economic criteria to be used in the development of water supply facilities costing for the 2005 District Water Supply Plan (DWSP). These criteria will be applied to all cost estimates and economic comparisons developed as part of the 2005 DWSP to ensure that all costs are directly comparable.

This TM provides a consistent set of definitions and criteria for the development of comparable planning level life cycle cost estimates for all water supply alternatives.

Definitions

The following definitions will be used in the 2005 DWSP project and should be adhered to when applicable. For the most part, these definitions are the same as used by SJRWMD, as well as by Southwest Florida Water Management District (SWFWMD), in the development of the initial DWSPs.

Construction Cost

The construction cost is the total amount expected to be paid to a qualified contractor to build the required facilities at peak design capacity.

Non-construction Capital Cost

Non-construction capital cost is an allowance for construction contingency, engineering design, permitting and administration associated with the constructed facilities.

Land Cost

The market value of the land required to implement the water supply option.

DWSP 2005 COST ESTIMATING CRITERIA TM 062404 FINAL DOC 1

Exhibit 1. Cost Estimating and Economic Criteria for 2005 District Water Supply Plan (Continued).

Land Acquisition Cost

The estimated cost of acquiring the required land, exclusive of the land cost.

Total Capital Cost

Total capital cost is the sum of construction cost, non-construction capital cost, land cost, and land acquisition cost.

Operation and Maintenance Cost

The estimated annual cost of operating and maintaining the water supply option when operated at average day capacity.

Equivalent Annual Cost

Total annual life cycle cost of the water supply option based on service life and time value of money criteria established for this project. Equivalent Annual Cost accounts for Total Capital Cost and O&M costs with facility operating at average day design capacity.

Present Worth

The equivalent present value of current and future expenditures for a specified planning period.

Unit Production Cost

Equivalent Annual Cost divided by annual water production. The Unit Production Cost will be expressed in terms of dollars per 1,000 gallons.

Criteria

Cost estimating and economic criteria are guidelines for estimating costs associated with water supply options.

Peak Flow Ratio

Capital cost of water supply facilities will be based on maximum installed capacity designed to accommodate peak or maximum daily flow (MDF) requirements. O&M costs and annual water production are based on the average daily flow (ADF) produced. The peak flow ratio (MDF/ADF) for an individual water supply system depends on the demand characteristics of the service area. For public supply systems the peak ratio is generally at least 1.25 for large systems and can be greater than 2.0 for small systems.

For water supply options where the service area peak flow ratio is known, the known value can and should be used in the cost estimating and economic calculations. For regional planning applications, a peak ratio of 1.5 will be used. This MDF/ADF ratio was applied in the 2000 DWSP.

Exhibit 1. Cost Estimating and Economic Criteria for 2005 District Water Supply Plan (Continued).

Cost Index

Engineering News Record (ENR) publishes a Construction Cost Index (CCI) that can be used to adjust the cost basis of a given construction project for past and future times. The ENRCCI is based on the following construction items: 200 hours of common labor at the 20-city average of common labor rates, plus 2,500 pounds of standard structural steel shapes at the mill price prior to 1996 and the fabricated 20-city price from 1996, plus 1.128 tons of Portland cement at the 20-city price, plus 1,088 board-ft of 2 x 4 lumber at the 20-city price.

Cost estimates, for the 2005 DWSP, will be expressed in estimated year 2005 dollars. Because much of 2005 DWSP cost estimating work will be completed prior to 2005, projection of the current ENRCCI (June 2004 ENRCCI = 7,109) to mid-year 2005 ENRCCI is required.

Basic construction materials costs have increased significantly in the first 6 months of 2004 and this recent history is included in the mid-year 2005 ENRCCI projection. Exhibit 1 shows the recent monthly historic ENRCCI trend, as well as monthly projections through June 2005. The projected ENRCCI for June 2005 is approximately 7,420. This projection is based on the observed mean monthly growth rate (0.357%) for the 30-month period from January 2003 through June 2004.

