Special Publication SJ98-SP1

WATER SUPPLY NEEDS AND SOURCES ASSESSMENT
ALTERNATIVE WATER SUPPLY STRATEGIES INVESTIGATION
ASSESSMENT OF THE COST OF SUPPLYING RECLAIMED WATER TO AREAS OF HIGH AGRICULTURAL WITHDRAWALS

by

Post, Buckley, Schuh & Jernigan, Inc.

St. Johns River Water Management District
Palatka, Florida

1998

EXECUTIVE SUMMARY

St. Johns River Water Management District (SJRWMD) is investigating alternative water supply strategies within Priority Water Resource Caution Areas (PWRCAs) identified by Vergara (1994). One strategy being investigated is the use of reclaimed water for irrigation in areas with high agricultural water withdrawals from the Floridan aquifer. These areas were identified by SJRWMD as citrus growing regions in Orange, Lake, and Seminole counties and the fern growing areas of northwest Volusia and southeast Putnam counties.

The study was divided into two phases. In Phase I, completed in 1996, data availability and sufficiency were evaluated and a methodology for conducting the second phase was developed. The Phase I results were presented in Jackson et al. (1996).

Based on the methodology outlined in Phase I, Phase II of the assignment was conducted. Phase II required an assessment of the availability of reclaimed water in locations that could reasonably serve fern and citrus growing areas, assessment of the water needs for the defined fern and citrus growing areas, and estimation of the cost of using reclaimed water for fern and citrus irrigation in the identified areas. This report presents the results of the Phase II study and includes a description of the Phase II methodology, discussion of findings, conclusions, and recommendations.

The Phase II methodology included a determination of the volume of water from the Floridan aquifer being used to irrigate citrus and ferns that potentially can be saved by using reclaimed water. Sizing criteria were established to estimate the cost of serving these agricultural water uses with reclaimed water.

SJRWMD monitors monthly water use for ferneries that participate in the Benchmark Farms program. Data provided by SJRWMD from the program were used to estimate an annual average irrigation requirement of 0.55-inches/week, exclusive of freeze protection needs. Using Geographic Information System (GIS) data provided by SJRWMD for areal coverage of ferneries and the irrigation

requirement, an average annual irrigation water use of 15.32 million gallons per day (mgd) for ferneries in Volusia County was estimated.

For estimating citrus irrigation needs, water use data provided in Phase I, as well as additional data collected in Phase II, were used. These included SJRWMD GIS data base on citrus coverage, SJRWMD records on citrus irrigation water use from the Benchmark Farms program, and the City of Orlando's and Orange County's Water Conserv II reclaimed water citrus irrigation system data.

SJRWMD water use data for citrus were used to develop an annual average irrigation demand of 9.61 inches per year, based on the period of record of January 1992 to December 1996. The GIS coverages were used to identify the location and size of citrus groves. From the coverage data and annual average irrigation rate, an irrigation demand was estimated by grove section. An average annual irrigation demand of 8.55 mgd was calculated for portions of Lake and Orange counties within SJRWMD.

Estimated reclaimed water availability data provided by SJRWMD from their 1995 wastewater and reuse inventory were compared to the potential irrigation needs of citrus. Areas within the citrus growing region were identified that could be most effectively served by reclaimed water. Considering just the citrus in close proximity to wastewater treatment plants (WWTPs), the potential water savings is 3.90 mgd.

Cost estimates were developed for irrigation of ferns and citrus with reclaimed water. For ferneries, four alternatives were developed with the following capital and equivalent unit costs:

Alternative	Water Savings (mgd)	Capital Cost (Million, $)	Capital Cost ($/gallon)	Equivalent Unit Cost, ($/1,000 gallons)
1	11.77	93.27	7.92	1.84
2	8.47	65.58	7.74	1.81
3	1.91	10.95	5.73	1.39
Deltona	10.91	83.76	7.24	1.57

Alternatives 1 and 2 would receive reclaimed water from WWTPs in Daytona Beach, Ormond Beach and DeLand. Alternative 3 would receive reclaimed water only from DeLand. The Deltona alternative was added at the request of SJRWMD to test the hypothetical case that Deltona develop a facility with 9.0 mgd of reclaimed water available that would be combined with reclaimed water from DeLand for a 10.91 mgd alternative.

For citrus irrigation, costs were developed by WWTP in proximity to the citrus growing region. A summary by WWTP is as follows:

Reclaimed Water Source (WWTPs)	Average Annual Water Savings (mgd)	Capital Cost (Million, $)	Capital Cost ($/gallon)	Equivalent Unit Cost, ($/1,000 gallons)
Tavares-Caroline St.	0.44	3.87	8.79	2.42
Clerbrook MHP	0.04	0.71	17.86	5.23
Clermont	0.62	4.97	8.01	2.22
Groveland	0.03	0.51	17.11	5.40
Orange Co.-Meadow Woods	0.06	0.62	10.37	2.65
Orange Co.-Northwest	0.31	2.06	6.66	1.79
Mid-Florida Lakes	0.10	1.27	12.67	3.57
Ocoee No. 2	0.44	3.19	7.25	2.10
Rock Springs	0.09	1.13	12.53	3.59
Sunshine Parkway	0.07	0.81	11.59	3.52
The Villages of Lake-Sumter	0.20	1.60	8.02	2.08
Winter Garden	1.11	7.99	7.20	1.89
Tavares-Woodlea Road	0.31	2.73	8.80	2.47
Zellwood	0.08	1.03	12.86	3.71
Total	**3.90**	**32.50**		
Average			**8.33**	**2.30**

Because the irrigation rates for citrus irrigated with ground water are so much lower than the rates for citrus irrigated with reclaimed water at Water Conserv II, an analysis was conducted using the higher, 33.84 in/yr irrigation rate. The analysis was performed using the City of Clermont area. By assuming a higher irrigation rate, a smaller area is actually irrigated, reducing pipe lengths, but also reducing the quantity of water saved. The equivalent unit cost per 1,000 gallons of reclaimed water used is reduced to $1.74, as compared to $2.22/1,000 gallons at the lower irrigation rate. However, the equivalent unit cost per 1,000 gallons of Floridan aquifer water saved is much higher at $6.12. Although, on the basis of cost per gallon of reclaimed water

used, it is more cost-effective to use the higher application rates, when the cost per gallon of water saved is considered, it is more cost-effective to use irrigation rates comparable to the rates used on the Benchmark Farms.

It is recommended that the costs developed using the Benchmark Farm irrigation data be used in the decision modeling for the Investigation of Alternative Water Supply Strategies. Should any of these alternatives be identified as viable, additional development of implementation strategies and reclaimed water availabilities should be conducted.

It is also recommended that SJRWMD consider other agricultural uses of reclaimed water in the Investigation of Alternative Water Supply Strategies process. Another potential use would be irrigation of ornamental plant nurseries located in the western Orange County vicinity.

CONTENTS

TABLES

FIGURES

INTRODUCTION

BACKGROUND

St. Johns River Water Management District (SJRWMD) is responsible for managing ground water resources in a nineteen-county area of northeastern Florida. Ground water aquifers are currently the primary sources of potable water supply in SJRWMD. The most dependable ground water source is the Floridan aquifer. However, Vergara (1994) projected shortfalls in available water supply in certain critical areas throughout SJRWMD boundaries by the year 2010. Areas with existing or 2010 projected water supply problems were designated as Priority Water Resource Caution Areas (PWRCAs).

As a result, SJRWMD embarked on an Investigation of Alternative Water Supply Strategies. Strategies being investigated include using lower quality ground water supplies, surface water, reclaimed water, aquifer recharge, aquifer storage and recovery, mitigation and avoidance, and various water conservation techniques.

SJRWMD contracted with Post, Buckley, Schuh & Jernigan, Inc. (PBS&J) to perform various tasks for the purpose of assessing water conservation and reuse of reclaimed water as effective alternative water supply strategies. This report specifically addresses Task II - *Assessment of the Cost of Supplying Reclaimed Water to Areas of High Agricultural Withdrawals*. The task was performed in association with PB Water, a division of Parsons Brinckerhoff Quade & Douglas, Inc.

The task was divided into two phases. The first phase was summarized by Jackson et al. (1996). The purpose of Phase I was to conduct a data assessment and develop a scope of services for Phase II.

PURPOSE

The purpose of Phase II is to assess the cost of transporting reclaimed water to areas of major agricultural withdrawals to reduce agricultural use of fresh ground water. Two agricultural uses were investigated: fern and citrus irrigation. Specific objectives of the task include:

- Assess the availability of reclaimed water in locations that could reasonably serve fern and citrus growing areas.

- Assess the water needs for the defined fern and citrus growing areas.

- Estimate the cost of using reclaimed water for fern and citrus irrigation in the identified areas.

The water savings and estimated costs will be used by SJRWMD in their overall decision-making in relation to the Investigation of Alternative Water Supply Strategies.

SCOPE OF SERVICES

Specific tasks performed in the Phase II investigation included:

- Subtask 1 - Fern irrigation requirements:

  1.1 Estimate average annual fern irrigation rate.

  1.2 Use SJRWMD Geographic Information System (GIS) data to identify fern location and size.

  1.3 Estimate annual average fern irrigation demand by site.

  1.4 Compare reclaimed water availability to fern irrigation demands and identify areas that can most cost-effectively be served by reclaimed water.

- Subtask 2 - Citrus irrigation requirements:

  2.1 Estimate an average annual irrigation rate.

  2.2 Use GIS data to locate and estimate the size of citrus groves.

  2.3 Determine irrigated acreage and potential average daily reclaimed water irrigation demand.

2.4 Compare estimated reclaimed water availability to potential irrigation needs of citrus and identify citrus growing areas that can be most cost-effectively served by reclaimed water.

- Subtask 3 - Cost Estimates:

  3.1 Develop cost estimates for fern and citrus irrigation with reclaimed water.

  3.2 Develop cost estimates for the use rapid infiltration basins (RIBs) in high recharge areas (for use by SJRWMD in other Investigation of Alternative Water Supply Strategies Assignments).

- Subtask 4 - Report:

  4.1 Prepare a report summarizing the methodologies, discussion, conclusions, and recommendations of this assignment.

- Subtask 5 - Project Progress Meetings:

  5.1 Participate in up to two project progress meetings.

METHODOLOGY

GENERAL

PBS&J (1997) includes reclaimed water availability and treatment requirement data obtained from SJRWMD's 1995 wastewater and reuse inventory data base for wastewater treatment plants (WWTPs) throughout the PWRCA. These data were utilized in this study to determine the availability of reclaimed water within Volusia County for serving ferneries and Orange and Lake counties for serving citrus.

FERN IRRIGATION REQUIREMENTS

Annual average fern irrigation requirements were determined by using fern water use and coverage data provided in Phase I by SJRWMD. Fern water use data were provided for 48 ferneries that participate in the SJRWMD Benchmark Farm program. Water use for these farms is metered and reported monthly to SJRWMD. Data were provided for the period of October 1989 to October 1995 and covered crop type (all data provided were for leatherleaf ferns), growing condition (either hammock or saran), and monthly water use in gallons and inches. Quality of data was indicated in the spreadsheet data base. Acreage information was not provided in the spreadsheet data base. Monthly water use for ferneries with "good" quality data was converted to inches per week for evaluation purposes. An annual average irrigation rate over the period of record was calculated.

As part of the Phase I assessment (Jackson et al. 1996), it was determined that this study would be based upon providing reclaimed water to meet irrigation demands, but not freeze protection needs. To exclude freeze protection water use, a linear interpolation of water use from November to March was performed.

To estimate water used for fern irrigation, the average irrigation rate (excluding freeze protection) was converted to gallons per day per acre and applied to areal coverage information provided in GIS format by SJRWMD. A total irrigation demand by farm was then calculated.

Based on questions received during an April 24, 1997 presentation to fern growing interests, a summary of typical reclaimed water quality was prepared based on in-house PBS&J data on typical WWTPs providing public access quality reclaimed water.

CITRUS IRRIGATION REQUIREMENTS

Water use data for citrus areas were provided by SJRWMD from the Benchmark Farms project. These data were initially provided in Phase I in the form of annual average water use for citrus grown on sandy-ridge soils for the period of 1992 to 1994. In Phase II, additional data were provided by SJRWMD in the form of monthly water use by farm for Orange and Lake counties for the period of 1992 to 1996. These data were analyzed to develop an annual average citrus irrigation demand. Data from the Benchmark Farms were compared to data from the City of Orlando's and Orange County's Water Conserv II reclaimed water citrus irrigation program.

SJRWMD provided GIS land use coverage data that contained irrigated citrus grove acreage by land section. These data were used to define the areal coverage and location of citrus groves within the study area. The study area was defined as the area of concentrated citrus production in parts of Orange and Lake counties that lie within SJRWMD.

COST ESTIMATES

Planning level cost estimates which can be used to approximate costs for system components were developed. The costs are not intended to be used for specific sites or facilities but for use in the planning process associated with the Investigation of Alternative Water Supply Strategies. Cost estimation procedures as defined for the project (Appendix A) were followed. Unit cost information provided in Law Engineering (1996) was used when appropriate.

For both ferns and citrus, it was assumed high-level disinfection would be needed. For citrus, this is required by regulation (Chapter 62-610, F.A.C.) because it is an edible crop. For ferneries, it was believed to be

necessary to protect the health of fern cutters, who contact the irrigation water, and to prevent plugging of irrigation equipment with solids. Existing levels of treatment from each reclaimed water facility were reviewed from the SJRWMD inventory. It was also assumed that existing methods of effluent disposal would be available to serve the backup needs of the reuse systems.

Additional costs were developed for distribution systems within citrus and fern irrigation areas. The citrus distribution cost estimates were developed based on construction cost data available from the City of Orlando's and Orange County's Water Conserv II citrus irrigation project. Fern distribution data were derived from planning-level estimates developed by PBS&J (1992), Water Conserv II information, and other in-house data.

For fern irrigation, several scenarios were developed for estimating the cost of supplying reclaimed water to the fern growing regions. All scenarios considered serving ferneries in Volusia County. The scenarios included maximum usage of reclaimed water produced in Volusia County, moderate usage of reclaimed water produced in Volusia County, and use only of reclaimed water produced in western Volusia County (DeLand area). A fourth hypothetical alternative was developed at the request of SJRWMD based on the availability of 9 mgd from the Deltona area. No treatment facility of this size is in place for the Deltona area, but it was assumed that should one be developed, the facility would meet high-level disinfection criteria established in state regulations.

For citrus irrigation, cost estimates were developed by summing component costs for each WWTP in the vicinity of areas of concentrated citrus production. An example calculation was also done for the city of Clermont to determine the impact that higher irrigation rates (as experienced at Water Conserv II) would have on cost. Higher irrigation rates result in shorter transmission distances for use of a given volume of reclaimed water, reducing the estimated capital costs. However, since only a fraction of the reclaimed water used at the higher irrigation rates represents the true water savings, the cost per gallon of water saved could increase.

In addition to the costs for fern and citrus irrigation systems, SJRWMD requested estimates of RIB costs in sandy-ridge areas that could be used in other tasks associated with the Investigation of Alternative Water Supply Strategies. These cost estimates were developed based on data available for the City of Orlando's and Orange County's Water Conserv II system which includes RIBs as a component of the citrus irrigation system.

DISCUSSION

FERN IRRIGATION

Fern irrigation rates were established to determine the potential Floridan aquifer water savings and to provide a basis for establishing transmission and distribution sizing and cost criteria for using reclaimed water as an irrigation source in the fern growing region. In Phase I (Jackson et al. 1996), it was determined that the analysis of fern irrigation requirements would be based on average rates excluding peaks experienced for freeze protection. It was to be assumed that additional irrigation required to meet the freeze protection peak demands could be obtained from existing sources (existing wells and storage ponds).

From a review of the Benchmark Farm data provided by SJRWMD, it was determined that the months of December through February had higher water use, most likely to provide freeze protection. During these months, the ferneries used in excess of 1 inch per week (in/wk) compared to annual average water use of 0.71 in/wk. All other months had average irrigation rates less than the annual average. Excluding the freeze protection needs, there was very little seasonal variation in demand. The non-freeze average monthly irrigation rates were within 25 percent of the annual average.

Using linear interpolation of the demands in November and March, the non-freeze irrigation rates for December through February were calculated. These revised non-freeze rates were used to estimate an annual average irrigation rate of 0.55 in/wk excluding water used for freeze protection. A summary of the irrigation rates with and without consideration of the freeze protection needs is presented in Table 1.

There are several different types of ferns and fern growing conditions that could potentially impact irrigation rates, but it is beyond the scope of a planning-level study to develop rates in such detail. All of the Benchmark Farm data was for the leatherleaf variety fern. Fern growing conditions include hammocks (natural shade) and sarans (artificial shade).

Table 1. Fern irrigation rate summary

Month	Irrigation Demand Including Freeze Protection[a] (in/wk)	Irrigation Demand Excluding Freeze Protection[b] (in/wk)
January	1.20	0.64[b]
February	1.09	0.67[b]
March	0.69	0.69
April	0.60	0.60
May	0.62	0.62
June	0.47	0.47
July	0.46	0.46
August	0.45	0.45
September	0.43	0.43
October	0.44	0.44
November	0.58	0.58
December	1.48	0.61
Average	0.71	0.55[b]

[a]As summarized from data provided by SJRWMD for the Benchmark Farm project for the period of October 1989 through October 1995.
[b]Estimated non-freeze flow value based on interpolation of November and March demands.

The rate of 0.55 in/wk (2,133 gpd/acre) was applied to the GIS fern coverage data provided by SJRWMD to estimate an average annual non-freeze irrigation water need of 15.32 mgd for the ferneries in Volusia County. The fern irrigation demand that can be effectively served is limited, however. One potential limitation is the proximity and availability of reclaimed water. As can be seen in Figure 1, most of the WWTPs in Volusia County are along the coast and the ferneries are in the northwestern portion of the County.

Reclaimed water availabilities for Volusia County as summarized by PBS&J (1997) from the SJRWMD wastewater and reuse inventory are presented in Table 2. It should be noted that these availabilities most likely overestimate the amount of reclaimed water truly available in 1995 for utilities with existing public access reuse programs. As presented in PBS&J (1997), on a peak day basis, a utility's reuse system may require 1.5 times or greater reclaimed water than the annual average demand during peak seasonal periods. For example, the City of Daytona Beach reported wastewater flows of 6.5 mgd in 1995 for their Regional WWTP. Five mgd was reused at golf courses and other public access areas. Therefore, the inventory shows an availability (unreused flow) of 1.5 mgd. During peak seasonal periods, however, the City's reuse needs could potentially exceed 7.5 mgd (1.5 times 5.0 mgd), leaving no additional capacity and even a deficit in supply.

In addition, many utilities are in the process of expanding reuse programs as wastewater flows increase. Others may have no future reuse plans. It was beyond the scope of this planning-level study to investigate the current and future availability for each WWTP. The SJRWMD inventory values are presented as preliminary planning-level numbers that can be used in the Investigation of Alternative Water Supply Strategies process. If irrigation with reclaimed water appears to be a viable option, further study of actual reclaimed water availability is needed.

