Special Publication SJ2001-SP5

WATER SUPPLY NEEDS AND SOURCES ASSESSMENT: ALTERNATIVE WATER SUPPLY STRATEGIES INVESTIGATION: BRACKISH GROUND WATER: PLANNING-LEVEL COST ESTIMATES

by

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2001

EXECUTIVE SUMMARY

This technical memorandum (TM) is the third in a series concerned with the feasibility of developing brackish ground water sources to help meet municipal water supply needs within the St. Johns River Water Management District. The first TM identified potential source areas and associated maximum quantities. The second TM discusses treatment processes applicable to developing brackish ground water supplies and a proposal for developing source-based water supply development cost estimates using selected treatment technologies and source area characteristic data. This TM presents the results of the brackish ground water cost analysis.

PURPOSE OF THIS TM

This TM presents the results of the cost estimation for water supply development at the following six candidate brackish ground water withdrawal sites:

- Lake Washington
- Titusville
- South Orange
- Volusia
- St. Johns County
- Lake Jessup

Cost equations were developed for two different sets of conditions: blending systems and desalting systems, using reverse osmosis (RO). These systems are described in further detail in the Treatment Requirements and Costs section of the report. A complete set of easy-to-apply cost estimating tools was developed and is presented. In most cases, costs are expressed as a function of the finish water average day demand (ADD). In all cases, a maximum day to average day demand ratio of 1.5 is assumed. Therefore, the maximum treatment capacity of all water supply systems described in this TM is 1.5 times greater than the average day demand provided.

BRACKISH GROUND WATER PRODUCTION COSTS

A complete set of planning level cost estimates has been developed for each candidate withdrawal site and each of the parameters of interest.

Cost parameters include construction cost, capital cost, operation and maintenance (O&M) cost, equivalent annual cost and unit cost. Previously established water supply component cost data (Law Engineering, 1996) were used to the greatest extent possible. All annual cost estimates were developed in accordance with previously established economic criteria, and all costs are expressed in 1996 dollars.

ILLUSTRATIVE EXAMPLE PROBLEMS

Two illustrative example problems are developed and presented in this TM to demonstrate proper application of the planning-level cost equations. The first example is a 5-mgd desalting system at the Lake Washington site. The second example is a 5-mgd combined blending and desalting system at the Lake Washington Site. Together, these illustrative examples demonstrate the correct application of each type of cost equation presented in this TM.

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INTRODUCTION

This technical memorandum (TM) is the third in a series addressing the feasibility of developing brackish ground water supplies to augment existing and future public water supplies within St. Johns River Water Management District (SJRWMD). The first brackish ground water supply TM, D.1.a, was prepared by SJRWMD staff. This TM identified six potential brackish ground water source areas and evaluated current and future water quality for each. The source analysis was based on GIS analysis to identify candidate withdrawal sites, and on solute transport modeling to quantify future water quality as a function of withdrawal rate and duration of pumping.

The second TM, D.2.c, reviewed relevant information and technical literature on technologies available to treat brackish ground water and disposal options available to manage the waste concentrate stream associated with brackish water treatment (CH2M HILL 1997).

This final brackish ground water feasibility TM presents the results of planning-level water supply development cost estimation for the six candidate brackish ground water withdrawal sites. These sites include Lake Washington, Titusville, South Orange, Volusia, St. Johns County, and Lake Jessup. For each site, two separate water supply development scenarios were considered from which cost equations were developed.

The first scenario, termed *blending systems,* includes developing the source wellfield and minimum conventional treatment of the brackish ground water. The product water may not meet all primary and secondary drinking water standards (DWS). In this case, the product water would be suitable for blending with another higher quality source so the resulting blended water supply will meet drinking water standards. An existing high quality source may be augmented by the brackish ground water source without expensive desalting.

The second scenario, termed *desalting systems,* includes developing the source wellfield, desalting the feedwater using reverse osmosis (RO), and disposing of the waste concentrate with a deep disposal well. This scenario provides a reliable stand-alone water supply system.

Cost equations developed for the blending systems and the desalting systems can also be used to estimate the cost of new split flow water supply systems designed to meet all DWS without desalting all raw feedwater. In this case a brackish ground water wellfield would be developed, but only a portion of the feedwater would be desalted.

Individual cost estimates are developed for each of the six sites using the two scenarios. These estimates are then used to develop planning-level cost equations, which relate cost to the water supply capacity developed. These cost equations can then be used to rapidly develop cost estimates for several brackish ground water alternatives, which can be used to define brackish ground water development costs in the University of Florida Decision Model in subsequent phases of this investigation.