EXHIBIT 1
ENRCCI Projection to 2005
Cost Estimating & Economic Evaluation Criteria

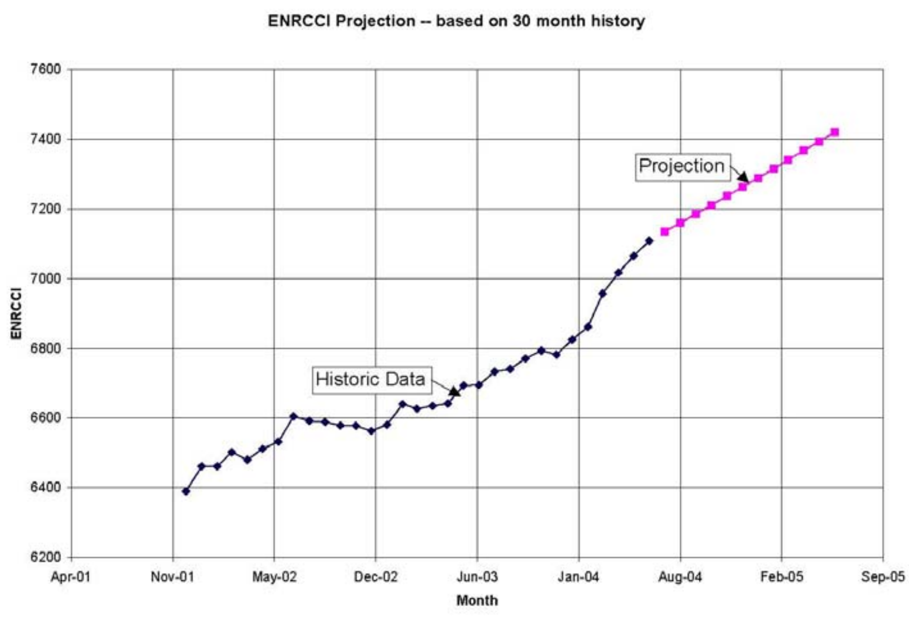


Exhibit 1. Cost Estimating and Economic Criteria for 2005 District Water Supply Plan (Continued).

The cost basis for the 2000 DWSP was March 1996 with a corresponding ENRCCI value of 5,537. Using the projected mid-year 2005 ENRCCI value of 7,420 represents an increase in the cost basis of about 34 percent.

The conceptual planning level cost estimates prepared for the 2004 Interim Update DWSP projects are expressed on an April 2003 cost basis with a corresponding ENRCCI value of 6,635. Therefore, the cost basis for the 2005 DWSP will be approximately 11.8 percent greater than the cost basis for the 2004 Interim Update.

Non-construction Capital Cost

Non-construction capital cost will equal 45% of the planning level estimated construction cost. This includes a 20% allowance for construction contingency and a 25% allowance for engineering design, permitting, and administration. This value is unchanged from the 2000 DWSP.

Land Cost

Unit land cost ($/acre) for each parcel are based upon land use classification and size as supplied by SJRWMD land acquisition staff for the 2000 DWSP. An evaluation of current land values, as per recent SJRWMD land purchases, did not provide an adequate basis for revising the 2000 DWSP values. If actual site-specific land values are available for a given parcel and water supply option the site-specific value should be used in lieu of these typical regional values.

General land use classifications include urban, suburban, and rural. Size is based on acreage, where *small* refers to parcels 50 acres or less in size and *large* refers to parcels greater than 50 acres in size. Exhibit 2 provides the unit land cost matrix for parcels located within SJRWMD.

EXHIBIT 2
Unit Land Cost for Parcels
Cost Estimating & Economic Evaluation Criteria

Land Use Classification	Parcel Size	
	Small (< or = 50 acres) ($/acre)	Large (> 50 acres) ($/acre)
Urban	$ 100,000	N/A
Suburban	$ 20,000	$ 10,000
Rural	$ 5,000	$ 3,000

Unit land costs ($/ft²) for pipeline corridors vary based on the land use classification and whether or not the parcel is adjacent to public right of way (ROW) or in an undeveloped (new) area, and whether an easement or full ROW is required. Exhibit 3 provides the unit

Exhibit 1. Cost Estimating and Economic Criteria for 2005 District Water Supply Plan (Continued).

cost matrix for pipeline corridors located within SJRWMD. These values are the same as used in the 2000 DWSP.

EXHIBIT 3
Unit Land Cost for Pipeline Corridors
Cost Estimating & Economic Evaluation Criteria

Land Use Classification	Adjacent to Public ROW		New Area	
	Easement ($/ft^2)	ROW ($/ft^2)	Easement ($/ft^2)	ROW ($/ft^2)
Urban	$ 4.00	$ 6.00	$ 3.00	$ 5.00
Suburban	$ 1.50	$ 3.00	$ 1.00	$ 2.00
Rural	$ 0.75	$ 1.00	$ 0.50	$ 0.75

Land Acquisition Cost

Land acquisition cost estimates will vary as a function of condemnation requirements, as follows:

- 12% of land value for known non-condemnation parcels
- 25% of land value for know condemnation parcels
- 18% of land value where condemnation status is unknown

In most case, at the conceptual regional planning level of analysis, it is anticipated that condemnation status will be unknown and therefore the 18% value will apply. A single value of 25% was used in the 2000 DWSP.