Adequate reclaimed water is needed to meet the peak seasonal irrigation needs of the ferneries. Although ferneries appear to irrigate at a fairly constant rate seasonally with the exception of the winter freeze protection peak, there is some variation in demand. The average annual

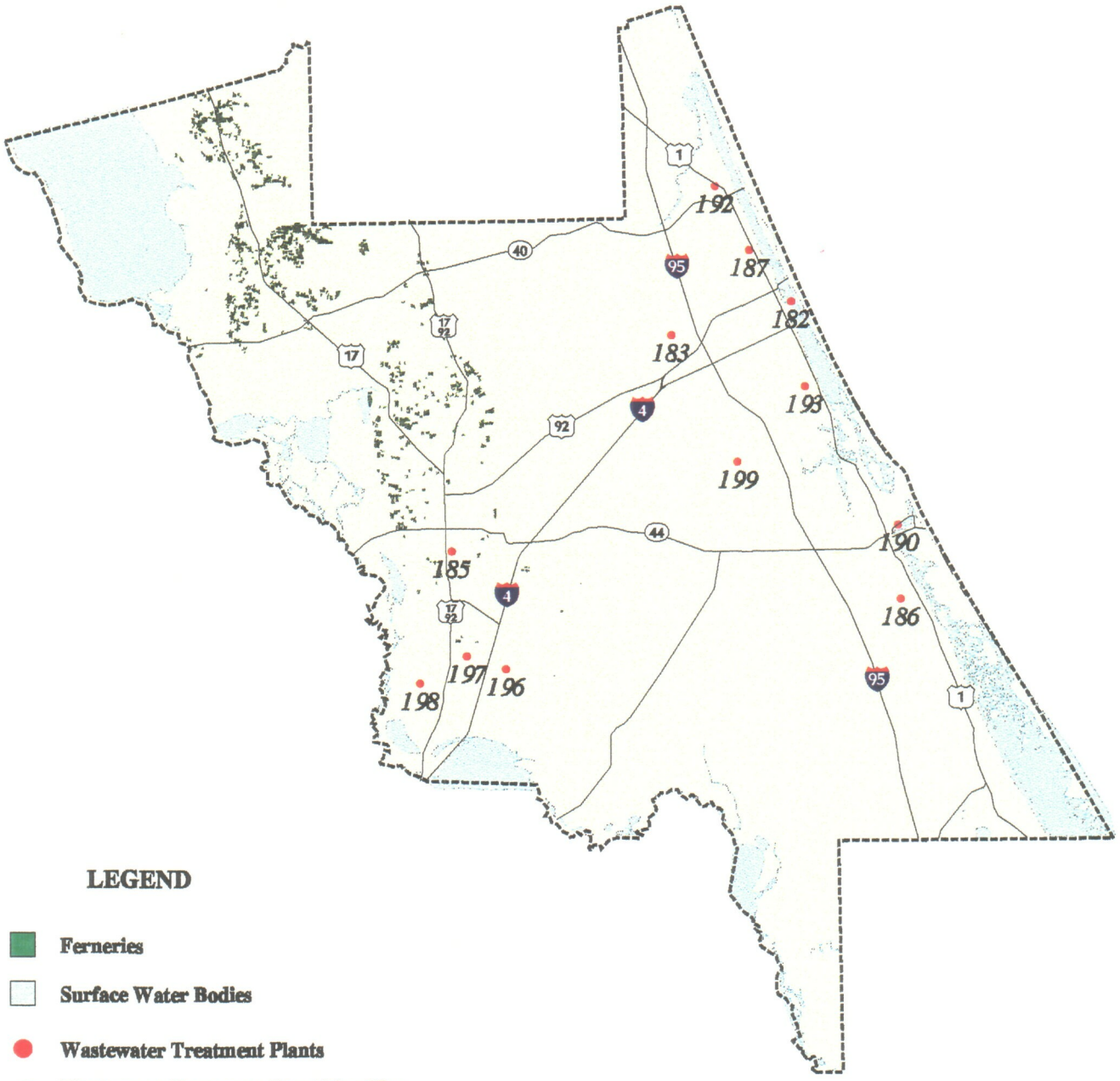


FIGURE 1. WASTEWATER TREATMENT/REUSE PLANT LOCATIONS AND FERN IRRIGATION AREAS IN VOLUSIA COUNTY

Table 2. Volusia County reclaimed water availability data

WWTP Reference Number[a]	WWTP Name	Disinfection Level[b]	Filters[b] (Y or N)	Reclaimed Water Availability[b,c] (mgd)
182	Daytona - Bethune Pt.	High	Y	6.33
183	Daytona - Regional	High	Y	1.50
185	DeLand - Regional	High	Y	2.39
186	Edgewater	High	Y	0.87
187	Holly Hill	Low	Y	0.28
190	New Smyrna Beach Util. Comm.	High	Y	1.74
192	Ormond Beach	High	Y	3.35
193	Port Orange	High	Y	4.04
196	Volusia County - Deltona North	Basic	N	0.31
197	Volusia County - Four Townes	Basic	N	0.20
198	Volusia County - Southwest Regional	High	Y	0.30
199	Volusia County - Spruce Creek	Basic	N	0.17
	Total Availability			**21.48**

[a]Refer to Figure 1 for WWTP location.
[b]Data as provided by SJRWMD in 1995 Wastewater Treatment and Reuse Inventory (PBS&J 1997). Y=Yes, N=No.
[c]Reclaimed Water Availability is based on unreused flow plus flows to wetlands and ground water recharge, as indicated in the 1995 Wastewater Treatment And Reuse Inventory (SJRWMD).

irrigation rate of 0.55 in/wk is 80 percent of the March seasonal peak of 0.69 in/wk. Therefore, to meet the seasonal peak (non-freeze) demands of ferns, only 80 percent of the "available" reclaimed water can actually be considered available on an annual average basis.

Another potential limitation is the cost-effectiveness of serving all the ferneries with reclaimed water. It is more effective to serve areas with the highest density of ferneries.

By state regulation (Chapter 62-610, F.A.C.), ferneries can be irrigated with reclaimed water that is treated to secondary standards with basic disinfection. However, during a presentation to representatives of the Volusia County fern growing community (April 24, 1997), concern was expressed regarding the adequacy of this level of treatment. Fern cutters come in close contact with the irrigation water, their clothing often becoming saturated. According to the fern growers' representatives, protective clothing would not be practical. Concern was also expressed about solids deposition on fern leaves and the potential for clogging of irrigation units. Therefore, for cost estimating purposes, it will be assumed that high-level disinfection will be provided. Providing the higher levels of treatment will allow greater flexibility in reuse systems since other potential users of reclaimed water could be served along the route to the ferneries.

High-level disinfection is defined in Chapter 62-600, F.A.C. as secondary treatment with filtration to reduce total suspended solids to 5 milligrams per liter (mg/L) or less followed by chlorination to produce a minimum 1.0 mg/L chlorine residual after 30 minutes contact at average daily flow. This level of treatment is required for reclaimed water that is used to irrigate areas with public access (golf courses, residential lawns, parks, etc.) or edible food crops (citrus, other fruits, vegetables, etc.). The typical composition of reclaimed water treated to meet high-level disinfection criteria is summarized in Table 3.

Further, at the request of the fern growing representatives at the April 24, 1997 meeting, inquiries were made to existing sites utilizing reclaimed water to irrigate ferns. These include the City of DeLand and City of Orlando's and Orange County's Water Conserv II.

Table 3. Summary of typical reclaimed water quality[a]

Parameter	Typical Quality	
	mg/L	lb/day[b]
Arsenic	BDL[c]	BDL
Barium	BDL	BDL
Cadmium	BDL	BDL
Chromium	BDL	BDL
Fluoride	0.19	0.003
Lead	BDL	BDL
Mercury	BDL	BDL
Nitrate	0.43	0.008
Selenium	BDL	BDL
Silver	BDL	BDL
Sodium	150	2.670
Volatile Organic Compounds	BDL	BDL
Organic Chemical Compounds	BDL	BDL
Chloride	226	4.023
Copper	BDL	BDL
Iron	BDL	BDL
Manganese	0.016	0.0003
Sulfate	120	2.136
Zinc	BDL	BDL
pH	7.37 units	N/A
Total Dissolved Solids	612	10.894

[a]Based on Brevard County's South Central Regional WWTP 1996 Reclaimed Water Analysis Report. WWTP provides secondary treatment and high-level disinfection.
[b]Units of mg/L were converted to pounds per day because pounds loading is a more familiar term to fern growers. The calculation is based on a 0.55 acre-in/wk application rate. To calculate pounds for different application rates, divide by 0.55 and multiply by the appropriate rate in units of acre-in/wk.
[c]BDL = Below detection limits.

The City of DeLand and Orange County have irrigated a fernery from their Brandy Trails WWTP for many years. The WWTP provides secondary treatment with basic disinfection. With good WWTP operation, there have been no complaints from the fern grower regarding water quality or any negative impact to ferneries (Jeffries 1997).

The City of Orlando and Orange County have irrigated a fernery as part of the Water Conserv II reclaimed water program for nearly 10 years. Telephone interviews were conducted with the manager of the Water Conserv II water distribution system (Cross 1977) and the operator of the fernery receiving reclaimed water (Gleason 1997) who also operates ferneries in Volusia County. Water Conserv II provides reclaimed water that meets the high-level disinfection criteria of Chapter 62-610, F.A.C. Both Cross and Gleason indicated that there have been no problems related to water quality, irrigation system performance, or fern appearance.

CITRUS IRRIGATION

The establishment of citrus irrigation rates is required to determine the volume of water from the Floridan aquifer that potentially can be saved by using reclaimed water and to provide the basis for establishing the sizing criteria to estimate the cost of a reclaimed water distribution system.

Citrus water use data for the period 1992-1996 are summarized in Table 4. These data were provided by SJRWMD from the Benchmark Farm project in the form of monthly water use by farm for citrus grown on sandy-ridge soils in Orange and Lake counties. The information was analyzed to develop an annual average citrus irrigation demand.

An analysis was performed to compare the Benchmark Farm data to PB Water's in-house information for the City of Orlando's and Orange County's Water Conserv II citrus irrigation program for 1992 through 1994. The Water Conserv II data are summarized in Table 5. The Water Conserv II distribution system was originally designed to offer reclaimed water on an irrigation schedule. Because the full capacity

Table 4. Average annual water use for citrus groves[a]

Date	Lake And Orange County By Farm	
	Average Monthly Irrigation (In/Acre)	Average Annual Irrigation (In/Acre)
Jan-92	1.56	
Feb-92	0.18	
Mar-92	0.49	
Apr-92	0.86	
May-92	1.18	
Jun-92	0.28	
Jul-92	1.11	
Aug-92	0.29	
Sep-92	0.55	
Oct-92	0.90	
Nov-92	0.28	
Dec-92	0.30	7.99
Jan-93	0.16	
Feb-93	0.11	
Mar-93	1.13	
Apr-93	0.86	
May-93	1.75	
Jun-93	1.16	
Jul-93	0.76	
Aug-93	1.49	
Sep-93	0.64	
Oct-93	0.78	
Nov-93	0.71	
Dec-93	1.56	11.10
Jan-94	0.16	
Feb-94	0.10	
Mar-94	0.97	
Apr-94	1.75	
May-94	1.66	
Jun-94	0.30	
Jul-94	0.41	
Aug-94	0.07	
Sep-94	0.20	
Oct-94	0.19	
Nov-94	0.29	
Dec-94	0.11	6.20

[a]Based on data provided by SJRWMD from Benchmark Farm project.

Table 4. Average annual water use for citrus groves (continuation)[a]

Date	Lake And Orange County By Farm	
	Average Monthly Irrigation (In/Acre)	Average Annual Irrigation (In/Acre)
Jan-95	0.04	
Feb-95	1.20	
Mar-95	0.55	
Apr-95	0.93	
May-95	1.84	
Jun-95	1.07	
Jul-95	0.77	
Aug-95	0.57	
Sep-95	0.52	
Oct-95	0.23	
Nov-95	0.93	
Dec-95	1.09	9.74
Jan-96	1.34	
Feb-96	2.61	
Mar-96	0.22	
Apr-96	0.78	
May-96	1.56	
Jun-96	0.72	
Jul-96	1.25	
Aug-96	0.89	
Sep-96	0.77	
Oct-96	0.96	
Nov-96	1.19	
Dec-96	0.70	13.00
Average		9.61

[a]Based on data provided by SJRWMD from Benchmark Farm project.

Table 5. Average annual water use for citrus groves - Water Conserv II

Date	Irrigation (Mg/Month)	Area (Acres)	Average Monthly Irrigation (In/Acre)	Average Annual Irrigation (In/Acre)
Jan/92	288.94	3,000	3.55	
Feb/92	29.74	3,000	0.37	
Mar/92	147.54	3,000	1.81	
Apr/92	218.41	3,000	2.68	
May/92	390.08	3,000	4.79	
Jun/96	193.47	3,000	2.37	
Jul/92	343.21	3,000	4.21	
Aug/92	163.22	3,000	2.00	
Sep/92	210.87	3,000	2.59	
Oct/92	182.57	3,000	2.24	
Nov/92	166.62	3,000	2.05	
Dec/92	159.34	3,000	1.96	30.62
Jan/93	177.39	3,500	1.87	
Feb/93	175.41	3,500	1.85	
Mar/93	236.14	3,500	2.48	
Apr/93	290.50	3,500	3.06	
May/93	296.45	3,500	3.12	
Jun/96	262.33	3,500	2.76	
Jul/93	251.99	3,500	2.65	
Aug/93	470.34	3,500	4.95	
Sep/93	384.95	3,500	4.05	
Oct/93	397.78	3,500	4.19	
Nov/93	398.86	3,500	4.20	
Dec/93	391.19	3,500	4.12	39.28
Jan/94	431.19	4,000	3.97	
Feb/94	368.39	4,000	3.39	
Mar/94	415.17	4,000	3.82	
Apr/94	541.66	4,000	4.99	
May/94	472.34	4,000	4.35	
Jun/96	365.89	4,000	3.37	
Jul/94	208.72	4,000	1.92	
Aug/94	305.73	4,000	2.81	
Sep/94	63.79	4,000	0.59	
Oct/94	127.13	4,000	1.17	
Nov/94	85.51	4,000	0.79	
Dec/94	49.34	4,000	0.45	31.62
Average				33.84

Source: PB Water in-house data base.

has not been reached, the reclaimed water is offered "on demand" and is currently provided at no cost to the growers beyond the initial connection from the turnout to their irrigation system. As a result of the water being available on demand and free of charge, reclaimed water uses are higher than would otherwise be expected. The average irrigation use for Water Conserv II calculated for 1992 to 1994 is 33.84 inches per year compared to 9.61 per year for the Benchmark Farms within Lake and Orange counties from 1992 to 1996. The large difference between the two numbers may be due to the cost of water. The SJRWMD Benchmark Farm growers must pay pumping costs versus Water Conserv II where water is supplied free. Higher application rates would be expected when a free irrigation source is available. The purpose of this study is to evaluate the replacement of existing agricultural water use with reclaimed water; therefore, the average annual rate utilized is 9.61 inches per year rather than the higher rate experienced at Water Conserv II. To prevent excessive water use, reclaimed water would have to be provided at a cost consistent with the existing costs associated with pumping. If usage is not controlled to prevent over use, only 50 percent or less of the reclaimed water used would represent a savings of water from the Floridan aquifer.

SJRWMD provided GIS land use coverage data that contained irrigated citrus grove acreage by land section. The GIS data were used to define the areal coverage and location of citrus groves within the study area. The study area is defined as the concentrated citrus areas of the parts of Orange and Lake counties that lie within SJRWMD boundaries. Based on the study area definition, the central and eastern parts of Orange County and the northern part of Lake County are excluded. Using the annual average irrigation rate with the estimated study area acreage resulted in a calculated potential daily reclaimed water irrigation demand on a section by section basis (see Figure 2). Table 6 shows the potential reclaimed water irrigation demand by county with a total potential demand of 8.55 mgd. The estimated reclaimed water availability data were screened to identify the sources which have available reclaimed water within the study area (see Table 7). Sources with less than 0.03 mgd available capacity or those too distant from the citrus production areas were not considered in the study. As discussed

Figure 2 - Wastewater Treatment/Reuse Plant Locations and Citrus Irrigation Demand by Land Section within the Study Area

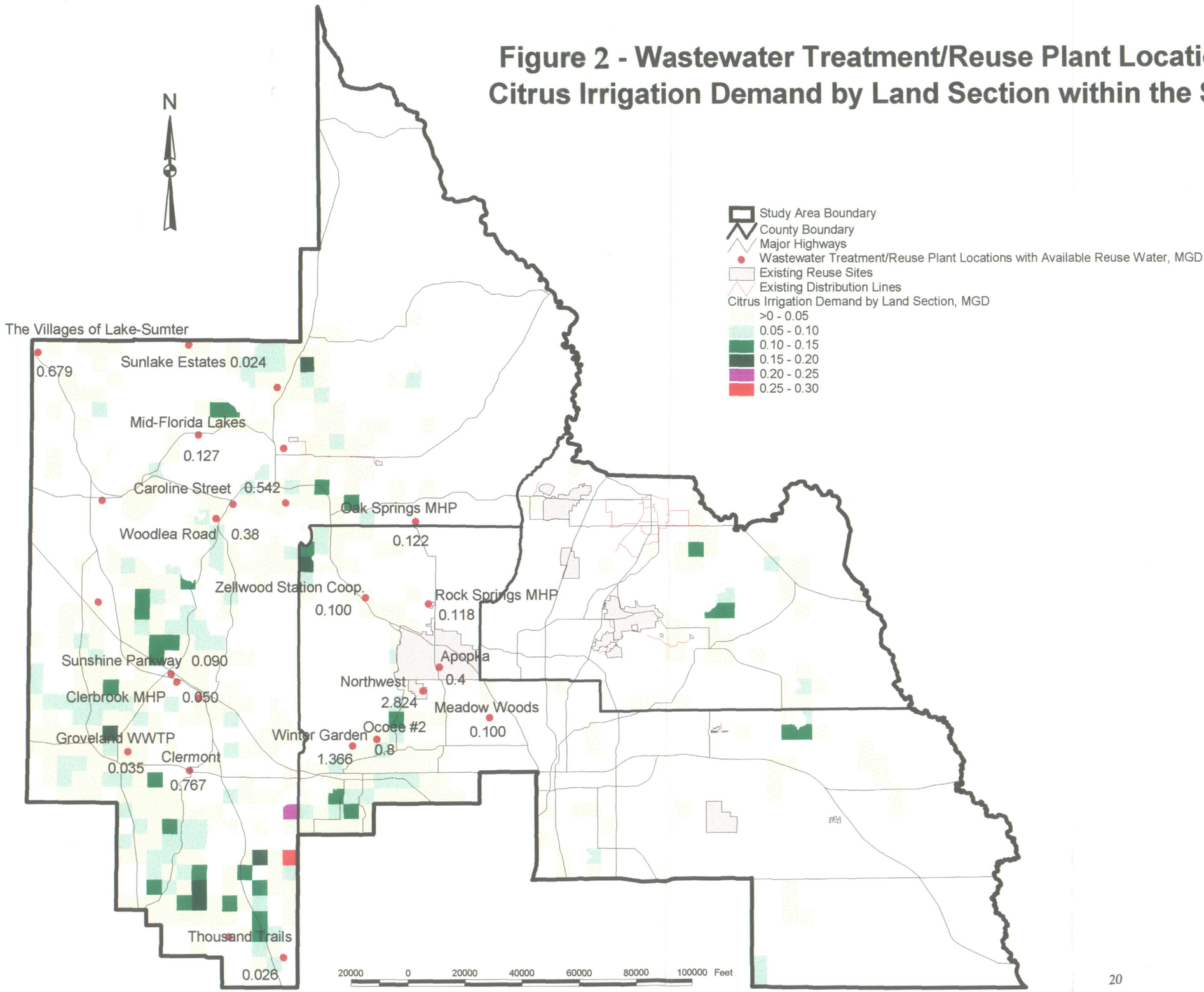


Table 6. Potential reclaimed water irrigation demand of citrus groves within the study area by County