The cost equations presented in this TM can also be used to investigate brackish ground water supply options independent of the University of Florida Decision Model application. Two hypothetical brackish ground water development examples are presented to illustrate proper application of these equations.

All cost estimates and cost equations presented in this TM are planning-level or "cost curve" estimates. These estimates will vary from actual project costs, which are based on detailed designs. Planning-level cost estimates are generally accurate to within plus or minus 50 percent of actual costs for the same design conditions and design criteria.

METHODS

To develop appropriate construction and operations and maintenance (O&M) cost estimates for the selected brackish groundwater sources, available facility cost information was reviewed. Primary sources included water and wastewater systems component cost information developed by Law Engineering (1996), for SJRWMD; and water supply alternatives cost data developed by Stone and Webster (1990), for the Southwest Florida Water Management District. Individual facility cost estimates were developed from component cost information obtained from these sources, supplemented by additional cost data from other sources as necessary. The individual cost estimates were then used, along with curve-fitting techniques, to develop appropriate, generalized cost functions. This section summarizes the methodology used to develop the brackish ground water facility cost equations.

TECHNOLOGY ASSESSMENT

The feasibility of developing brackish ground water has been addressed in TM D.2.C, *Brackish Ground Water: Treatment Technology Assessment (CH2M HILL, 1997).* This TM reviews relevant information and technical literature on technologies available to treat brackish ground water and disposal options available to manage the waste concentrate stream associated with brackish water treatment. Brackish ground water facilities requirements are based on the technologies identified in this TM.

SOURCE ASSESSMENT

Potential source areas and associated maximum quantities have been identified by SJRWMD and are reported in TM D.1.b *Brackish Ground Water: Source Identification and Assessment* (SJRWMD, 1998). As a result, six potential sites have been identified. The six sites are Lake Washington, Titusville, South Orange, Volusia, St. Johns County, and Lake Jessup. The source assessment identifies the relationship between water quality and withdrawal rate and duration for each of the candidate sites. Therefore, the source assessment results provide a basis for establishing site-specific desalting requirements at each candidate site.

COST PARAMETERS

Cost parameters considered in this TM were previously established by the project team and include the following:

- Construction cost
- Non-construction capital cost
- Land cost
- Land acquisition cost
- Total capital cost
- O&M cost
- Equivalent annual cost
- Annualized set-up cost
- Annualized unit cost

Economic criteria, including cost basis, non-construction capital cost factor, unit land costs, interest rate, and facilities life expectancies, have been previously established for all cost estimates developed as part of the SJRWMD Alternative Water Supply Strategies Investigations. These previously established criteria are used to develop the required cost estimates for the brackish ground water facilities.

In all cases, costs are expressed as constant 1996 dollars. The interest rate or time value of money used in all calculations is 7 percent per year. Non-construction capital costs are estimates computed as 45 percent of the construction cost, while land acquisition costs are computed as 25 percent of the land value. Total capital cost is then the sum of the construction cost, land cost, non-construction capital cost, and land acquisition cost. These criteria are consistent throughout this TM and will be used for other water supply alternatives to ensure a consistent basis of comparison among the various water supply strategies under investigation.

All cost estimates, and resulting cost equations, are related to the average day demand (ADD) provided by the brackish ground water treatment facilities. However, the maximum design capacity of all facilities considered in this TM is based on an assumed maximum day demand (MDD) to average day demand ratio of 1.5. Therefore, the maximum treatment capacity of all water supply systems described in this TM is 1.5 times greater than the average day demand provided by the system. For example, the maximum treatment capacity of a 10 mgd water supply system would be 15 mgd, and the cost estimates for a

10 mgd ADD system include facilities with a peak delivery capacity of 15 mgd.

Construction and O&M cost estimates have been developed at the preliminary planning or cost curve level for the major components required. The major components required for each candidate withdrawal site include the following:

- Raw water wellfields
  - Wells
  - Pumps
  - Piping and instrumentation and controls (I&C)
- Membrane pretreatment
  - Sulfuric acid addition
  - Scale inhibitor addition
  - Five-micron cartridge filtration
- Membrane process train
  - Membrane feed pump
  - Membrane module(s)
- Membrane post-treatment
  - Degasifier (airstripping tower with blowers)
  - Product transfer pump
  - Chemical addition (caustic, chlorine, inhibitors)
  - Ozone disinfection
  - Storage
  - Pumping facilities
  - Blending facilities
- Well concentrate disposal
  - Deep injection well

Applicable cost data have been identified in the literature. Cost information presented in TM B.2.b, *Water Supply and Wastewater Systems Component Cost Information* (Law Engineering 1996) was used as much as possible. Where necessary, cost curves or unit costs for individual items (for example, pumps) or major systems (for example, complete RO treatment plant) have been developed. Using the identified or developed construction and O&M cost curves, a spreadsheet application was developed and applied to the six candidate sources.