Interest Rate

For the 2005 DWSP, the interest rate to be used in all economic analysis calculations will be the current (FY04) federal water resources planning rate. This rate, set annually by the US Bureau of Reclamation for use by all federal agencies, is based on US Treasury bond rates. Although it is adjusted annually, it cannot be changed by more than ¼ percent in any single year. The current (FY04) federal planning rate, as published in the Federal Register (April 26, 2004), is 5.625 % per annum. This value will be used in all economic calculations for the 2005 DWSP.

The interest rate used in the 2000 DWSP was 7 % per annum. A value of 6 % was used in the 2004 Interim Update DWSP. Since that time the Federal water resources planning discount rate has been chosen as the interest rate criterion for water supply planning.

Economic Life of Facilities

The economic service life of facilities is based on the criteria used in the 2000 DWSP. Exhibit 4 provides the economic service life, in years based on component type. These values will be used in all annual cost and present worth calculations.

Exhibit 1. Cost Estimating and Economic Criteria for 2005 District Water Supply Plan (Continued).

In all cases, land is considered a permanent resource and therefore has an infinite service life.

EXHIBIT 4
Economic Service Life
Cost Estimating & Economic Evaluation Criteria

Component Type	Service Life (years)
Water Conveyance Structures	40
(pipelines, collection and distribution systems)	
Other Structures	35
(buildings, tankage, site improvements, etc.)	
Wells	30
Process and Auxiliary Equipment (treatment equipment, pumps motors, mechanical equipment, etc.)	20
Reverse Osmosis Membranes	5

The non-construction capital costs associated with a given project, or major project component, will also be distributed in proportion to expected service life of the project. For example, if a given project, or major project component, has an economic service life of 20 years then the non-construction capital cost for that project, or major project component, also has an economic service life of 20 years.

Present Worth

A 20-year planning period will be used in present worth calculations. This present worth planning period was also used in the 2000 DWSP.

Summary

Generally, definitions and cost estimating and economic criteria applied to the 2005 DWSP will be the same as those applied to the 2000 DWSP. The main exceptions are the cost basis, the land acquisition cost factor and the interest rate.

All 2005 DWSP costs will be estimated year 2005 costs; whereas, the 2000 DWSP was developed using March 1996 costs. The cost basis for the 2004 Interim Update DWSP was April 2003.

The second change is the land acquisition factor. Land acquisition costs were estimated as 25% of land value for the 2000 DWSP. For the 2005 DWSP, this factor will vary depending upon condemnation status.

The final change is the interest rate used in the economic calculations. An interest rate of 7% was used for the 2000 DWSP and an interest rate of 6% was used for the 2004 Interim

Exhibit 1 Cost Estimating and Economic Criteria for 2005 District Water Supply Plan (Continued).

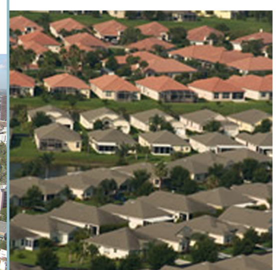
Update DWSP. An interest rate of 5.625% will be used for the 2005 DWSP. The 2005 DWSP interest rate is equal to the current (FY04) Federal water resources planning rate.

All other definitions and criteria remain unchanged.

REFERENCES CITED

St. Johns River Water Management District. 2004. *Cost Estimating and Economic Criteria for 2005 District Water Supply – Technical Memorandum*. CH2M Hill. Palatka, FL.

SFWMD



MEETING SOUTH FLORIDA'S RAPIDLY GROWING WATER SUPPLY NEEDS WHILE SAFEGUARDING ITS NATURAL SYSTEMS REQUIRES INNOVATIVE SOLUTIONS, COHESIVE PLANNING AND A SHARED VISION FOR THE FUTURE.

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South Florida Water Management District
3301 Gun Club Road • West Palm Beach, Florida 33406
561-686-8800 • FL WATS 1-800-432-2045 • www.sfwmd.gov
MAILING ADDRESS: P.O. Box 24680 • West Palm Beach, FL 33416-4680

sfwmd.gov