County	Citrus Irrigation Demand (mgd)
Lake County	2.842
Orange County	5.708
Total	**8.550**

Table 7. Wastewater treatment plants within the study area with available reclaimed water (mgd)[a]

Name	Facility	Disinfection Level	Filters[b] (Y or N)	Reclaimed Water Availability (mgd)
Clerbrook RV Resorts	Clerbrook MHP	Basic	N	0.050
Clermont; City of	Clermont	Basic	N	0.767
Groveland; City of	Groveland WWTP	Basic	N	0.035
M.H.C. Corporation (DeAnza)	Mid-Florida Lakes	Basic	N	0.127
Florida Water Services	Sunshine Parkway	Basic	N	0.090
Tavares; City of	Caroline Street	Basic	N	0.542
Tavares; City of	Woodlea Road	Basic	N	0.380
Thousand Trails; Inc.	Thousand Trails	Basic	N	0.026
Village Center Comm. Dev. Dist.	The Villages of Lake-Sumter	High	Y	0.679
Water Oaks Utility; Inc.	Water Oaks Estates	Basic	N	0.124
Wilder Corporation	Sunlake Estates	Basic	N	0.024
Wekiva Falls Resort Campground	Wekiva Falls Resort	Basic	N	0.062
Apopka; City of	Apopka	High	Y	0.400
Ocoee; City of	#2	Basic	N	0.800
Orange County	Meadow Woods	High	Y	0.100
Orange County	Northwest	Basic	N	2.284
Reeco Properties	Rock Springs MHP	Basic	N	0.118
Winter Garden; City of	Winter Garden	Basic	Y	1.366
Zellwood Station Coop.	Zellwood Station Coop.	Basic	N	0.100

[a]Data based on 1995 Wastewater and Reuse Inventory provided by SJRWMD (PBS&J 1997). Reclaimed water availability is based on unreused flow plus flows to ground water recharge.
[b]Y = Yes, N=No filters

previously regarding fern irrigation, these availabilities are based on annual average "unreused flow plus wetlands and recharge." For utilities that have portions of their flow dedicated to public access reuse or agricultural reuse programs subject to seasonal variabilities in demands, there may be times of the year when little to no additional reclaimed water is available. The numbers in Table 7 are presented for preliminary planning purposes only.

COST ESTIMATES

General

Components considered to estimate costs for both fern and citrus irrigation with reclaimed water include additional reclaimed water treatment needed to meet high-level disinfection requirements; operational storage to meet the diurnal variations in irrigation demands; transmission from reclaimed water facilities to agricultural sites; and distribution within the agricultural areas. Unit cost information provided by Law Engineering (1996) was used to the extent feasible in estimating costs for supplying reclaimed water to ferneries and concentrated citrus areas. Additional unit cost information was developed for distribution of reclaimed water within the agricultural areas.

Fern Irrigation

According to data from the 1995 wastewater and reuse inventory provided by SJRWMD (PBS&J 1997), most of the WWTPs in Volusia County with reclaimed water availability provide filtration and chlorination to meet high-level disinfection. The only exceptions are Holly Hill and three of the four Volusia County facilities. (Refer to previous Table 2).

Because of the long transmission distance between most of the WWTPs and the fern sites, it is more practical to provide remote storage in the vicinity of the ferneries to provide capacity for diurnal variations in irrigation demands than size the transmission line to handle the peak diurnal demands. The transmission line can be sized to handle the

seasonal irrigation and peak wastewater flows to avoid the need for additional storage capacity at each WWTP.

A peaking factor of 1.5 was used to size the transmission mains. Storage capacity was based on one average day of reclaimed water demand. Transmission and distribution piping beyond the storage facilities were sized with a 3.75 peaking factor (3.0 hourly x 1.25 seasonal =3.75) to account for irrigation occurring during an 8.0 hour period each day. Pumping facilities would be required at the WWTPs and at remote storage locations. Micro-distribution costs (pipes with diameters of 12 inches and less) within the fern areas were based on a hydraulic analysis for an example fern area (presented in Appendix B).

To estimate costs, three irrigation scenarios or alternatives were developed. These are summarized in Table 8 and on Figures 3 through 5.

The first alternative is based on maximizing the use of reclaimed water to irrigate ferns. A two-mile wide transmission corridor was developed through the fern areas and irrigation demands were estimated to serve all of the ferns within the corridor. For this alternative, reclaimed water would be provided from the following WWTPs:

- City of Daytona Beach Bethune Point
- City of Daytona Beach Regional
- DeLand Regional
- Ormond Beach

Although additional reclaimed water is available from other Volusia County WWTPs, projected irrigation demands can be met by the facilities in closest proximity to the fern areas. Each of these facilities currently provides filtration and chlorination to meet high-level disinfection, so additional treatment is not necessary.

Because of the long transmission distance to the Seville and Lake Dias areas of northwest Volusia County, a second alternative was developed based on eliminating reclaimed water service to these areas. The same WWTPs would provide reclaimed water; however, because

Table 8. Fern irrigation alternatives

Alternative Number	Number of Ferneries Served	Area (acre)	Annual Average Demand (mgd)	Seasonal Peak (mgd)	Daily Peak (mgd)
1	938	5,519	11.77	14.71	44.14
2	724	3,971	8.47	10.59	31.76
3	164	1,014	1.91	2.39	7.16

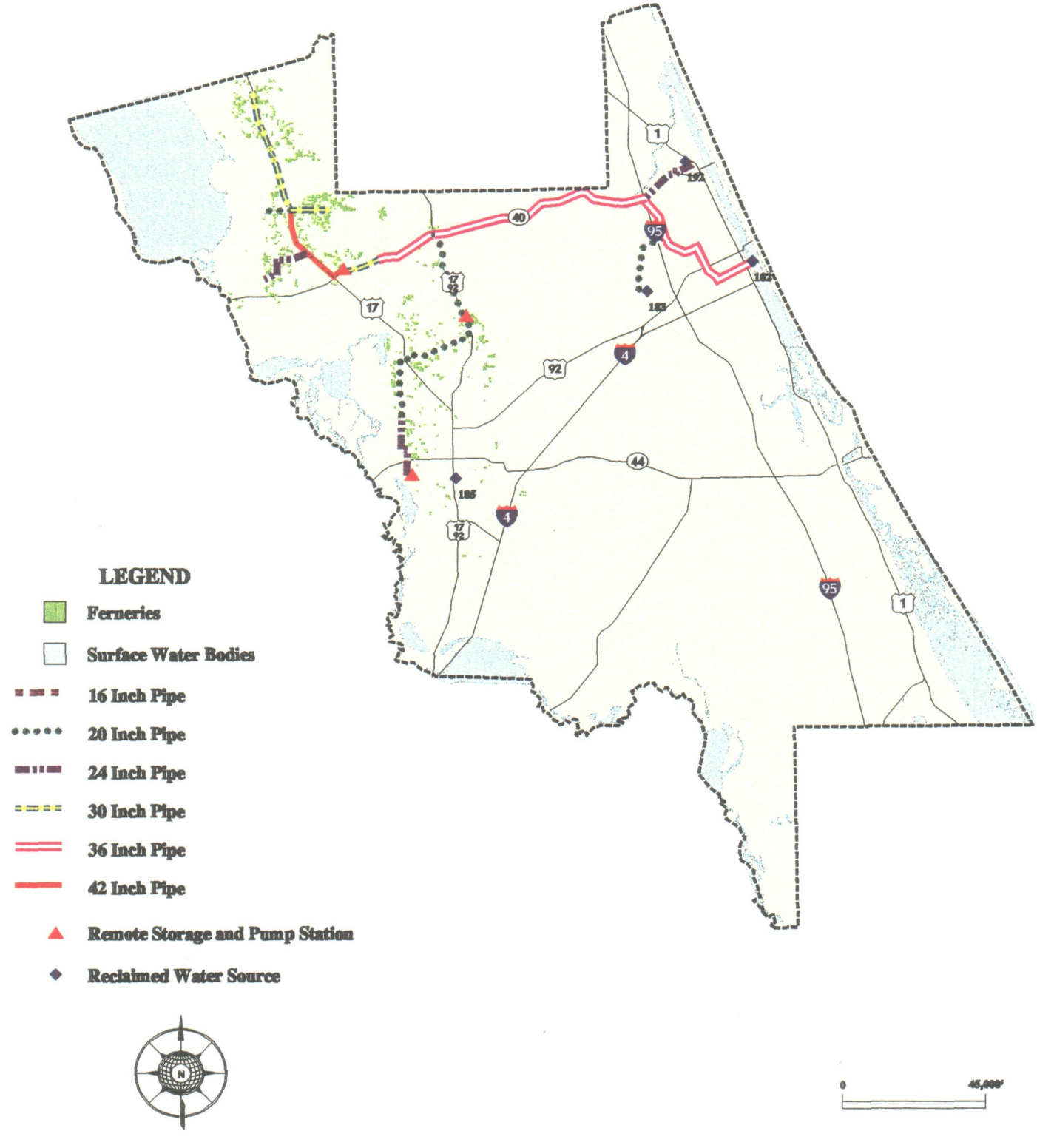


FIGURE 3. ALTERNATIVE 1 - IRRIGATION OF FERNERIES IN WEST VOLUSIA COUNTY WITH RECLAIMED WATER

PBSJ

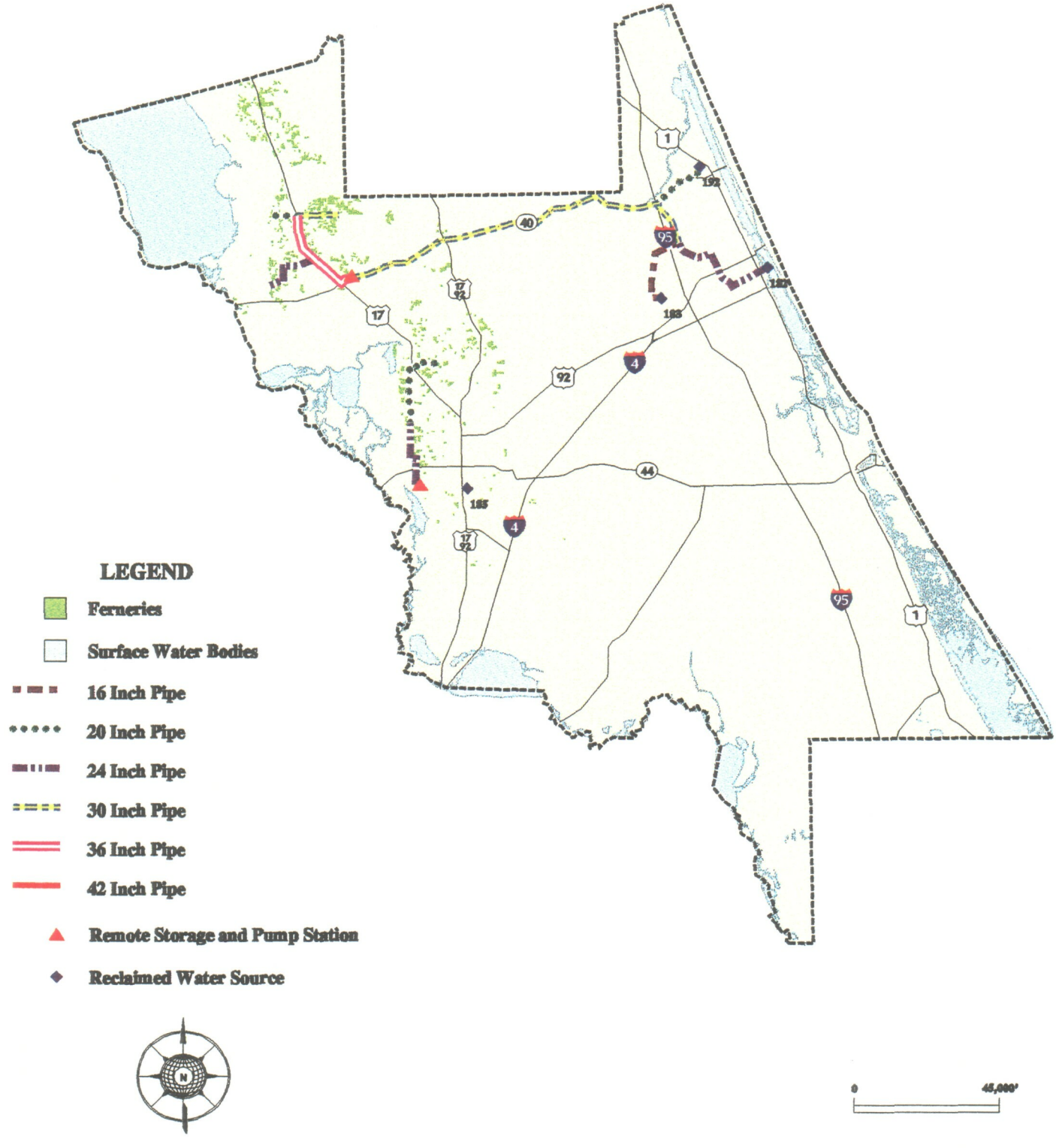


FIGURE 4. ALTERNATIVE 2 - IRRIGATION OF FERNERIES IN WEST VOLUSIA COUNTY WITH RECLAIMED WATER

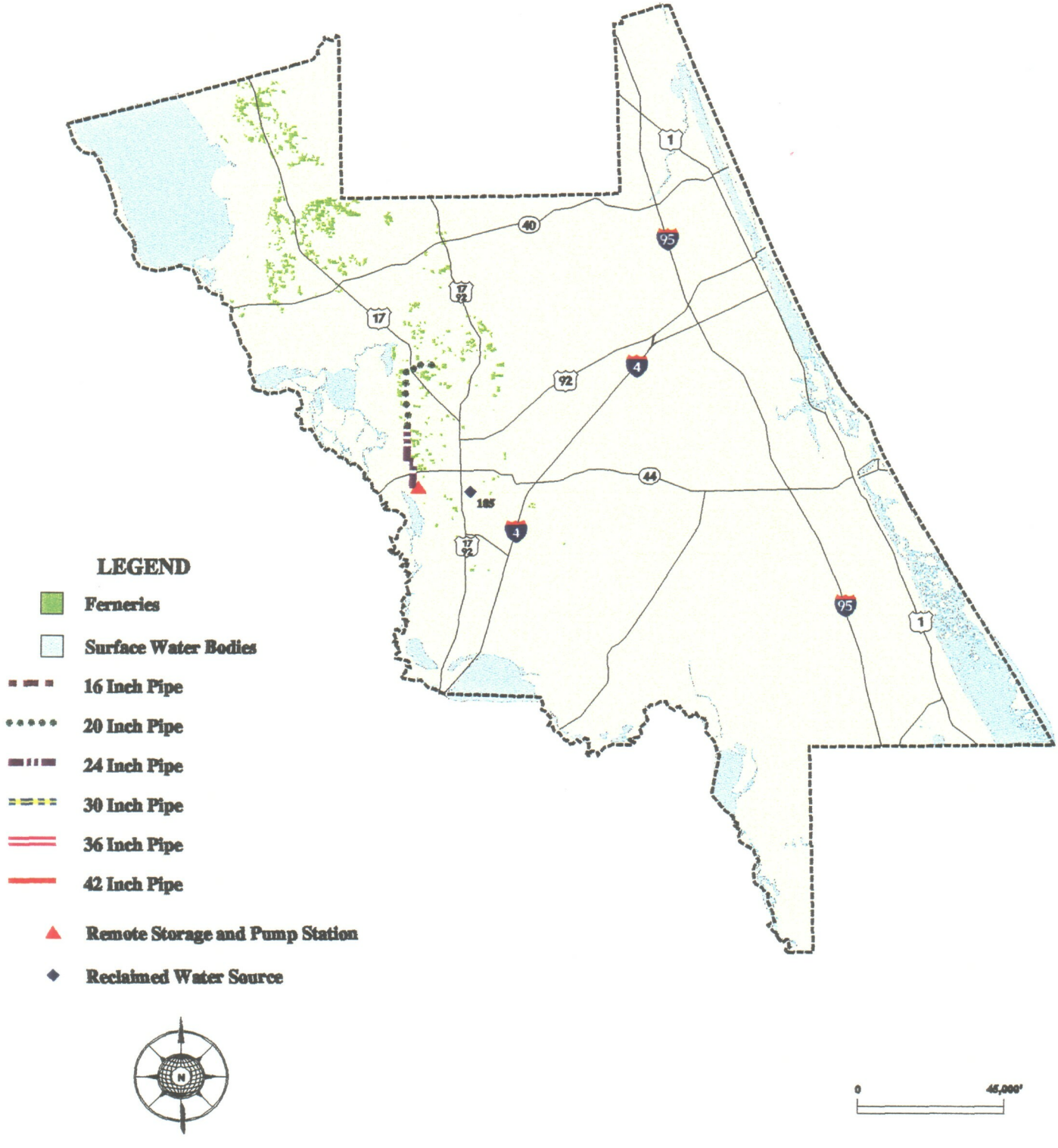


FIGURE 5. ALTERNATIVE 3 - IRRIGATION OF FERNERIES IN WEST VOLUSIA COUNTY WITH RECLAIMED WATER

of the shorter transmission distance and the lower total irrigation demand, costs would be expected to be reduced.

For Alternatives 1 and 2, cost estimates were based on a single transmission line from the coast to the fern growing area. Because of economies of scale, a single pipeline is more cost effective than two pipelines. Although the use of two pipelines could result in lower initial cost by allowing construction in phases, the total long-term cost would be higher for two smaller pipelines than for one larger line of the same capacity.

A major cost component of the first two alternatives is the long transmission distance from the coastal areas to the fern growing region. Therefore, a third alternative that considered provision of reclaimed water from the City of DeLand's Regional WWTP to nearby ferneries was considered in order to reduce transmission distance. This alternative is limited by the availability of reclaimed water from DeLand.

As a separate analysis, SJRWMD requested that PBS&J consider an alternative that would utilize 9 mgd of reclaimed water from the Deltona region. This was combined with the 1.91 mgd potentially available from DeLand to develop a 10.91 mgd alternative. Currently, Deltona does not have a significant availability of reclaimed water, but it does have a potential for growth. For this alternative, it was assumed that the reclaimed water facility would be built to provide high-level disinfection and that a means of backup disposal would be available during periods of low irrigation demand. These assumptions would allow the Deltona option to be compared on an equal level to Alternatives 1, 2, and 3. As with the other options, pumping would be provided from a central area of Deltona to a storage/distribution center in the fern region. The same peak factors and assumptions used for Alternatives 1, 2, and 3 would apply.