CANDIDATE BRACKISH GROUND WATER WITHDRAWAL SITES

LOCATION

The brackish ground water source assessment identified six candidate water supply withdrawal sites as shown in Figure 1. The criteria and procedures used to identify the candidate withdrawal sites are fully defined in TM D.1.b *Brackish Ground Water: Source Identification and Assessment* (SJRWMD, 1998).

LONG TERM RESPONSE TO PUMPING

In general, brackish ground water quality will change if significant volumes of water are removed. The rate of change of water quality is site-specific and complex. It depends on such factors as number of wells, well spacing, well pumping rate, duration of pumping, aquifer hydrologic characteristics, and native ground water quality characteristics. These interrelationships were investigated and reported in detail in TM D.1.b. for each candidate withdrawal site. Estimates of water quality response to long-term pumping are based on the results of the source analysis solute transport modeling, which in turn are based on site-specific hydrologic and current water quality characteristics.

As discussed in TM D.1.d, well spacing used in the solute transport simulations was 2,500 feet. This is a rather large spacing for freshwater wellfield application but was chosen for this brackish ground water application in an attempt to minimize long-term water quality deterioration.

On October 23, 1997, preliminary results of the brackish ground water source analysis, and associated planning level facility costs estimates, were presented to the SJRWMD Public Water Supply Advisory Group for review and comment. Among the significant assumptions used in the initial brackish ground water source assessment was a production well spacing of 750 feet. Based on review comments received from the advisory group, it was decide to investigate the sensitivity of the SJRWMD solute transport modeling results to production well spacing. The objective of this sensitivity analysis was to determine if