Summaries of the projected costs for each alternative are presented in Appendix B. Total construction, land acquisition, and capital costs are summarized in Table 9.

Table 9. Fern irrigation estimated cost summary

Alternative Number	Average Annual Irrigation Demand (mgd)	Construction Cost (million $)	Non-Construction Cost (million $)	Land Acquisition (million $)	Capital Cost (million $)	O & M Cost (million $/year)	Equivalent Annual Cost (million $/year)
1	11.77	64.01	28.80	0.45	93.27	1.85	7.92
2	8.47	44.97	20.24	0.38	65.58	1.31	5.60
3	1.91	7.50	3.38	0.07	10.95	0.28	0.97
Deltona[a]	10.91	54.32	24.45	0.23	78.99	1.79	6.75

[a]The Deltona alternative was reviewed at the request of SJRWMD. Currently, there is not a significant quantity of reclaimed water available in the Deltona region. This alternative was based on the assumption that a reclaimed water treatment facility with 9 mgd of available reclaimed water would be constructed in the Deltona region and adequate backup/alternate disposal facilities would be available. The additional 1.91 mgd for this alternative is from DeLand.

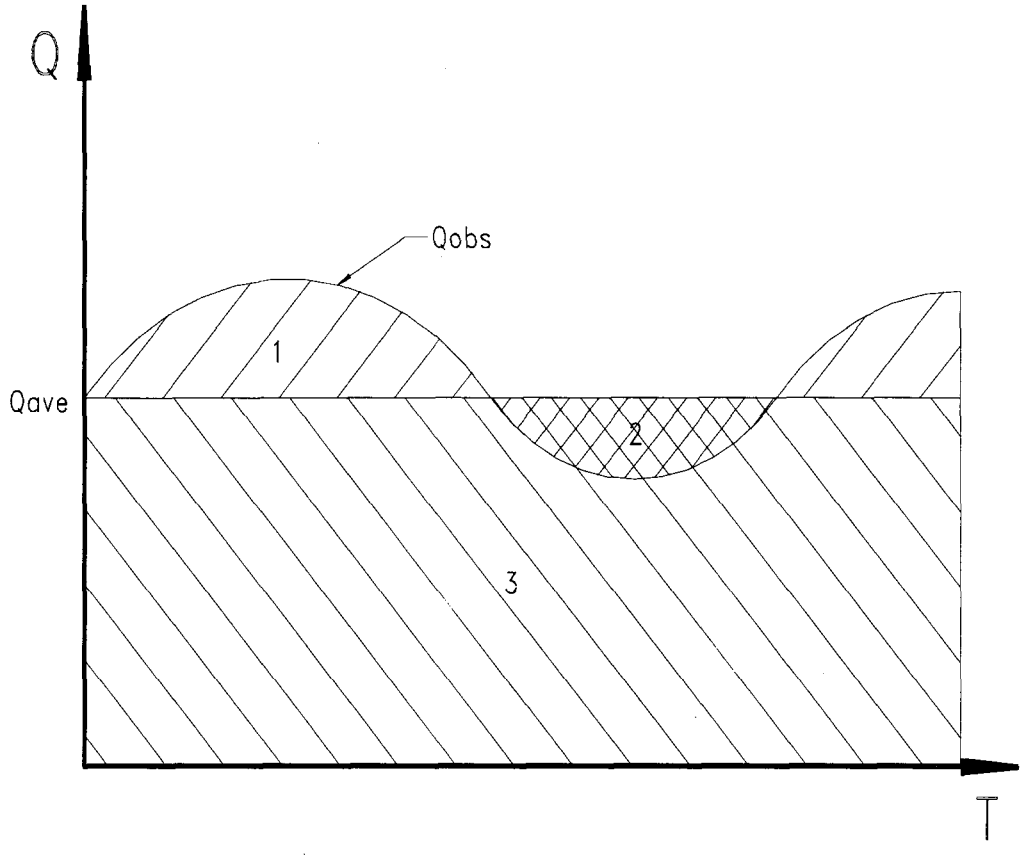
Citrus Irrigation

The cost analyses to serve citrus areas considered additional treatment required to achieve high-level disinfection and transmission unit cost, including the pipeline construction and materials, valves, and jack and bores. Operational storage at the wastewater treatment plants was also included in the costs. It was assumed storage of one day flow based on the average daily flow proposed to be reused would be provided. Distribution pipe unit costs include the force main, fittings, and installation of the main. Unit cost for turnouts were projected from 1996 costs associated with the Southwest Rapid Water Infiltration Basin Expansion Sites 11 and 12 at the Water Conserv II project. Metering and backflow prevention costs were included as part of the construction costs. Costs for pumping reclaimed water from the treatment plant to the groves were also taken into consideration. The total estimated capital costs consider construction costs (described above), non-construction costs, land cost, and land acquisition. Unit costs were obtained from data presented by Law Engineering (1996).

It was assumed that each grower has existing wells that provide irrigation to the citrus groves. In order to maximize reclaimed water use, the distribution system was developed assuming that growers will first use the reclaimed water from the WWTPs, and then, if any extra supply is required, it will be provided by the existing grower's wells. This is presented by area 1 in Figure 6. During sustained wet weather, citrus irrigation demand can drop to zero. Therefore, the existing wet weather disposal systems at WWTPs will have to be preserved (area 2 of Figure 6). Additional costs were not included for wet weather disposal. Actual water saved, assuming that the average water use is equal to water use prior to receiving reclaimed water, is represented by area 3 of Figure 6.

Based on Water Conserv II irrigation data from 1989 to 1996, a ratio was developed to determine water savings. Water Conserv II has had higher application rates, but also has a longer period of record that allows a more thorough representation of dry and wet periods. Water Conserv II data for this analysis are presented in Table 10. In this table, "Min" is the smaller of the observed irrigation for that month

Figure 6. Typical citrus irrigation demand curve



Legend

Q	=	Irrigation demand
Q_{ave}	=	Average monthly irrigation demand
Q_{obs}	=	Observed monthly irrigation
T	=	Time

Table 10. Water Conserv II - irrigation rates

Date	Irrigation (Mgal/month)	Min (Mgal/Month)
1/89	5.80	5.80
2/89	12.73	8.09
3/89	8.93	8.09
4/89	12.71	8.09
5/89	15.18	8.09
6/89	12.79	8.09
7/89	9.61	8.09
8/89	10.94	8.09
9/89	4.79	4.79
10/89	10.30	8.09
11/89	9.02	8.09
12/89	10.37	8.09
1/90	1.96	1.96
2/90	3.23	3.23
3/90	7.43	7.43
4/90	6.16	6.16
5/90	7.26	7.26
6/90	2.88	2.88
7/90	4.68	4.68
8/90	2.04	2.04
9/90	5.99	5.99
10/90	4.53	4.53
11/90	9.76	8.09
12/90	6.09	6.09
1/91	4.26	4.26
2/91	9.16	8.09
3/91	4.77	4.77
4/91	4.36	4.36
5/91	6.44	6.44
6/91	3.50	3.50
7/91	2.69	2.69

Note: Mgal = million gallons
Min = The smaller of the observed irrigation for the month or the average monthly irrigation for the period of record.
Source: Water Conserv II operational data

Table 10. Water Conserv II - irrigation rates (continued)

Date	Irrigation (Mgal/Month)	Min (Mgal/Month)
8/91	7.63	7.63
9/91	9.35	8.09
10/91	3.76	3.76
11/91	6.15	6.15
12/91	9.05	8.09
1/92	9.32	8.09
2/92	1.03	1.03
3/92	4.76	4.76
4/92	7.28	7.28
5/92	12.58	8.09
6/92	6.45	6.45
7/92	11.07	8.09
8/92	5.27	5.27
9/92	7.03	7.03
10/92	5.89	5.89
11/92	5.55	5.55
12/92	5.14	5.14
1/93	5.72	5.72
2/93	6.26	6.26
3/93	7.62	7.62
4/93	9.68	8.09
5/93	9.56	8.09
6/93	8.74	8.09
7/93	8.13	8.09
8/93	15.17	8.09
9/93	12.83	8.09
10/93	12.83	8.09
11/93	13.30	8.09
1/94	13.91	8.09
2/94	13.16	8.09
3/94	13.39	8.09

Note: Mgal = million gallons
Min = The smaller of the observed irrigation for the month or the average monthly irrigation for the period of record.
Source: Water Conserv II operational data

Table 10. Water Conserv II - irrigation rates (continued)

Date	Irrigation (Mgal/Month)	Min (Mgal/Month)
4/94	18.06	8.09
5/94	15.24	8.09
6/94	12.20	8.09
7/94	6.73	6.73
8/94	9.86	8.09
9/94	2.13	2.13
10/94	4.10	4.10
11/94	2.85	2.85
12/94	1.59	1.59
1/95	2.77	2.77
2/95	6.82	6.82
3/95	5.79	5.79
4/95	7.79	7.79
5/95	13.84	8.09
6/95	11.33	8.09
7/95	9.52	8.09
8/95	6.63	6.63
9/95	5.55	5.55
10/95	7.94	7.94
11/95	8.96	8.09
12/95	10.30	8.09
1/96	8.33	8.09
2/96	14.14	8.09
3/96	3.77	3.77
4/96	9.20	8.09
5/96	12.56	8.09
6/96	6.80	6.80
7/96	11.55	8.09
8/96	6.29	6.29
9/96	6.71	6.71
10/96	6.55	6.55
11/96	11.44	8.09
12/96	8.97	8.09
AVERAGE	8.09	6.56
RATIO		0.81

Note: Mgal = million gallons
Min = The smaller of the observed irrigation for the month or the average monthly irrigation for the period of record.
Source: Water Conserv II operational data

(Q_{obs}) or the average monthly irrigation (Q_{ave}) for the period of record. A ratio between average Min and average irrigation can be calculated. For Water Conserv II, the ratio is 0.81. when applied to the study area's available reclaimed water in the vicinity of the citrus groves, the resultant savings from the aquifer when using the reclaimed water distribution system described above would be 3.90 mgd. This is the value that should be utilized when estimating the cost per gallon of water saved.

Pipe size was estimated based on the seasonal peak demand of 1.25 times the average demand and adjusted for a daily peaking factor of 4 based on the assumption that all irrigation will occur during a six-hour period in each day.

The completed cost analysis is summarized in Table 11. A detailed cost breakdown is presented in Appendix C.

Because the irrigation rates for citrus irrigated with ground water are so much lower than the rates for citrus irrigated with reclaimed water at Water Conserv II, an analysis was conducted using the higher, 33.84 in/yr irrigation rate. The analysis was performed using the City of Clermont system only. By assuming a higher irrigation rate, a smaller area is actually irrigated, reducing pipe lengths, but also reducing the quantity of water saved. The estimated costs for the Clermont example are presented in Table 12. Although, on the basis of cost per gallon of reclaimed water used, it is more cost-effective to use the higher application rates, when cost per gallon of water saved is considered, it is more cost-effective to use the application rates comparable to the Benchmark Farms.

RAPID INFILTRATION BASINS

Costs typical for the conditions encountered in areas suitable for RIB sites on the Lake Wales Ridge in central Florida were developed for this study. The Lake Wales Ridge is characterized by excessively-drained sandy soils with hydraulic conductivities in the range of 15-60 feet/day, and depth to water table in the range of 10-40 feet below land surface. Typical RIB sites on the Lake Wales Ridge are frequently active or former orange groves.

Table 11. Citrus irrigation cost summary[a]

Reclaimed Water Source	Average Annual Water Savings[b] (mgd)	Construction Cost (Million $)	Non-Construction Cost (Million $)	Land Acquisition Cost (Million $)	Capital Cost (Million $)	O & M Cost (Million $/year)	Equivalent Annual Cost (Million $/year)
Tavares - Caroline St.	0.44	2.65	1.19	0.03	3.87	0.08	0.39
Clerbrook MHP	0.04	0.48	0.21	0.02	0.71	0.02	0.08
Clermont	0.62	3.41	1.53	0.03	4.97	0.11	0.50
Groveland	0.03	0.34	0.15	0.02	0.51	0.02	0.06
Orange Co. - Meadow Woods	0.06	0.41	0.19	0.02	0.62	0.01	0.06
Orange Co. - Northwest	0.31	1.41	0.63	0.02	2.06	0.05	0.20
Mid-Florida Lakes	0.10	0.86	0.39	0.02	1.27	0.03	0.13
Ocoee No. 2	0.44	2.19	0.98	0.02	3.19	0.08	0.34
Rock Springs	0.09	0.76	0.34	0.03	1.13	0.03	0.12
Sunshine Parkway	0.07	0.54	0.24	0.03	0.81	0.02	0.09
The Villages of Lake -Sumter	0.20	1.09	0.49	0.02	1.60	0.03	0.15
Winter Garden	1.11	5.49	2.47	0.03	7.99	0.16	0.76
Tavares - Woodlea Road	0.31	1.86	0.84	0.02	2.73	0.06	0.28
Zellwood	0.08	0.69	0.31	0.03	1.03	0.03	0.01
Total	3.90	22.18	9.98	0.34	32.50	N/A	N/A

[a]Reference Appendix B for detailed cost analysis.
[b]Average annual water savings are based on 81 percent of the available reclaimed water or are limited by the available citrus irrigation in the vicinity of the WWTPs.

Note: N/A = Not applicable

Table 12. Estimated cost of citrus irrigation with reclaimed water at higher application rates (City of Clermont example)[a]

Annual Average Reclaimed Water Use, mgd	0.62
Annual Average Floridan Aquifer Water Saved, mgd	0.18
Construction Cost, Million $	2.53
Non-Construction Cost, Million $	1.14
Land Acquisition Cost, Million $	0.02
Capital Cost, Million $	3.70
O&M cost, Million $/yr	0.11
Equivalent Annual Cost, Million $/yr	0.39
Equivalent Unit Cost, $/1,000 gallons used	1.74
Equivalent Unit Cost, $/1,000 gallons saved	6.12

[a]Based on using 0.62 mgd available from Clermont to irrigate citrus at a rate of 0.65 in/wk (as opposed to 0.18 in/wk based on the Benchmark Farms).

Recharge to the Floridan aquifer beneath these sites is generally dominated by lateral flow through the surficial aquifer to localized zones of high leakage which provide interconnection to the deeper aquifer. These high-leakage zones are related to the karstic subsurface conditions and are commonly reflected at the surface by depressions or sinkholes.

Based on Water Conserv II cost data, the typical construction cost for RIBs under these conditions is $1.00 per gallon per day (gpd) of capacity. The land purchase cost is an additional $0.75 per gpd. Using a factor of 45 percent for non-construction costs, the total capital cost is $2.20 per gpd. The annual O&M cost is $0.02 per gpd (see Appendix D). The total equivalent annual cost, considering an average facility life of 20 years for all components, is $0.23 per gpd of capacity.

CONCLUSIONS

FERN IRRIGATION

Based on a review of Benchmark Farm data provided by SJRWMD, ferneries in west Volusia County irrigate at a rate of approximately 0.55 in/wk. When freeze protection is included, the annual average irrigation rate increases to 0.71 in/wk.

There are approximately 7,182 acres of ferneries in Volusia County. Based on the scope of this assignment, the non-freeze irrigation rate was used to estimate an annual average irrigation demand of 15.32 mgd. A maximum of 17.18 mgd of reclaimed water is available in Volusia County (based on a 1995 wastewater and reuse inventory prepared by SJRWMD (PBS&J 1997) to serve the estimated irrigation demand. There are two limitations that must be considered when developing costs for serving the fern irrigation demands: the ferneries are dispersed over a large area and the sources of reclaimed water are generally not in close proximity to the fern production areas. In consideration of these limitations, three alternatives were developed for cost estimating purposes.

Alternative 1 is based on serving all ferneries within a one-mile wide transmission corridor with reclaimed water from the cities of Ormond Beach, Daytona Beach, and DeLand. This alternative would reduce aquifer withdrawals by approximately 11.77 mgd on an annual average basis at an equivalent unit cost of $1.84 per 1,000 gallons.

Alternative 2 was developed as a means to reduce the cost while still providing a significant reduction in aquifer withdrawals. The Seville and Lake Dias areas were eliminated from the reclaimed water service area in order to reduce transmission costs. By eliminating Seville and Lake Dias, water savings would be reduced to 8.47 mgd, but the equivalent unit cost is also reduced to $1.81 per 1,000 gallons.

Because a significant portion of the costs of the first two alternatives is attributed to the long transmission distance from the Ormond Beach/Daytona Beach areas, a third alternative was developed to assess

the cost of serving ferneries from the City of DeLand only. This alternative was limited by the estimated reclaimed water availability of the City's Regional WWTP. With this alternatives, a reduction in aquifer withdrawal of 1.91 mgd was estimated. The equivalent unit cost is significantly reduced with this alternative to $1.39 per 1,000 gallons.

At the request of SJRWMD, a fourth alternative was developed for comparison. This alternative is based on the availability of 9 mgd from the Deltona area combined with 1.91 mgd from DeLand. Currently, reclaimed water is not available nor is it planned from Deltona, but it could be easier to implement fern irrigation from a new facility rather than existing systems. The equivalent unit cost of the Deltona alternative is $1.57 per 1,000 gallons.

CITRUS IRRIGATION

Review of Benchmark Farm data resulted in an annual average irrigation rate of 9.61 in/yr for citrus grown in the sandy-ridge soils of Lake and Orange counties. Although Water Conserv II data for citrus irrigated with reclaimed water show much higher irrigation rates (33.84 in/yr), the rates developed from the Benchmark Farm data were utilized since they represent the quantity of Floridan aquifer withdrawals that can be saved. If citrus irrigation is actually implemented as part of the Investigation of Alternative Water Supply Strategies, rates between the Water Conserv II and Benchmark Farm data developed rates may be most practical; however, Floridan aquifer withdrawal savings should be based on the lower Benchmark Farm value.

A total water savings of 3.90 mgd can be realized by using reclaimed water available from 19 WWTPs scattered throughout the study area. Equivalent annual costs developed on a per WWTP basis ranged from $1.79/1,000 gallons for Orange County Northwest to $5.40/1,000 gallons for Groveland. Total capital cost, including all 19 facilities and the total 3.90 mgd water savings, was estimated to be $32,501,000. The average capital cost per gpd for citrus irrigation ($8.33/gpd) is higher than that typically seen for agricultural systems irrigated with reclaimed water. This can be explained by considering the combination of two factors: most of the citrus sections within the study area are small groves of less than 0.05 mgd demand (see Figure 2) and the assumed average

irrigation rate of 9.61 in/yr represents actual aquifer withdrawals at the Benchmark Farms and not the additional use seen when reclaimed water is provided at no cost. Taken together, these two factors resulted in low flow volumes over a given area with a correspondingly high cost per gallon per day. However, these cost factors should be considered in the context of the larger study being conducted by SJRWMD. The cost of reducing withdrawals from the aquifer by irrigating citrus with reclaimed water is to be compared with numerous other alternative water supply strategies. Therefore the present evaluation has only considered estimated cost and cost-effectiveness will be evaluated by others when the costs of all the alternatives are compared.

The City of Clermont example at the higher irrigation rate of 33.84 in/yr experienced at the Water Conserv II reclaimed water system was presented as a comparison. Based on reclaimed water used, the capital cost of $5.96/gpd is much lower because a much smaller area is irrigated with the same quantity of reclaimed water; however, on the basis of water savings, the cost is $20.99/gpd, considerably higher than the costs estimated for irrigation at the lower rate of 9.61/in yr.

RIB COSTS

RIB costs estimated using Water Conserv II data were developed for use by SJRWMD. Based on sandy-ridge soil conditions, total capital cost of $2.20/gpd, O&M cost of $0.02/gpd, and equivalent annual cost of $0.23/gpd of capacity were estimated.

RECOMMENDATIONS

It is recommended that the results of this study be used by SJRWMD in the overall Investigation of Alternative Water Supply Strategies. The use of reclaimed water for citrus irrigation has the potential of reducing Floridan aquifer withdrawals by approximately 4 mgd on an annual average basis. The use of reclaimed water for fern irrigation has the potential of reducing Floridan aquifer withdrawals by over 11 mgd.

This study was conducted on a broad, planning-level basis. While the results are appropriate for use in the decision modeling being conducted by SJRWMD and their consultants, additional study and alternative development is needed should any of the agricultural reuse options presented appear to be viable alternative water supply strategies. This study was limited to fern and citrus. It is recommended that other crops, such as ornamentals in western Orange County be considered in future studies.

Several implementation issues that require further investigation include:

- Irrigation rates - Irrigation rates used in this study were based on actual irrigation records from SJRWMD Benchmark Farms. As illustrated by data from Water Conserv II, when reclaimed water is used as an irrigation supply, it is frequently offered at no or little charge as an incentive. This can encourage excessive use. An implementation issue that should be addressed in more detail in future alternative development is whether irrigation with reclaimed water should be restricted to existing application rates (such as by charging a price for reclaimed water similar to the existing cost of irrigation with wells). If it is determined that reclaimed water use is not to be restricted, higher application rates can be used, however, under this scenario, actual Floridan aquifer water savings would remain 9.61 in/year.

- Reclaimed water availability - It was beyond the scope of this study to conduct a detailed evaluation of reclaimed water available from facilities within and near the citrus and fern study areas. Data utilized were based on a 1995 wastewater and reuse

inventory prepared by SJRWMD and described by PBS&J (1997). It is thought that these data most likely overestimate the availability in 1995 for facilities with existing reuse programs. Because of the seasonal variability in reclaimed water demand in public access and agricultural reuse programs, facilities with these type reuse systems may have little to no excess capacity during certain times of the year. In addition, many utilities have plans to expand their reuse programs with infrastructure already committed for the expansion -- what is reported as available reclaimed water may actually be already committed to other users. On the other hand, other facilities may have no future reuse plans and may be expecting growth in the service area which would actually increase the reclaimed water availability above that reported in the inventory. If it appears that agricultural reuse is a viable alternative water supply strategy in the decision modeling analysis, additional evaluation and estimation of reclaimed water availability should be conducted.

REFERENCES

Cross, Phil (Woodard and Curran Environmental Services). May 12, 1997. Telephone Communication. Winter Garden, FL.

Gleason, Tom (Fern Grower). May 12, 1997. Telephone Communication. Volusia County, FL.

Jackson, Jo Ann, Morrell, Robert A., and MacIntyre, David. 1996. *Final Report - Phase I - Assessment of the Cost of Supplying Reclaimed Water to Areas of High Agricultural Withdrawals.* Post, Buckley, Schuh & Jernigan, Inc. for St. Johns River Water Management District, Palatka, FL.

Jeffries, John (City of DeLand). May 14, 1997. Telephone Communication. Deland, FL.

Law Engineering. 1996. *Water supply needs and sources assessment: Alternative water supply strategies investigation: Water supply and wastewater systems component cost information.* Special Publication SJ97 SP3., Palatka, FL. St. Johns River Water Management District.

Post, Buckley, Schuh & Jernigan, Inc. (PBS&J). 1997. *Final Report - Phase II: Replacement of Potable Quality Water for Landscape Irrigation.* St. Johns River Water Management District, Palatka, FL.

Post, Buckley, Schuh & Jernigan, Inc. 1992. *Wastewater Reuse Feasibility Study.* Miami-Dade Water and Sewer Authority Department. Miami, FL.

Vergara, Barbara (ed.). 1994. *Water supply needs and sources assessment: 1994: St. Johns River Water Management District.* Technical Publication SJ94-7. Palatka, FL. St. Johns River Water Management District.

Appendix A

Cost Estimation Procedure Letters

ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

Henry Dean, Executive Director
John R. Wehle, Assistant Executive Director
Charles T. Myers III, Deputy Assistant Executive Director

POST OFFICE BOX 1429 PALATKA, FLORIDA 32178-1429
TELEPHONE 904-329-4500 SUNCOM 904-860-4500
TDD 904-329-4450 TDD SUNCOM 860-4450
FAX (EXECUTIVE/LEGAL) 329-4125 (PERMITTING) 329-4315 (ADMINISTRATION/FINANCE) 329-4508

SERVICE CENTERS

618 E. South Street
Orlando, Florida 32801
407-897-4300
TDD 407-897-5960

7775 Baymeadows Way
Suite 102
Jacksonville, Florida 32256
904-730-6270
TDD 904-730-7900

PERMITTING
305 East Drive
Melbourne, Florida 32904
407-984-4940
TDD 407-722-5368

OPERATIONS
2133 N. Wickham Road
Melbourne, Florida 32935-8109
407-254-1762
TDD 407-253-1203

February 29, 1996

Ms. Jo Ann Jackson, P.E.
Post, Buckley, Schuh & Jernigan, Inc.
1560 Orange Avenue, Suite 700
Winter Park, Florida 32789

Re: SJRWMD Contract No. 95W166A, Alternative Water Supply Strategies Investigation, economic analysis criteria

Dear Ms. Jackson: Jo Ann

Thank you for your participation in the February 16, 1996, project team meeting. Based on the discussions held at that meeting the following economic analysis criteria are to be used in association with the referenced contract. Using these criteria, capital costs, annual operation and maintenance costs, and total annualized costs should be developed.

- Construction cost index - Construction and subsequent capital cost should be expressed in current (1996) dollars.

- Land cost- Land costs from the following table should be used plus a land acquisition factor of 25 percent of the estimated land cost. This 25 percent includes the cost of engineering, administrative, and legal services, etc. associated with the land acquisition process.

	Parcels for Individual Wells, Booster Stations, Small WTPs, etc. 2 - 50 acres (ac) ($/ac)	Parcels for Wellfields, Major WTPs, etc. 100 - 500 ac ($/ac)	Parcels for Reservoirs, Mitigation areas, etc. 250-3000 ac ($/ac)	Pipeline Corridors			
				Adjacent to Public ROW		New Areas	
				Easement ($/sq ft)	ROW ($/sq ft)	Easement ($/sq ft)	ROW ($/sq ft)
Urban	$100,000	-	-	$4.00	$6.00	$3.00	$5.00
Suburban	$20,000	$10,000	-	$1.50	$3.00	$1.00	$2.00
Rural	$5,000	$3,000	$3,000	$0.75	$1.00	$0.50	$0.75

- Non-construction capital cost allowance - An allowance of 45 percent should be used with the following breakdown of percent by category.

Category	Percent
engineering and permitting	15 percent
administration	10 percent
contingency	20 percent

- Time value of money - A time value of money of 7 percent should be used.

- Cost escalation - None - all cost comparisons and economic optimization should be developed in current(1996) dollars.

- Economic life of facilities - The following economic service life guidelines for water resources system components should be used.

Component Type	Service Life
Land	permanent
Water conveyance structures (including pipelines, collection and distribution systems, interceptors, force mains, drop shafts, tunnels, spillways, etc.)	50 years
Other structures (including buildings, concrete tankage, pumping station structures, and site improvements, etc.)	40 years
Process and auxiliary equipment (including treatment equipment such as clarifier mechanisms and filters, steel process tankage, chemical storage facilities, standby electrical generating equipment, pumps and motors, instrumentation and control facilities, mechanical equipment such as compressors, aeration systems chlorinators, other electrical equipment in regular service, etc.)	20 years
Wells	40 years
Reverse osmosis membranes	5 years

Please contact me if you have questions concerning this matter.

Sincerely,

Donald Brandes, Ph.D.
Water Conservation Program Manager

DB:bv
cc: Ron Wycoff, P.E.
Ed Copeland, P.E.
Donald Hearn, Ph.D.
Kirk Hatfield, Ph.D
Carol Demas
Hal Wilkening, P.E.
Doug Munch, P.G.
Don Brandes, Ph.D.
Cynthia Moore
Patrick Burger

ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

Henry Dean, Executive Director
John R. Wehle, Assistant Executive Director
Charles T. Myers III, Deputy Assistant Executive Director

POST OFFICE BOX 1429 PALATKA, FLORIDA 32178-1429
TELEPHONE 904-329-4500 SUNCOM 904-860-4500
TDD 904-329-4450 TDD SUNCOM 860-4450
FAX (EXECUTIVE/LEGAL) 329-4125 (PERMITTING) 329-4315 (ADMINISTRATION/FINANCE) 329-4508

SERVICE CENTERS

618 E. South Street
Orlando, Florida 32801
407-897-4300
TDD 407-897-5960

7775 Baymeadows Way
Suite 102
Jacksonville, Florida 32256
904-730-6270
TDD 904-730-7900

PERMITTING
305 East Drive
Melbourne, Florida 32904
407-984-4940
TDD 407-727-5368

OPERATIONS
2133 N. Wickham Road
Melbourne, Florida 32935-8109
407-254-1762
TDD 407-253-1203

April 5, 1996

Ms. Jo Ann Jackson, P.E.
Post, Buckley, Schuh, and Jernigan, Inc.
1560 Orange Avenue, Suite 700
Winter Park, Florida 32789

Re: SJRWMD Contract No. 95W166B, Alternative Water Supply Strategies Investigation, economic analysis criteria

Dear Ms. ~~Jackson~~ Jo Ann:

The following definitions supplement the economic analysis criteria cited in my February 29, 1996, letter to you. This array of cost parameters should be developed for each alternative water supply option.

1. **construction cost** - The total amount expected to be paid to a qualified contractor to build the required facilities.
2. **non-construction capital cost** - An allowance for engineering design, permitting, administration and construction contingency associated with the constructed facilities. In this project non-construction capital cost will equal 45 percent of the estimated construction cost.
3. **land cost** - The market value of the land required to implement the water supply option.
4. **land acquisition cost** - The estimated cost of acquiring the required land. In this project land acquisition cost will equal 25 percent of the land market value.
5. **total capital cost** - Construction cost plus non-construction capital cost plus land cost plus land acquisition cost (the sum of items 1 through 4).
6. **operation and maintenance (O&M) cost** - The estimated annual cost of operating and maintaining the water supply option when operating at design capacity. The average daily flow (production or transport) associated with the annual O&M cost should also be reported.
7. **equivalent annual cost** - Total annual life cycle cost of water supply option based on service life and time value of money criteria established in the economic analysis criteria letter dated February 29, 1996.
8. **unit cost** - That portion of the annual O&M cost that varies with production (or transport) rate. For example, energy and chemical costs are components of the unit cost, whereas routine maintenance and base level labor are not. The unit cost should be expressed in terms of dollars per 1,000 gallons.

Each of these cost categories were addressed in the economic analysis criteria letter with the exception of the unit cost. This cost parameter will allow representation of a variable production rate from a given option in the decision model which is being prepared by the University of Florida.

Sincerely,

Don Brandes, Ph.D.
Water Conservation Program Manager

DB:bav
cc: Hal Wilkening, P.E.
Barbara A. Vergara, P.G.
Patrick Burger
Alan Weaver

ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

Henry Dean, Executive Director
John R. Wehle, Assistant Executive Director
Charles T. Myers III, Deputy Assistant Executive Director

POST OFFICE BOX 1429 PALATKA, FLORIDA 32178-1429
TELEPHONE 904-329-4500 SUNCOM 904-860-4500
TDD 904-329-4450 TDD SUNCOM 860-4450
FAX (EXECUTIVE/LEGAL) 329-4125 (PERMITTING) 329-4315 (ADMINISTRATION/FINANCE) 329-4508

SERVICE CENTERS

618 E. South Street
Orlando, Florida 32801
407-897-4300
TDD 407-897-5960

7775 Baymeadows Way
Suite 102
Jacksonville, Florida 32256
904-730-6270
TDD 904-730-7900

PERMITTING
305 East Drive
Melbourne, Florida 32904
407-984-4940
TDD 407-722-5368

OPERATIONS
2133 N. Wickham Road
Melbourne, Florida 32935-8109
407-254-1762
TDD 407-253-1203

June 5, 1996

Ms. Jo Ann Jackson, P.E.
Post, Buckley, Schuh, and Jernigan, Inc.
1560 Orange Avenue, Suite 700
Winter Park, FL 32789

Re: SJRWMD Contract No. 95W166B, Alternative Water Supply Strategies Investigation, economic analysis criteria

Dear Ms Jackson:

As a result of issues raised by Jerry Salsano, Sanlando Utilities Corp., at a recent Public Water Supply Advisory Group meeting, revisions to the water supply facilities service life criteria appear to be necessary for the purpose of consistency with Public Service Commission (PSC) requirements. Attached is a table comparing the current service life criteria, PSC service life criteria, and proposed revised service life criteria. Please use the proposed revised service life criteria in place of the current criteria which is set forth in my February 29, 1996, letter to you.

Please contact me if you have questions concerning this matter.

Sincerely,

Barbara A. Vergara

Barbara A. Vergara, P.G., Director
Division of Needs and Sources

BAV
Attachment
cc: Public Water Supply Advisory Group
Donald Hearn, Ph.D.
Kirk Hatfield, Ph.D.
Carol Demas
Hal Wilkening, P.E.
Don Brandes, Ph.D.
Patrick Burger

Water Supply Facilities Service Life Criteria Comparison

Component Type	Current Service Life Criteria (established by project team)	PSC - Service Life Criteria (from Sanlando Utilities annual report)	Proposed Revised Service Life Criteria
Land	permanent	na	permanent
Water Conveyance Structures (pipelines, collection and distribution systems)	50 years	35 to 43 years	40 years
Other Structures (buildings, tankage, site improvements etc.)	40 years	33 years	35 years
Wells	40 years	30 years	30 years
Process and Auxiliary Equipment (treatment equipment, pumps motors, mechanical equipment etc.)	20 years	20 to 22 years	20 years
Reverse Osmosis Membranes	5 years	na	5 years

Appendix B

Fern Irrigation Cost Estimates

Table B.1- Summary of Fern Irrigation Demands Proposed for Replacement w/ Reclaimed Water

Fernery Group #	Ferneries Potentially Served with Reclaimed Water All Ferneries within 1 mile of the proposed transmission system						
	Number	Area	Avg. Annual gpd	Seasonal gpd	Seasonal gpm	Peak Design Flow gpd	Peak Design Flow gpm
1	138	1,058	2,255,861	2,819,826	1,958	8,459,478	5,875
2	137	437	932,334	1,165,418	809	3,496,254	2,428
3	188	1,210	2,579,863	3,224,829	2,239	9,674,488	6,718
4	11	131	280,276	350,345	243	1,051,036	730
5	114	633	1,349,549	1,686,936	1,171	5,060,809	3,514
6	105	479	1,021,920	1,277,400	887	3,832,201	2,661
7	16	199	424,254	530,317	368	1,590,951	1,105
8	107	637	1,359,361	1,699,201	1,180	5,097,603	3,540
9	76	490	1,045,383	1,306,729	907	3,920,187	2,722
10	57	376	802,648	1,003,310	697	3,009,930	2,090
Total	949	5,650	12,051,450	15,064,313	10,461	45,192,938	31,384
Averages		6.0	12,699				
DeLand 8,9,10		1,504	3,207,392	4,009,240	2,784	12,027,720	8,353
Beaches 1,2,3,4,5,6,7		4,494	9,585,702	14,017,010	9,734	5,423,153	3,766
Service Assumptions							
Maximum Reuse	Serve all areas exept 4						
	938	5,519	11,771,174	14,713,967	10,218	44,141,902	30,654
Medium Reuse	Serve all except 1,4,9						
	724	3,971	8,469,930	10,587,412	7,352	31,762,236	22,057
Minimum Reuse	Serve only areas 8,10						
	164	1,014	2,162,009	2,702,511	1,877	8,107,533	5,630
Max.							
Pierson/Seville Repump/Fill 1,2,3,5,6	682	3,816	8,139,528	12,209,292	8,479	n/a	n/a
Lake Dias Repump/Fill 9	76	490	1,045,383	1,568,075	1,089	n/a	n/a
Med.							
Pierson/Seville Repump/Fill 2,3,5,6	544	2,758	5,883,667	8,825,501	6,129	n/a	n/a
Lake Dias Repump/Fill 9	76	490	1,045,383	1,568,075	1,089	n/a	n/a

Number of Ferneries estimated to have retention ponds for irrigation supply = 47 ferneries (based on SJRWMD CUP information)

Maximum Seasonal Factor = 1.25 * average annual flow

Peak Flow Factor = 3 * maximum seasonal flow

Remote Storage Fill Demand Factor = 1.5 * average annual flow

Table B.2 - Micro-Distribution Cost Development for Proposed Reclaimed Water Fern Irrigation System Distribution in Area 5

Pipe Number	Length feet	Diameter inch	Urban/ Rural	Unit Capital Urban Pipe Cost	Unit Capital Rural Pipe Cost	Total Capital Urban Pipe Cost	Total Capital Rural Pipe Cost	Total Capital Pipe Cost
501	1,263	12	R		$43.50		$54,941	
502	2,235	8	R		$31.90		$71,297	
503	2,278	12	R		$43.50		$99,093	
504	1,745	12	R		$43.50		$75,908	
506	1,859	12	R		$43.50		$80,867	
507	1,006	8	R		$31.90		$32,091	
510	4,808	8	R		$31.90		$153,375	
511	4,072	8	R		$31.90		$129,897	
512	2,117	8	R		$31.90		$67,532	
513	3,400	12	R		$43.50		$147,900	
514	3,332	8	R		$31.90		$106,291	
519	2,615	12	R		$43.50		$113,753	
526	5,063	12	R		$43.50		$220,241	
527	1,168	8	R		$31.90		$37,259	
530	4,586	12	R		$43.50		$199,491	
531	2,229	12	R		$43.50		$96,962	
532	756	8	R		$31.90		$24,116	
535	4,918	12	R		$43.50		$213,933	
540	2,928	12	R		$43.50		$127,368	
551	2,604	12	R		$43.50		$113,274	
552	1,626	8	R		$31.90		$51,869	
553	3,658	8	R		$31.90		$116,690	
556	1,626	8	R		$31.90		$51,869	
560	5,439	12	R		$43.50		$236,597	
						$0	$2,622,612	$2,622,612

Area	Ferneries	AAF, gpd
#5	114	1,349,549

Connection Cost

including meter, tapping sleeve & valve, disconnect couping

Unit Construction	$2,500	per connection
Unit Capital	$3,625	per connection
Total Capital	$413,250	

Total Distribution Cost

	$2,622,612
	$413,250
	$3,035,862
	$2.25 per gpd
Use ==>	$2.25 per gpd

Table B.3 - Cost Summary for Proposed Reclaimed Water Fern Irrigation System
Alternative 1 (Maximum Reuse)

Transmission

Pipe Number	Length feet	Diameter inch	Flow gpm	Urban/ Rural	Unit Capital Urban Pipe Cost	Total Capital Urban Pipe Cost
1	19,426	24	3,209	U	$109.00	$2,117,434
10	14,306	36	7,723	U	$171.00	$2,446,326
20	24,688	20	1,365	U	$88.00	$2,172,544
30	37,637	36	6,358	U	$171.00	$6,435,927
50	21,090	24	4,763	U	$109.00	$2,298,810
55	23,061	20	2,672	U	$88.00	$2,029,368
61	4,066	20	868	U	$88.00	$357,808
65	12,635	20	868	U	$88.00	$1,111,880
70	9,447	20	3,589	U	$88.00	$831,336
75	1,271	20	3,589	U	$88.00	$111,848
80	28,213	20	1,350	U	$88.00	$2,482,744
100	69,551	36	10,932	U	$171.00	$11,893,221
101	843	36	10,932	U	$171.00	$144,153
110	20,183	36	8,478	U	$171.00	$3,451,293
112	11,273	30	8,478	U	$140.00	$1,578,220
115	4,473	42	21,192	U	$201.00	$899,073
116	11,249	42	18,531	U	$201.00	$2,261,049
117	19,033	24	3,513	U	$109.00	$2,074,597
120	15,503	42	15,018	U	$201.00	$3,116,103
122	9,547	20	2,427	U	$88.00	$840,136
123	12,658	30	6,717	U	$140.00	$1,772,120
150	40,034	30	5,874	U	$140.00	$5,604,760
						$56,030,750

Distribution

Cost per gpd = $2.25 /gpd
Total Fern Irrigation = 11,771,174 gpd

Capital Cost = $26,485,141
O&M Cost = $730,401 * Estimated O&M costs $0.17 per 1000 gallon

Pump Station

Plant #	Name	Peak Flow gpm	Peak Flow mgd	Capital Non-Land Cost	O & M Costs per year	Land and Aquisition Cost	Total Capital Cost	Equivalent Annualized Cost
1	Ormand Beach	3209.36	4.62	$912,376	$90,302	$75,000	$987,376	$98,448
2	Daytona Beach Regional	1364.60	1.97	$586,867	$39,933	$75,000	$661,867	$67,724
3	Daytona Beach Bethune	6358.04	9.16	$1,349,577	$176,273	$75,000	$1,424,577	$139,716
4	Port Orange	0.00	0.00	$0	$0	$0	$0	$0
5	DeLand	4762.80	6.86	$1,139,811	$132,717	$75,000	$1,214,811	$119,916
Repump 1	Pierson	21192.00	30.52	$2,841,498	$581,296	$75,000	$2,916,498	$280,538
Repump 2	Lake Dias	3589.20	5.17	$970,741	$100,673	$75,000	$1,045,741	$103,957
				$7,800,870	$1,121,194	$450,000	$8,250,870	$810,300

Storage

Plant #	Name	Average Annual Cap. mgd	Storage Volume Mgal	Capital Non-Land Cost	O & M Costs per year	Land and Aquisition Cost	Total Capital Cost	Equivalent Annualized Cost
1	Ormand Beach	3.08	0	n/a	n/a	n/a	n/a	n/a
2	Daytona Beach Regional	1.31	0	n/a	n/a	n/a	n/a	n/a
3	Daytona Beach Bethune	6.10	0	n/a	n/a	n/a	n/a	n/a
4	Port Orange	0.00	0	n/a	n/a	n/a	n/a	n/a
5	DeLand	1.83	1.83	$568,265	$0	$0	$568,265	$43,887
Repump 1	Pierson	8.14	8.14	$1,455,411	$0	$0	$1,455,411	$112,401
Repump 2	Lake Dias	1.38	1.38	$475,495	$0	$0	$475,495	$36,722
		12.3	11.3	$2,499,171	$0	$0	$2,499,171	$193,011

Total Project Cost

Item	Construction Cost	Capital Non-Land Cost	Land and Aquisition Cost	Total Capital Cost	O & M Costs per year	Equivalent Annualized Cost	Equivalent Unit Cost $/1000 gal.
Transmission	$38,641,897	$56,030,750		$56,030,750	$0	$4,202,867	$0.98
Distribution	$18,265,615	$26,485,141		$26,485,141	$730,401	$2,717,052	$0.63
Pumping	$5,379,910	$7,800,870	$450,000	$8,250,870	$1,121,194	$810,300	$0.19
Storage	$1,723,566	$2,499,171		$2,499,171	$0	$193,011	$0.04
Total	$64,010,987			$93,265,932	$1,851,595	$7,923,229	$1.84
				$7.92 /gpd			

Table B.4 - Cost Summary for Proposed Reclaimed Water Fern Irrigation System
Alternative 2 (Medium Reuse)

Transmission

Pipe Number	Length feet	Diameter inch	Flow gpm	Urban/ Rural	Unit Capital Urban Pipe Cost	Total Capital Urban Pipe Cost
1	19,426	20	2,971	U	$88.00	$1,709,488
10	14,306	30	4,262	U	$140.00	$2,002,840
20	24,688	16	1,285	U	$67.00	$1,654,096
30	37,637	24	2,977	U	$109.00	$4,102,433
50	21,090	24	5,631	U	$109.00	$2,298,810
55	23,061	20	3,540	U	$88.00	$2,029,368
61	4,066	20	0	U	$88.00	$357,808
65	12,635	n/a	0	U	n/a	$0
70	9,447	n/a	0	U	n/a	$0
75	1,271	n/a	0	U	n/a	$0
80	28,213	n/a	0	U	n/a	$0
100	69,551	30	7,233	U	$140.00	$9,737,140
101	843	30	7,233	U	$140.00	$118,020
110	20,183	30	6,129	U	$140.00	$2,825,620
112	11,273	30	6,129	U	$140.00	$1,578,220
115	4,473	36	15,318	U	$171.00	$764,883
116	11,249	36	12,657	U	$171.00	$1,923,579
117	19,033	24	3,513	U	$109.00	$2,074,597
120	15,503	36	9,144	U	$171.00	$2,651,013
122	9,547	20	2,427	U	$88.00	$840,136
123	12,658	30	6,717	U	$140.00	$1,772,120
150	40,034	n/a	0	U	n/a	$0
						$38,440,171

Distribution

Cost per gpd = $2.25 /gpd
Total Fern Irrigation = 8,469,930 gpd

Capital Cost = $19,057,342
O&M Cost = $525,559 * Estimated O&M costs $0.17 per 1000 gallon

Pump Station

Plant #	Name	Peak Flow gpm	Peak Flow mgd	Capital Non-Land Cost	O & M Costs per year	Land and Aquisition Cost	Total Capital Cost	Equivalent Annualized Cost
1	Ormand Beach	2,971	4.28	$874,570	$83,785	$75,000	$949,570	$94,880
2	Daytona Beach Regional	1,285	1.85	$570,402	$37,767	$75,000	$645,402	$66,169
3	Daytona Beach Bethune	2,977	4.29	$875,599	$83,960	$75,000	$950,599	$94,977
4	Port Orange	0	0.00	$0	$0	$0	$0	$0
5	DeLand	5,631	8.11	$1,256,352	$156,422	$75,000	$1,331,352	$130,916
Repump 1	Pierson	15,318	22.06	$2,312,671	$420,914	$75,000	$2,387,671	$230,622
Repump 2	Lake Dias	0	0.00	n/a	n/a	n/a	n/a	n/a
				$5,889,593	$782,847	$375,000	$6,264,593	$617,565

Storage

Plant #	Name	Average Annual Cap. mgd	Storage Volume Mgal	Capital Non-Land Cost	O & M Costs per year	Land and Aquisition Cost	Total Capital Cost	Equivalent Annualized Cost
1	Ormand Beach	2.85	0	n/a	n/a	n/a	n/a	n/a
2	Daytona Beach Regional	1.23	0	n/a	n/a	n/a	n/a	n/a
3	Daytona Beach Bethune	2.86	0	n/a	n/a	n/a	n/a	n/a
4	Port Orange	0.00	0	n/a	n/a	n/a	n/a	n/a
5	DeLand	2.16	2.16	$631,490	$0	$0	$631,490	$48,770
Repump 1	Pierson	5.88	5.88	$1,186,246	$0	$0	$1,186,246	$91,614
Repump 2	Lake Dias	0	0.00	n/a	n/a	n/a	n/a	n/a
		9.1	8.0	$1,817,735	$0	$0	$1,817,735	$140,384

Total Project Cost

Item	Construction Cost	Capital Non-Land Cost	Land and Aquisition Cost	Total Capital Cost	O & M Costs per year	Equivalent Annualized Cost	Equivalent Unit Cost $/1000 gal.
Transmission	$26,510,463	$38,440,171		$38,440,171	$0	$2,883,397	$0.93
Distribution	$13,142,994	$19,057,342		$19,057,342	$525,559	$1,955,050	$0.63
Pumping	$4,061,788	$5,889,593	$375,000	$6,264,593	$782,847	$617,565	$0.20
Storage	$1,253,611	$1,817,735		$1,817,735	$0	$140,384	$0.05
Total	$44,968,856			$65,579,841	$1,308,406	$5,596,396	$1.81
				$7.74 /gpd			

Table B.5 - Cost Summary for Proposed Reclaimed Water Fern Irrigation System
Alternative 3 (Minimum Reuse)

Transmission

Pipe Number	Length feet	Diameter inch	Flow gpm	Urban/ Rural	Unit Capital Urban Pipe Cost	Total Capital Urban Pipe Cost
1	19,426	n/a	2,971	U	n/a	$0
10	14,306	n/a	4,262	U	n/a	$0
20	24,688	n/a	1,285	U	n/a	$0
30	37,637	n/a	2,977	U	n/a	$0
50	21,090	24	5,631	U	$109.00	$2,298,810
55	23,061	20	3,540	U	$88.00	$2,029,368
61	4,066	20	0	U	$88.00	$357,808
65	12,635	n/a	0	U	n/a	$0
70	9,447	n/a	0	U	n/a	$0
75	1,271	n/a	0	U	n/a	$0
80	28,213	n/a	0	U	n/a	$0
100	69,551	n/a	7,233	U	n/a	$0
101	843	n/a	7,233	U	n/a	$0
110	20,183	n/a	6,129	U	n/a	$0
112	11,273	n/a	6,129	U	n/a	$0
115	4,473	n/a	15,318	U	n/a	$0
116	11,249	n/a	12,657	U	n/a	$0
117	19,033	n/a	3,513	U	n/a	$0
120	15,503	n/a	9,144	U	n/a	$0
122	9,547	n/a	2,427	U	n/a	$0
123	12,658	n/a	6,717	U	n/a	$0
150	40,034	n/a	0	U	n/a	$0
						$4,685,986

Distribution

Cost per gpd = $2.25 /gpd
Total Fern Irrigation = 1,912,000 gpd

Capital Cost = $4,302,000
O&M Cost = $118,640 * Estimated O&M costs $0.17 per 1000 gallon

Pump Station

Plant #	Name	Peak Flow gpm	Peak Flow mgd	Capital Non-Land Cost	O & M Costs per year	Land and Aquisition Cost	Total Capital Cost	Equivalent Annualized Cost
1	Ormand Beach	0	0.00	n/a	n/a	n/a	n/a	n/a
2	Daytona Beach Regional	0	0.00	n/a	n/a	n/a	n/a	n/a
3	Daytona Beach Bethune	0	0.00	n/a	n/a	n/a	n/a	n/a
4	Port Orange	0	0.00	n/a	n/a	n/a	n/a	n/a
5	DeLand	5,631	8.11	$1,256,352	$156,422	$75,000	$1,331,352	$130,916
Repump 1	Pierson	0	0.00	n/a	n/a	n/a	n/a	n/a
Repump 2	Lake Dias	0	0.00	n/a	n/a	n/a	n/a	n/a
				$1,256,352	$156,422	$75,000	$1,331,352	$130,916

Storage

Plant #	Name	Average Annual Cap. mgd	Storage Volume Mgal	Capital Non-Land Cost	O & M Costs per year	Land and Aquisition Cost	Total Capital Cost	Equivalent Annualized Cost
1	Ormand Beach	0.00	0	n/a	n/a	n/a	n/a	n/a
2	Daytona Beach Regional	0.00	0	n/a	n/a	n/a	n/a	n/a
3	Daytona Beach Bethune	0.00	0	n/a	n/a	n/a	n/a	n/a
4	Port Orange	0.00	0	n/a	n/a	n/a	n/a	n/a
5	DeLand	2.16	2.16	$631,490	$0	$0	$631,490	$48,770
Repump 1	Pierson	0.00	0.00	n/a	n/a	n/a	n/a	n/a
Repump 2	Lake Dias	0	0.00	n/a	n/a	n/a	n/a	n/a
		2.2	2.2	$631,490	$0	$0	$631,490	$48,770

Total Project Cost

Item	Construction Cost	Capital Non-Land Cost	Land and Aquisition Cost	Total Capital Cost	O & M Costs per year	Equivalent Annualized Cost	Equivalent Unit Cost $/1000 gal.
Transmission	$3,231,714	$4,685,986		$4,685,986	$0	$351,496	$0.50
Distribution	$2,966,897	$4,302,000		$4,302,000	$118,640	$441,333	$0.63
Pumping	$866,449	$1,256,352	$75,000	$1,331,352	$156,422	$130,916	$0.19
Storage	$435,510	$631,490		$631,490	$0	$48,770	$0.07
Total	$7,500,571			$10,950,827	$275,062	$972,515	$1.39
				$5.73 /gpd			

Table B.6 - Cost Summary for Proposed Reclaimed Water Fern Irrigation System Alternative 4 (Maximum Reuse from Future Deltona Regional WWTP)

Transmission

Pipe Number	Length feet	Diameter inch	Flow gpm	Urban/ Rural	Unit Capital Urban Pipe Cost	Total Capital Urban Pipe Cost
50	21,090	42	-	U	$201.00	$4,239,090
55	23,061	36	-	U	$171.00	$3,943,431
61	4,066	20	-	U	$88.00	$357,808
65	12,635	24	-	U	$109.00	$1,377,215
70	9,447	20	-	U	$88.00	$831,336
99	42,389	30	-	U	$140.00	$5,934,460
115	4,473	42	-	U	$201.00	$899,073
116	11,249	42	-	U	$201.00	$2,261,049
120	15,503	42	-	U	$201.00	$3,116,103
122	9,547	20	-	U	$88.00	$840,136
123	12,658	30	-	U	$140.00	$1,772,120
151	7,393	24	-	U	$109.00	$805,837
153	2,031	24	-	U	$109.00	$221,379
156	1,386	24	-	U	$109.00	$151,074
158	6,163	24	-	U	$109.00	$671,767
159	2,060	24	-	U	$109.00	$224,540
200	40,034	30	-	U	$140.00	$5,604,760
300	90,000	30	-	U	$140.00	$12,600,000
						$45,851,178

Distribution

Cost per gpd = $2.25 /gpd
Total Fern Irrigation = 10,910,000 gpd

Capital Cost = $24,547,500
O&M Cost = $676,966 * Estimated O&M costs $0.17 per 1000 gallon

Pump Station

Plant #	Name	Peak Flow gpm	Peak Flow mgd	Capital Non-Land Cost	O & M Costs per year	Land and Aquisition Cost	Total Capital Cost	Equivalent Annualized Cost
5/REPUMP	DeLand	11302.79	16.28	$1,912,952	$311,283	$75,000	$1,987,952	$192,893
6	Future Deltona	7812.50	11.25	$1,526,476	$215,985	$75,000	$1,601,476	$156,413
Repump 1	Pierson	21192.00	30.52	$2,841,498	$581,296	$75,000	$2,916,498	$280,538
				$6,280,925	$1,108,564	$225,000	$6,505,925	$629,844

Storage

Plant #	Name	Average Annual Cap. mgd	Storage Volume Mgal	Capital Non-Land Cost	O & M Costs per year	Land and Aquisition Cost	Total Capital Cost	Equivalent Annualized Cost
5	DeLand	2.16	2.16	$631,490	$0	$0	$631,490	$48,770
X	Future Deltona	9.00	0.00	n/a	n/a	n/a	n/a	n/a
Repump 1	Pierson	8.14	8.14	$1,455,411	$0	$0	$1,455,411	$112,401
		11.2	10.3	$2,086,901	$0	$0	$2,086,901	$161,171

Total Project Cost

Item	Construction Cost	Capital Non-Land Cost	Land and Aquisition Cost	Total Capital Cost	O & M Costs per year	Equivalent Annualized Cost	Equivalent Unit Cost $/1000 gal.
Transmission	$31,621,502	$45,851,178		$45,851,178	$0	$3,439,297	$0.80
Distribution	$16,929,310	$24,547,500		$24,547,500	$676,966	$2,518,273	$0.59
Pumping	$4,331,673	$6,280,925	$225,000	$6,505,925	$1,108,564	$629,844	$0.15
Storage	$1,439,242	$2,086,901		$2,086,901	$0	$161,171	$0.04
Total	$54,321,727			$78,991,504	$1,785,530	$6,748,586	$1.57
				$7.24 /gpd			

Appendix C

Citrus Irrigation Cost Estimates

TABLE C.1 - PHASE II - ASSESSMENT OF THE COST OF SUPPLYING RECLAIMED WATER TO CITRUS AREAS WITHIN THE SJRWMD BOUNDARY

ESTIMATED CAPITAL COSTS OF THE PROPOSED RECLAIMED WATER DISTRIBUTION SYSTEM

Assumed Annual Average Irrigation Rate: 9.61in/yr

SOURCES	DESCRIPTION	QUANTITY	AVERAGE ANNUAL DEMAND (MGD)	AVERAGE WATER REPLACED (MGD)	CONSTRUCTION COST ($)	NON-LAND CAPITAL COST ($)	LAND COST ($)	TOTAL CAPITAL COST ($)	UNIT CAPITAL COST (REPLACED) ($/GPD)	O&M COST ($/yr)	EQUIVALENT ANNUAL COST ($/yr)	UNIT EQUIV-ALENT COST (REPLACED) ($/1000 gal)
CLERMONT	Storage facility		0.765	0.620	$198,247	$287,459	$5,511	$292,969		$0	$22,586	
	Local area piping		0.765	0.620	$1,302,123	$1,888,078	$0	$1,888,078		$38,471	$180,096	
	Transmission from WWTP to bound.,LF	10,000			$150,000	$217,500	$0	$217,500		$0	$16,315	
	Pumping cost		0.765	0.620	$453,523	$657,608	$18,750	$676,358		$49,697	$101,797	
	Turnouts	5			$230,000	$333,500	$0	$333,500		$0	$25,016	
	Reuse metering and backflow devices	36			$361,458	$524,114	$0	$524,114		$0	$40,477	
	Reclaimed Water Filtration		0.765	0.620	$618,133	$896,293	$489	$896,782		$5,253	$89,889	
	High Level Disinfection		0.765	0.620	$94,019	$136,328	$0	$136,328		$14,465	$27,333	
	TOTAL COST				$3,407,504	$4,940,881	$24,749	$4,965,630	$8.01	$107,887	$503,509	$2.22
GROVELAND WWTP	Storage facility		0.030	0.030	$29,432	$42,676	$4,714	$47,390		$0	$3,626	
	Local area piping		0.030	0.030	$77,175	$111,904	$0	$111,904		$1,863	$10,257	
	Transmission from WWTP to bound.,LF	0			$0	$0	$0	$0		$0	$0	
	Pumping cost		0.030	0.030	$70,842	$102,722	$18,750	$121,472		$4,951	$14,197	
	Turnouts	1			$46,000	$66,700	$0	$66,700		$0	$5,003	
	Reuse metering and backflow devices	1			$10,041	$14,559	$0	$14,559		$0	$1,124	
	Reclaimed Water Filtration		0.030	0.030	$94,589	$137,154	$385	$137,540		$3,304	$16,277	
	High Level Disinfection		0.030	0.030	$9,706	$14,074	$0	$14,074		$7,338	$8,866	
	TOTAL COST				$337,785	$489,788	$23,849	$513,637	$17.11	$17,456	$59,151	$5.40
ZELLWOOD	Storage facility		0.090	0.080	$54,569	$79,125	$4,781	$83,906		$0	$6,446	
	Local area piping		0.090	0.080	$220,437	$319,634	$0	$319,634		$4,964	$28,940	
	Transmission from WWTP to bound.,LF	0			$0	$0	$0	$0		$0	$0	
	Pumping cost		0.090	0.080	$138,079	$200,215	$18,750	$218,965		$8,742	$25,517	
	Turnouts	1			$46,000	$66,700	$0	$66,700		$0	$5,003	
	Reuse metering and backflow devices	4			$40,162	$58,235	$0	$58,235		$0	$4,497	
	Reclaimed Water Filtration		0.090	0.080	$173,666	$251,816	$394	$252,210		$3,469	$27,266	
	High Level Disinfection		0.090	0.080	$20,241	$29,350	$0	$29,350		$7,941	$10,712	
	TOTAL COST				$693,155	$1,005,075	$23,925	$1,029,000	$12.86	$25,116	$108,380	$3.71
ROCK SPRINGS	Storage facility		0.090	0.090	$58,804	$85,265	$4,795	$90,060		$0	$6,921	
	Local area piping		0.090	0.090	$220,437	$319,634	$0	$319,634		$5,589	$29,565	
	Transmission from WWTP to bound.,LF	6,000			$37,800	$54,810	$0	$54,810		$0	$4,111	
	Pumping cost		0.090	0.090	$149,697	$217,061	$18,750	$235,811		$9,506	$27,582	
	Turnouts	1			$46,000	$66,700	$0	$66,700		$0	$5,003	
	Reuse metering and backflow devices	4			$40,162	$58,235	$0	$58,235		$0	$4,497	
	Reclaimed Water Filtration		0.090	0.090	$186,921	$271,035	$396	$271,431		$3,503	$29,113	
	High Level Disinfection		0.090	0.090	$22,125	$32,081	$0	$32,081		$8,063	$11,091	
	TOTAL COST				$761,945	$1,104,820	$23,940	$1,128,761	$12.53	$26,661	$117,884	$3.59
MID-FLORIDA LAKES	Storage facility		0.127	0.100	$62,806	$91,069	$4,808	$95,877		$0	$7,370	
	Local area piping		0.127	0.100	$266,373	$386,241	$0	$386,241		$6,205	$35,177	
	Transmission from WWTP to bound.,LF	6,000			$37,800	$54,810	$0	$54,810		$0	$4,111	
	Pumping cost		0.127	0.100	$160,740	$233,073	$18,750	$251,823		$10,258	$29,571	
	Turnouts	1			$46,000	$66,700	$0	$66,700		$0	$5,003	
	Reuse metering and backflow devices	6			$60,243	$87,352	$0	$87,352		$0	$6,746	
	Reclaimed Water Filtration		0.127	0.100	$199,434	$289,179	$398	$289,577		$3,535	$30,859	
	High Level Disinfection		0.127	0.100	$23,929	$34,697	$0	$34,697		$8,183	$11,458	
	TOTAL COST				$857,325	$1,243,121	$23,956	$1,267,077	$12.67	$28,182	$130,296	$3.57

TABLE C.1 - PHASE II - ASSESSMENT OF THE COST OF SUPPLYING RECLAIMED WATER TO CITRUS AREAS WITHIN THE SJRWMD BOUNDARY

ESTIMATED CAPITAL COSTS OF THE PROPOSED RECLAIMED WATER DISTRIBUTION SYSTEM

Assumed Annual Average Irrigation Rate: 9.61in/yr

SOURCES	DESCRIPTION	QUANTITY	AVERAGE ANNUAL DEMAND (MGD)	AVERAGE WATER REPLACED (MGD)	CONSTRUCTION COST ($)	NON-LAND CAPITAL COST ($)	LAND COST ($)	TOTAL CAPITAL COST ($)	UNIT CAPITAL COST (REPLACED) ($/GPD)	O&M COST ($/yr)	EQUIVALENT ANNUAL COST ($/yr)	UNIT EQUIV-ALENT COST (REPLACED) ($/1000 gal)
THE VILLAGES OF LAKE SUMTER	Storage facility		0.200	0.200	$97,248	$141,010	$4,943	$145,953		$0	$11,236	
	Local area piping		0.200	0.200	$488,835	$708,811	$0	$708,811		$12,420	$65,588	
	Transmission from WWTP to bound.,LF	17,500			$110,250	$159,863	$0	$159,863		$0	$11,991	
	Pumping cost		0.200	0.200	$257,855	$373,890	$18,750	$392,640		$17,856	$48,044	
	Turnouts	1			$46,000	$66,700	$0	$66,700		$0	$5,003	
	Reuse metering and backflow devices	9			$90,365	$131,029	$0	$131,029		$0	$10,119	
	Reclaimed Water Filtration		0.200	0.200	$0	$0	$0	$0		$0	$0	
	High Level Disinfection		0.200	0.200	$0	$0	$0	$0		$0	$0	
	TOTAL COST				$1,090,552	$1,581,301	$23,693	$1,604,994	$8.02	$30,276	$151,982	$2.08
WINTER GARDEN	Storage facility		1.365	1.110	$286,124	$414,880	$6,173	$421,052		$0	$32,473	
	Local area piping		1.365	1.110	$3,394,569	$4,922,125	$0	$4,922,125		$68,876	$438,084	
	Transmission from WWTP to bound.,LF	0			$0	$0	$0	$0		$0	$0	
	Pumping cost		1.365	1.110	$615,539	$892,532	$18,750	$911,282		$86,861	$157,104	
	Turnouts	9			$414,000	$600,300	$0	$600,300		$0	$45,029	
	Reuse metering and backflow devices	64			$642,592	$931,758	$0	$931,758		$0	$71,960	
	Reclaimed Water Filtration		1.365	1.110	$0	$0	$0	$0		$0	$0	
	High Level Disinfection		1.365	1.110	$141,581	$205,292	$0	$205,292		$0	$19,378	
	TOTAL COST				$5,494,405	$7,966,887	$24,923	$7,991,809	$7.20	$155,736	$764,027	$1.89
CLERBROOK MHP	Storage facility		0.050	0.040	$35,261	$51,129	$4,727	$55,856		$0	$4,280	
	Local area piping		0.050	0.040	$132,174	$191,652	$0	$191,652		$2,482	$16,858	
	Transmission from WWTP to bound.,LF	5,000			$31,500	$45,675	$0	$45,675		$0	$3,426	
	Pumping cost		0.050	0.040	$86,125	$124,881	$18,750	$143,631		$5,708	$16,665	
	Turnouts	1			$46,000	$66,700	$0	$66,700		$0	$5,003	
	Reuse metering and backflow devices	2			$20,081	$29,117	$0	$29,117		$0	$2,249	
	Reclaimed Water Filtration		0.050	0.040	$112,999	$163,849	$387	$164,236		$3,337	$18,830	
	High Level Disinfection		0.050	0.040	$12,036	$17,452	$0	$17,452		$7,458	$9,105	
	TOTAL COST				$476,176	$690,455	$23,864	$714,319	$17.86	$18,985	$76,416	$5.23
MEADOW WOODS	Storage facility		0.060	0.060	$45,548	$66,044	$4,754	$70,798		$0	$5,433	
	Local area piping		0.060	0.060	$165,438	$239,885	$0	$239,885		$3,726	$21,720	
	Transmission from WWTP to bound.,LF	2,000			$12,600	$18,270	$0	$18,270		$0	$1,370	
	Pumping cost		0.060	0.060	$113,578	$164,688	$18,750	$183,438		$7,228	$21,260	
	Turnouts	1			$46,000	$66,700	$0	$66,700		$0	$5,003	
	Reuse metering and backflow devices	3			$30,122	$43,676	$0	$43,676		$0	$3,373	
	Reclaimed Water Filtration		0.060	0.060	$0	$0	$0	$0		$0	$0	
	High Level Disinfection		0.060	0.060	$0	$0	$0	$0		$0	$0	
	TOTAL COST				$413,285	$599,264	$23,504	$622,768	$10.37	$10,955	$58,160	$2.65
SUNSHINE PARKWAY	Storage facility		0.093	0.070	$50,166	$72,741	$4,768	$77,509		$0	$5,952	
	Local area piping		0.093	0.070	$77,175	$111,904	$0	$111,904		$4,344	$12,737	
	Transmission from WWTP to bound.,LF	4,000			$25,200	$36,540	$0	$36,540		$0	$2,741	
	Pumping cost		0.093	0.070	$126,077	$182,812	$18,750	$201,562		$7,983	$23,414	
	Turnouts	1			$46,000	$66,700	$0	$66,700		$0	$5,003	
	Reuse metering and backflow devices	4			$40,162	$58,235	$0	$58,235		$0	$4,497	
	Reclaimed Water Filtration		0.093	0.070	$159,867	$231,808	$392	$232,200		$3,436	$25,344	
	High Level Disinfection		0.093	0.070	$18,312	$26,553	$0	$26,553		$7,821	$10,327	
	TOTAL COST				$542,960	$787,292	$23,910	$811,202	$11.59	$23,584	$90,016	$3.52

TABLE C.1 - PHASE II - ASSESSMENT OF THE COST OF SUPPLYING RECLAIMED WATER TO CITRUS AREAS WITHIN THE SJRWMD BOUNDARY

ESTIMATED CAPITAL COSTS OF THE PROPOSED RECLAIMED WATER DISTRIBUTION SYSTEM

Assumed Annual Average Irrigation Rate: 9.61in/yr

SOURCES	DESCRIPTION	QUANTITY	AVERAGE ANNUAL DEMAND (MGD)	AVERAGE WATER REPLACED (MGD)	CONSTRUCTION COST ($)	NON-LAND CAPITAL COST ($)	LAND COST ($)	TOTAL CAPITAL COST ($)	UNIT CAPITAL COST (REPLACED) ($/GPD)	O&M COST ($/yr)	EQUIVALENT ANNUAL COST ($/yr)	UNIT EQUIV-ALENT COST (REPLACED) ($/1000 gal)
OCOEE #2	Storage facility		0.440	0.440	$159,811	$231,726	$5,268	$236,994		$0	$18,265	
	Local area piping		0.440	0.440	$719,832	$1,043,756	$0	$1,043,756		$27,325	$105,617	
	Transmission from WWTP to bound.,LF	0			$0	$0	$0	$0		$0	$0	
	Pumping cost		0.440	0.440	$384,353	$557,311	$18,750	$576,061		$36,074	$80,427	
	Turnouts	3			$138,000	$200,100	$0	$200,100		$0	$15,010	
	Reuse metering and backflow devices	21			$210,851	$305,733	$0	$305,733		$0	$23,612	
	Reclaimed Water Filtration		0.440	0.440	$499,997	$724,995	$457	$725,453		$4,660	$73,124	
	High Level Disinfection		0.440	0.440	$72,742	$105,476	$0	$105,476		$12,295	$22,251	
	TOTAL COST				$2,185,585	$3,169,099	$24,475	$3,193,574	$7.25	$80,354	$338,306	$2.10
CAROLINE STREET	Storage facility		0.542	0.440	$159,726	$231,603	$5,267	$236,870		$0	$18,255	
	Local area piping		0.542	0.440	$1,097,787	$1,591,791	$0	$1,591,791		$27,302	$146,702	
	Transmission from WWTP to bound.,LF	0			$0	$0	$0	$0		$0	$0	
	Pumping cost		0.542	0.440	$384,201	$557,092	$18,750	$575,842		$36,045	$80,382	
	Turnouts	4			$184,000	$266,800	$0	$266,800		$0	$20,013	
	Reuse metering and backflow devices	25			$251,013	$363,968	$0	$363,968		$0	$28,109	
	Reclaimed Water Filtration		0.542	0.440	$499,735	$724,616	$457	$725,073		$4,659	$73,087	
	High Level Disinfection		0.542	0.440	$72,696	$105,410	$0	$105,410		$12,291	$22,240	
	TOTAL COST				$2,649,158	$3,841,279	$24,474	$3,865,754	$8.79	$80,297	$388,789	$2.42
WOODLEA ROAD	Storage facility		0.340	0.310	$128,103	$185,749	$5,092	$190,841		$0	$14,702	
	Local area piping		0.340	0.310	$697,128	$1,010,836	$0	$1,010,836		$19,236	$95,058	
	Transmission from WWTP to bound.,LF	0			$0	$0	$0	$0		$0	$0	
	Pumping cost		0.340	0.310	$328,289	$476,019	$18,750	$494,769		$26,186	$64,261	
	Turnouts	2			$92,000	$133,400	$0	$133,400		$0	$10,006	
	Reuse metering and backflow devices	16			$160,648	$232,940	$0	$232,940		$0	$17,990	
	Reclaimed Water Filtration		0.340	0.310	$402,201	$583,192	$434	$583,626		$4,229	$59,307	
	High Level Disinfection		0.340	0.310	$55,904	$81,061	$0	$81,061		$10,720	$18,371	
	TOTAL COST				$1,864,273	$2,703,196	$24,276	$2,727,472	$8.80	$60,370	$279,696	$2.47
NORTHWEST	Storage facility		0.310	0.310	$128,171	$185,848	$5,092	$190,940		$0	$14,709	
	Local area piping		0.310	0.310	$687,009	$996,163	$0	$996,163		$19,252	$93,974	
	Transmission from WWTP to bound.,LF	5,000			$31,500	$45,675	$0	$45,675		$0	$3,426	
	Pumping cost		0.310	0.310	$328,408	$476,192	$18,750	$494,942		$26,206	$64,294	
	Turnouts	2			$92,000	$133,400	$0	$133,400		$0	$10,006	
	Reuse metering and backflow devices	14			$140,567	$203,822	$0	$203,822		$0	$15,741	
	Reclaimed Water Filtration		0.310	0.310	$0	$0	$0	$0		$0	$0	
	High Level Disinfection		0.310	0.310	$0	$0	$0	$0		$0	$0	
	TOTAL COST				$1,407,655	$2,041,100	$23,842	$2,064,942	$6.66	$45,457	$202,151	$1.79
TOTAL	Storage facility		4.503	3.901	$1,494,016	$2,166,324	$70,692	$2,237,016		$0	$172,254	
	Local area piping		4.503	3.901	$9,546,492	$13,842,413	$0	$13,842,413		$242,054	$1,280,374	
	Transmission from WWTP to bound.,LF	55,500			$436,650	$633,143	$0	$633,143		$0	$47,492	
	Pumping cost		4.503	3.901	$3,597,306	$5,216,094	$262,500	$5,478,594		$333,300	$754,514	
	Turnouts	33			$1,518,000	$2,201,100	$0	$2,201,100		$0	$165,105	
	Reuse metering and backflow devices	209			$2,098,465	$3,042,774	$0	$3,042,774		$0	$234,993	
	Reclaimed Water Filtration		4.503	3.901	$2,947,543	$4,273,938	$4,189	$4,278,126		$39,386	$443,097	
	High Level Disinfection		4.503	3.901	$543,292	$787,773	$0	$787,773		$96,576	$170,933	
	TOTAL COST				$22,181,764	$32,163,558	$337,381	$32,500,938	$8.33	$711,316	$3,268,761	$2.30

TABLE C.2 - PHASE II - ASSESSMENT OF THE COST OF SUPPLYING RECLAIMED WATER TO CITRUS AREAS WITHIN THE SJRWMD BOUNDARY

ESTIMATED CAPITAL COSTS OF THE PROPOSED RECLAIMED WATER DISTRIBUTION SYSTEM

Assumed Annual Average Irrigation Rate: 33.84 inch/year

SOURCE	DESCRIPTION	QUANTITY	AVERAGE ANNUAL DEMAND (MGD)	AVERAGE WATER USED (MGD)	AVERAGE WATER REPLACED (MGD)	CONSTRUCTION COST ($)	UNIT CONST-UCTION COST (USED/REPLACED ($/GPD)	NON-LAND CAPITAL COST ($)	LAND COST ($)	TOTAL CAPITAL COST ($)	UNIT CAPITAL COST (USED/REPLACED ($/GPD)	O&M COST ($/yr)	EQUIVALENT ANNUAL COST ($/yr)	UNIT EQUIV-ALENT COST (USED/REPLACED) ($/1000 gal)
CLERMONT	Storage facility		0.765	0.620	0.176	$198,247		$287,459	$5,511	$292,969		$0	$22,586	
	Local area piping		0.765	0.620	0.176	$687,106		$996,304	$0	$996,304		$38,471	$115,416	
	Transmission from WWTP to bound.,LF	10,000				$150,000		$217,500	$0	$217,500		$0	$16,798	
	Pumping cost		0.765	0.620	0.176	$453,523		$657,608	$18,750	$676,358		$49,697	$101,797	
	Turnouts	5				$230,000		$333,500	$0	$333,500		$0	$25,756	
	Reuse metering and backflow devices	10				$100,405		$145,587	$0	$145,587		$0	$11,244	
	Reclaimed Water Filtration		0.765	0.620	0.176	$618,133		$896,293	$489	$896,782		$5,253	$74,508	
	High Level Disinfection		0.765	0.620	0.176	$94,019	$4.08	$136,328	$0	$136,328	$5.96	$14,465	$24,994	$1.74
	TOTAL COST					$2,531,434	$14.38	$3,670,579	$24,749	$3,695,328	$20.99	$107,887	$393,098	$6.12

Appendix D

RIB O & M Cost Estimates

PHASE II - ASSESSMENT OF THE COST OF SUPPLYING RECLAIMED WATER TO CITRUS AREAS WITHIN THE SJRWMD BOUNDARY

APPENDIX D PHASE II - WATER CONSERV II - O&M COST PER GPD PER YEAR FOR RIB SITES 6A AND 6C

STARTING DAY	ENDING DAY	RIB SITE 6A (MGW)	RIB SITE 6B (MGW)	RIB SITE 6C (MGW)	TOTAL (MGW)
9/15/92	9/22/92	23.56	9.62	0.00	33.18
9/22/92	9/29/92	0.00	19.21	29.66	48.86
9/29/92	10/06/92	22.15	0.00	9.23	31.37
10/06/92	10/13/92	33.34	16.56	0.00	49.90
10/13/92	10/20/92	0.00	8.64	34.32	42.97
10/20/92	10/27/92	28.94	0.00	16.58	45.52
10/27/92	11/03/92	20.37	15.20	0.00	35.57
11/03/92	11/10/92	0.00	12.15	39.57	51.71
11/10/92	11/17/92	27.68	0.00	14.48	42.16
11/17/92	11/24/92	21.62	14.79	0.00	36.41
11/24/92	12/01/92	0.00	11.40	14.13	25.53
12/01/92	12/08/92	21.25	0.00	7.34	28.59
12/08/92	12/15/92	16.92	16.14	0.00	33.06
12/15/92	12/22/92	0.00	2.70	23.12	25.82
12/22/92	12/29/92	26.13	0.00	6.41	32.54
12/29/92	1/05/93	20.02	15.68	0.00	35.69
1/05/93	1/12/93	0.00	6.73	21.63	28.36
1/12/93	1/19/93	26.84	0.00	10.32	37.15
1/19/93	1/26/93	26.07	11.84	0.00	37.91
1/26/93	2/02/93	0.00	10.13	17.54	27.67
2/02/93	2/09/93	16.51	0.00	5.80	22.30
2/09/93	2/16/93	22.92	11.92	0.00	34.83
2/16/93	2/23/93	0.00	5.35	12.25	17.60
2/23/93	3/02/93	6.55	0.00	14.73	21.28
3/02/93	3/09/93	19.26	12.83	0.00	32.09
3/09/93	3/16/93	0.00	3.63	15.78	19.42
3/16/93	3/23/93	23.73	0.00	0.00	23.73
3/23/93	3/30/93	21.02	8.56	0.00	29.57
3/30/93	4/06/93	0.00	2.52	21.63	24.15
4/06/93	4/13/93	20.36	0.00	6.73	27.09
4/13/93	4/20/93	17.77	8.16	0.00	25.93
4/20/93	4/27/93	0.00	8.38	18.25	26.63
4/27/93	5/4/93	13.79	0.00	10.35	24.14
5/4/93	5/11/93	26.47	5.34	0.00	31.81
5/11/93	5/18/93	0.00	9.77	16.31	26.08
5/18/93	5/25/93	16.91	0.00	9.23	26.14
5/25/93	6/1/93	17.63	8.13	0.00	25.75
6/1/93	6/8/93	0.00	10.30	17.90	28.20
6/8/93	6/15/93	22.38	0.00	13.01	35.39
6/15/93	6/22/93	22.12	12.97	0.00	35.10
6/22/93	6/28/93	0.00	6.48	22.71	29.19
6/28/93	7/6/93	24.10	0.00	8.36	32.46
7/6/93	7/13/93	18.23	13.90	0.00	32.13

PHASE II - ASSESSMENT OF THE COST OF SUPPLYING RECLAIMED WATER TO CITRUS AREAS WITHIN THE SJRWMD BOUNDARY

APPENDIX D PHASE II - WATER CONSERV II - O&M COST PER GPD PER YEAR FOR RIB SITES 6A AND 6C

STARTING DAY	ENDING DAY	RIB SITE 6A (MGW)	RIB SITE 6B (MGW)	RIB SITE 6C (MGW)	TOTAL (MGW)
7/13/93	7/20/93	0.00	4.51	20.49	25.00
7/20/93	7/27/93	19.08	0.00	6.49	25.57
7/27/93	8/3/93	18.93	10.30	0.00	29.23
8/3/93	8/10/93	0.00	13.21	18.54	31.75
8/10/93	8/17/93	23.98	0.00	17.18	41.16
8/17/93	8/24/93	27.10	6.93	0.00	34.03
8/24/93	8/31/93	0.00	19.83	24.24	44.07
8/31/93	9/07/93	21.13	0.00	10.31	31.44
9/07/93	9/14/93	22.92	13.94	0.00	36.86
9/14/93	9/21/93	0.00	7.97	16.47	24.43
9/21/93	9/28/93	28.13	0.00	10.25	38.38
9/28/93	10/05/93	24.09	10.25	0.00	34.34
10/05/93	10/12/93	0.00	11.59	25.64	37.23
10/12/93	10/19/93	22.43	0.00	7.37	29.81
34247	34254	0.00	11.59	25.64	37.23
34254	34261	22.43	0.00	7.37	29.81
34261	34268	22.18	9.48	0.00	31.66
34268	34275	0.00	13.61	23.91	37.52
34275	34282	25.57	0.00	10.01	35.58
34282	34289	21.75	9.48	0.00	31.23
34289	34296	0.00	12.03	24.21	36.24
34296	34303	26.73	0.00	11.08	37.81
34303	34310	27.50	11.89	0.00	39.39
34310	34317	0.00	10.88	22.98	33.86
34317	34324	27.68	0.00	12.98	40.66
34324	34331	19.33	9.06	0.00	28.39
34331	34338	0.00	12.96	25.47	38.44
34338	34345	27.54	0.00	10.58	38.13
34345	34352	25.34	14.40	0.00	39.74
34352	34359	0.00	11.84	23.38	35.22
34359	34366	25.14	0.00	12.31	37.45
34366	34373	21.86	13.81	0.00	35.67
34373	34380	0.00	12.42	23.51	35.93
34380	34387	29.54	0.00	8.86	38.40
34387	34394	25.78	12.27	0.00	38.05
34394	34401	0.00	12.43	26.57	39.00
34401	34408	25.69	0.00	7.35	33.04
34408	34415	22.02	9.97	0.00	31.99
34415	34422	0.00	13.27	14.23	27.50
34422	34429	21.20	0.00	17.93	39.13
34429	34436	18.82	9.65	0.00	28.48
34436	34443	0.00	10.90	15.38	26.28
34443	34450	29.03	0.00	15.06	44.09

PHASE II - ASSESSMENT OF THE COST OF SUPPLYING RECLAIMED WATER TO CITRUS AREAS WITHIN THE SJRWMD BOUNDARY

APPENDIX D PHASE II - WATER CONSERV II - O&M COST PER GPD PER YEAR FOR RIB SITES 6A AND 6C

STARTING DAY	ENDING DAY	RIB SITE 6A (MGW)	RIB SITE 6B (MGW)	RIB SITE 6C (MGW)	TOTAL (MGW)
34450	34457	27.05	8.65	0.00	35.69
34457	34464	0.00	21.23	16.53	37.76
34464	34471	20.76	0.00	17.23	37.99
34471	34478	26.86	11.16	0.00	38.02
34478	34485	0.00	14.40	13.32	27.72
34485	34492	26.79	0.00	19.55	46.34
34492	34499	33.59	12.97	0.00	46.55
34499	34506	0.00	7.96	11.74	19.70
34506	34513	0.00	0.00	8.57	8.57
34513	34520	11.73	1.92	0.00	13.65
34520	34527	0.00	4.24	4.13	8.37
34527	34534	5.92	0.00	8.26	14.18
34534	34541	20.32	0.00	0.00	20.32
34541	34548	0.00	7.11	4.92	12.03
34548	34555	6.47	0.00	16.67	23.14
34555	34562	3.75	6.91	0.00	10.66
34562	34569	0.00	6.48	6.76	13.24
34569	34576	7.03	0.00	16.74	23.77
34576	34583	14.68	2.61	0.00	17.29
34583	34590	0.00	7.34	5.60	12.93
34590	34597	21.01	0.98	18.76	40.76
34597	34604	25.73	12.57	20.05	58.36
34604	34611	14.77	8.08	8.84	31.69
34611	34618	7.45	4.08	6.49	18.03
34618	34625	12.67	6.93	10.84	30.43
34625	34632	8.17	6.20	11.12	25.50
34632	34639	11.17	7.22	17.14	35.54
34639	34646	9.77	6.73	11.86	28.36
34646	34653	10.97	0.00	16.02	26.99
34653	34660	50.16	38.54	9.95	98.65
34660	34667	4.12	11.70	17.62	33.44
34667	34674	9.17	2.63	18.77	30.57
34674	34681	20.94	13.10	15.07	49.10
34681	34688	18.75	14.44	16.23	49.42
34688	34695	24.05	14.91	16.32	55.27
34695	34702	30.76	15.93	19.28	65.98
34702	34709	26.30	16.40	19.18	61.88
34709	34716	6.30	9.45	18.94	34.69
34716	34723	8.63	0.00	15.83	24.46
34723	34730	10.73	0.01	12.69	23.42
34730	34737	14.21	4.38	11.97	30.55
34737	34744	4.84	4.48	20.03	29.36
34744	34751	17.39	7.03	0.00	24.43

PHASE II - ASSESSMENT OF THE COST OF SUPPLYING RECLAIMED WATER TO CITRUS AREAS WITHIN THE SJRWMD BOUNDARY

APPENDIX D. PHASE II - WATER CONSERV II - O&M COST PER GPD PER YEAR FOR RIB SITES 6A AND 6C

STARTING DAY	ENDING DAY	RIB SITE 6A (MGW)	RIB SITE 6B (MGW)	RIB SITE 6C (MGW)	TOTAL (MGW)
34751	34758	0.00	6.93	12.30	19.24
34758	34765	13.34	0.00	9.03	22.38
34765	34772	14.60	6.79	0.00	21.39
34772	34779	0.08	8.02	15.12	23.22
34779	34786	12.63	0.00	9.29	21.92
34786	34793	13.97	5.88	0.00	19.85
34793	34800	0.00	6.84	17.02	23.87
34800	34807	15.00	0.00	12.08	27.08
34807	34814	13.26	4.08	0.00	17.34
34814	34821	0.00	8.74	22.34	31.08
34821	34828	21.95	0.00	19.01	40.96
34828	34835	30.14	9.03	0.00	39.17
34835	34842	0.00	12.96	28.82	41.78
34842	34849	20.45	0.00	15.60	36.05
34849	34856	22.31	11.44	0.00	33.75
34856	34863	0.00	12.49	19.40	31.89
34863	34870	25.67	0.00	21.84	47.51
34870	34877	29.07	16.80	0.00	45.86
34877	34884	0.04	14.32	34.66	49.02
34884	34891	23.89	1.24	8.93	34.06
34891	34898	19.76	15.81	1.88	37.45
34898	34905	0.96	7.66	19.47	28.09
34905	34912	29.40	0.00	14.22	43.63
34912	34919	27.95	18.17	1.99	48.11
34919	34926	0.01	6.02	21.24	27.27
34926	34933	9.73	0.00	8.69	18.43
34933	34940	11.29	9.40	11.44	32.14
34940	34947	9.13	15.06	28.74	52.93
34947	34954	14.58	15.74	5.95	36.27
34954	34961	8.32	0.22	9.03	17.57
34961	34968	11.18	0.00	17.32	28.49
34968	34975	14.15	0.61	29.38	44.15
34975	34982	10.74	5.70	7.76	24.20
34982	34989	12.89	21.48	29.79	64.16
34989	34996	19.55	7.93	11.23	38.71
34996	35003	5.12	0.85	9.60	15.56
35003	35010	1.98	1.67	1.27	4.92
35010	35017	2.96	0.25	1.85	5.06
35017	35024	1.41	0.29	1.18	2.88
35024	35031	15.14	0.00	17.64	32.78
35031	35038	18.84	5.85	1.56	26.26
35038	35045	0.00	7.61	12.34	19.95
35045	35052	8.18	3.48	16.04	27.70

PHASE II - ASSESSMENT OF THE COST OF SUPPLYING RECLAIMED WATER TO CITRUS AREAS WITHIN THE SJRWMD BOUNDARY

APPENDIX D. PHASE II - WATER CONSERV II - O&M COST PER GPD PER YEAR FOR RIB SITES 6A AND 6C

STARTING DAY	ENDING DAY	RIB SITE 6A (MGW)	RIB SITE 6B (MGW)	RIB SITE 6C (MGW)	TOTAL (MGW)
35052	35059	11.95	6.91	0.00	18.86
35059	35066	7.34	6.49	17.59	31.42
35066	35073	17.55	1.05	26.35	44.94
35073	35080	28.73	12.60	2.54	43.88
35080	35087	12.49	7.87	14.39	34.76
35087	35094	25.38	0.03	10.68	36.08
35094	35101	6.03	4.82	2.04	12.88
35101	35108	0.44	9.39	19.51	29.34
35108	35115	14.04	0.03	9.61	23.67
35115	35122	16.39	8.59	0.03	25.01
35122	35129	0.08	5.11	19.20	24.38
35129	35136	20.09	2.76	8.91	31.76
35136	35143	20.59	8.17	1.33	30.08
35143	35150	1.52	7.76	22.49	31.78
35150	35157	27.12	2.41	20.51	50.04
35157	35164	19.47	15.91	8.83	44.22
35164	35171	5.46	9.55	27.28	42.30
35171	35178	14.04	0.00	6.27	20.31
35178	35185	7.19	8.75	0.00	15.93
35185	35192	0.00	7.49	11.52	19.01
35192	35199	7.22	0.00	5.50	12.71
35199	35206	4.90	2.57	0.00	7.47
35206	35213	1.79	2.38	17.95	22.12
35213	35220	25.88	3.45	12.65	41.98
35220	35227	11.74	9.77	0.90	22.41
35227	35234	6.66	12.05	24.71	43.42
35234	35241	22.24	2.18	13.74	38.16
35241	35248	31.09	6.98	13.16	51.24
35248	35255	5.58	10.88	22.77	39.23
35255	35262	18.91	6.25	18.59	43.75
35262	35269	17.45	15.30	3.74	36.49
35269	35276	3.53	7.97	7.03	18.54
35276	35283	12.26	0.00	6.43	18.69
35283	35290	22.14	6.08	4.73	32.95
35290	35297	3.67	11.79	48.18	63.63
35297	35304	27.96	2.11	11.30	41.37
35304	35311	29.37	9.68	2.67	41.73
35311	35318	4.29	16.56	26.32	47.18
35318	35325	21.85	8.92	23.10	53.87
35325	35332	12.09	3.98	6.50	22.57
35332	35339	6.02	11.13	14.02	31.17
35339	35346	14.90	10.99	27.52	53.41
35346	35353	32.83	16.88	10.58	60.29

PHASE II - ASSESSMENT OF THE COST OF SUPPLYING RECLAIMED WATER TO CITRUS AREAS WITHIN THE SJRWMD BOUNDARY

APPENDIX D PHASE II - WATER CONSERV II - O&M COST PER GPD PER YEAR FOR RIB SITES 6A AND 6C

STARTING DAY	ENDING DAY	RIB SITE 6A (MGW)	RIB SITE 6B (MGW)	RIB SITE 6C (MGW)	TOTAL (MGW)
35353	35360	0.00	8.56	16.01	24.56
35360	35367	7.07	0.00	8.04	15.11
35367	35374	16.67	4.12	0.00	20.79
35374	35381	0.55	8.48	14.57	23.60
35381	35388	15.68	0.00	8.16	23.84
35388	35395	9.33	3.74	0.00	13.07
35395	35402	0.00	9.82	21.06	30.88
35402	35409	19.59	0.00	9.49	29.07
35409	35416	20.85	9.78	0.00	30.63
35416	35423	14.76	9.76	26.13	50.64
35423	35430	14.73	0.00	9.04	23.77
35430	35437	18.08	10.70	0.00	28.78
35437	35444	0.00	5.72	20.18	25.90
35444	35451	17.07	1.52	11.63	30.22
35451	35458	22.62	12.60	0.00	35.22
35458	35465	0.00	12.35	33.09	45.44
35465	35472	20.26	0.00	14.71	34.97
35472	35479	19.92	9.07	8.08	37.07
Avg MG/wk		13.72	6.94	11.56	32.22
Avg MGD		1.96	0.99	1.65	4.60
% of total		0.43	0.22	0.36	1.00

* Compared to rated AADF capacity of 5.6 MGD

RIB SITES A+C = 4.39 MGD AADF capacity

Therefore O&M cost per MGD per year = $23,201.56

Therefore O&M cost per gpd per year = $0.02

PHASE II - ASSESSMENT OF THE COST OF SUPPLYING RECLAIMED WATER TO CITRUS AREAS WITHIN THE SJRWMD BOUNDARY

APPENDIX D. PHASE II - WATER CONSERV II - O&M COST PER YEAR FOR RIB SITES 6A AND 6C

THREE COMPONENTS:

1 RIB OPERATIONS
2 RIBS AND GROUNDS MAINTAINANCE
3 GROUNDWATER SAMPLING AND WATER LEVEL DATA COLLECTION

RIB OPERATIONS: (Labor hours calculated at $15/hr)

Site 6A

Description	Quarterly (hours)	Cost Per Quarter	Cost Per Year
Set-up/weekly	24	$360	$1,080
Inspection/daily	120	$1,800	$5,400
Total Cost		$2,160	$6,480

Site 6C

Description	Quarterly (hours)	Cost Per Quarter	Cost Per Year
Set-up/weekly	18	$270	$810
Inspection/daily	45	$675	$2,025
Total Cost		$945	$2,835

RIBS AND GROUNDS MAINTAINANCE: (Labor hours calculated at $15/hr)

Site 6A

Description	Quarterly (hours)	Cost Per Quarter	Cost Per Year
Cultivate RIB Bottoms	127	$1,905	$5,715
Hoe and Rake RIB Bottoms	344	$5,160	$15,480
Mow Slopes, Roadways, Well R	114	$1,710	$5,130
Roadways	36	$540	$1,620
Structure Routes	82	$1,230	$3,690
RIB Tops	53	$795	$2,385
Total	3024	$11,340	$34,020

Site 6C

Description	Quarterly (hours)	Cost Per Quarter	Cost Per Year
Cultivate RIB Bottoms	111	$1,665	$4,995
Hoe and Rake RIB Bottoms	296	$4,440	$13,320
Mow Slopes, Roadways, Well R	96	$1,440	$4,320
Roadways	22	$330	$990
Structure Routes	72	$1,080	$3,240
RIB Tops	48	$720	$2,160
Total	2580	$9,675	$29,025

GROUNDWATER SAMPLING AND WATER LEVEL DATA COLLECTION (Labor hours calculated at $15/hr)

Site 6A

Description	Quarterly (hours)	Cost Per Quarter	Cost Per Year
Services:			
Groundwater sampling, preparation for sampling, and making the lab run	52.3076923	$785	$3,138
Water quality analysis		$1,536	$6,144
Measurement of water levels	88.6153846	$1,329	$5,317
Maintainance of wells	29.5384615	$443	$1,772
Equipment used each period:			
Calibration/Spike Standards		$63	$250
pH paper		$5	$20
Disposable Gloves		$25	$100
Waterproof Pens		$5	$20
Logbook		$13	$50
Kimwipes		$13	$50
Total Cost		$4,215	$16,862

Site 6C

Description	Quarterly (hours)	Cost Per Quarter	Cost Per Year
Services:			
Groundwater sampling, preparation for sampling, and making the lab run	32.6923077	$490	$1,962
Water quality analysis		$960	$3,840
Measurement of water levels	88.6153846	$1,329	$5,317
Maintainance of wells	18.4615385	$277	$1,108
Equipment used each period:			$0
Calibration/Spike Standards		$63	$250
pH paper		$5	$20
Disposable Gloves		$25	$100
Waterproof Pens		$5	$20
Logbook		$13	$50
Kimwipes		$13	$50
Total Cost		$3,179	$12,716