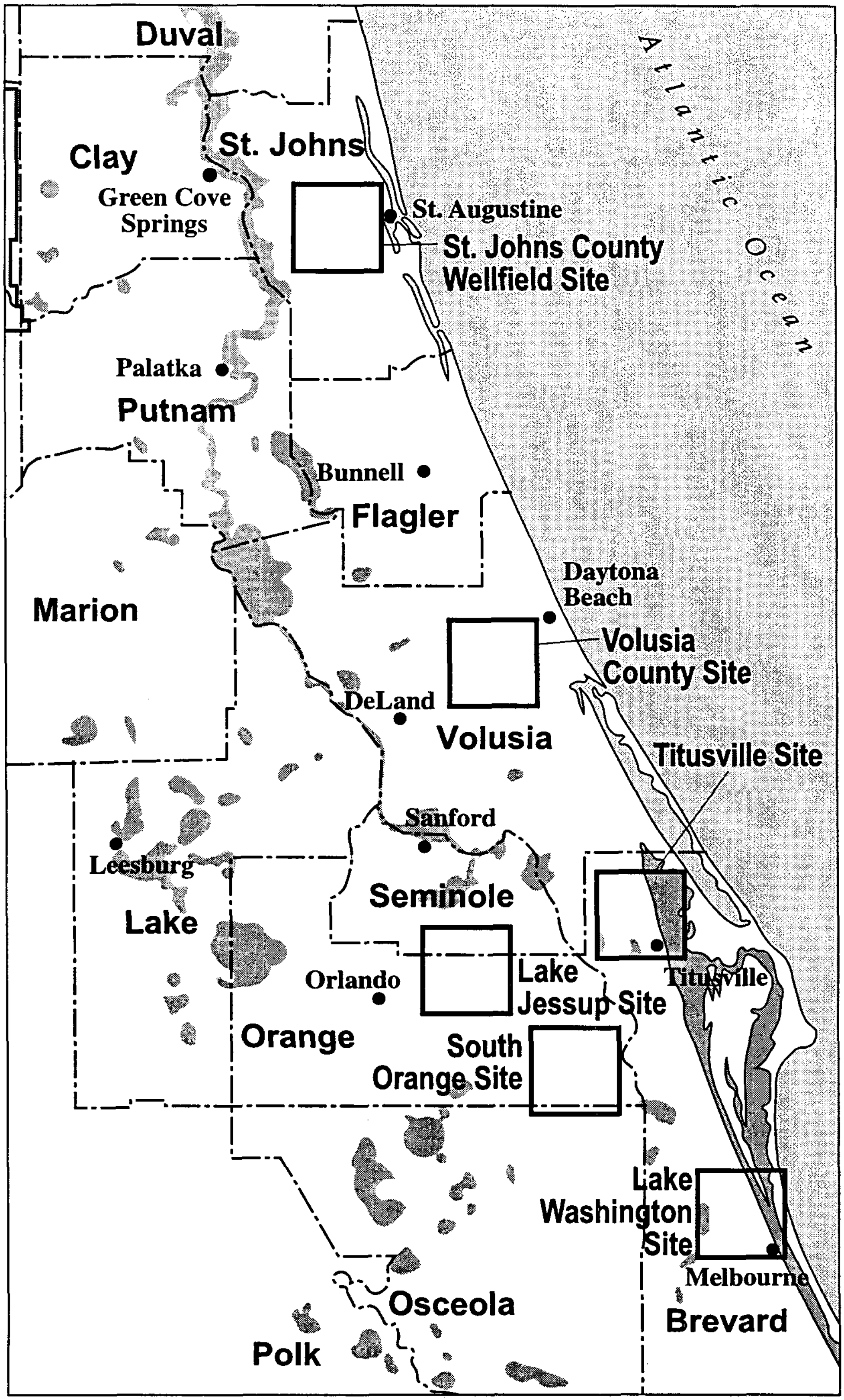

Figure 1. Location of the Candidate Brackish Ground Water Withdrawal Sites.

water quality deterioration (with time and pumping rate) could be reduced by increased well spacing.

The sensitivity analysis indicated that well spacing was a very significant variable and that the rate of ground water quality deterioration could be significantly reduced if well spacing were increased. A new source analysis was conducted, based on a 2,500 foot production well spacing, which is the well spacing chosen for all water quality response and cost estimates presented here.

In addition, the water quality conditions at the end of 20 years of pumping were chosen as a basis of system design and costing. This criterion will insure a reasonably long useful life for the constructed brackish ground water facilities.

The source assessment results of most interest to planning level cost estimates were the chloride concentrations expected for various pumping rates at the end of 20 years of operations. These data were plotted, and equations fit, to express the expected end-of-period chloride concentration as a function of the long-term average wellfield production rate and the average well pumping rates. Pumping rates of 750, 1,000 and 1,250 gallons per minute (gpm) were evaluated in the source analysis, and equations for each pumping rate were developed for each candidate withdrawal site. These equations were plotted for each site and are presented in this TM. The intermediate pumping rate (1,000 gpm) was chosen as a basis for estimating end-of-period chloride concentrations and facilities costs.

CHLORIDE-TDS RELATIONSHIP

Chloride was tracked in the source assessment solute transport simulation because the distribution of chlorides throughout the Floridan aquifer is better known than the distribution of other constituents of interest, including total dissolved solids (TDS). However, in brackish ground water desalting applications, TDS is often the constituent that controls the required degree of desalting. Reverse osmosis (RO) treatment costs are often estimated as a function of the feedwater TDS concentration. Therefore, an estimate of expected end-of-period TDS concentration is needed to estimate treatment requirements and costs. Expected TDS is estimated as a function of chloride concentration by application of the following equation:

$$TDS = 1.78*Cl + 297 \qquad (1)$$

Where:

TDS = Expected TDS concentration, in mg/L

Cl = Chloride concentration, in mg/L

This equation was developed by regression analysis of concurrent observations of TDS and chloride concentrations in the Floridan aquifer within SJRWMD. Based on this equation, feedwater can be expected to exceed the 500 mg/L secondary DWS for TDS when the chloride concentration is about 114 mg/L.

In the brackish ground water treatment technology assessment (TM D.2.c, CH2M HILL, 1997) feedwater was classified as slightly brackish, moderately brackish, highly brackish, and saline according to chloride and TDS concentrations. This classification is used to establish levels of necessary treatment and RO system performance. Performance parameters of interest in cost estimating include salt removal efficiency and recovery efficiency. The salt removal efficiency defines the expected level of salt reduction in the finish water, and the recovery efficiency defines the expected percentage of feedwater that becomes finish water. Conversely, that portion of the feedwater that is not finish water becomes waste concentrate. The feedwater classification system and RO performance parameters used in the development of desalting system cost estimates are presented in Table 1.

EXPECTED WATER QUALITY AT CANDIDATE SITES

Lake Washington Site

The end-of-period Cl concentration as a function of individual well pumping rate and average wellfield production for the Lake Washington site is presented in Figure 2. Generally, the values of the end-of-period Cl concentration indicate that the drinking water standard for chlorides is exceeded for all combinations of wellfield pumping and individual well pumping rates.

For the purpose of the preliminary desalting system cost estimates, design feedwater Cl concentration for the Lake Washington site is based on an average pumping rate of 1,000 gpm and is estimated by applying the following equation, as illustrated in Figure 2:

$$Cl = 10.8*(Q) + 235 \qquad (2)$$

Table 1. Feedwater Quality Classification and RO Performance Criteria

Feedwater Classification	Cl	TDS	Salt Removal %	Recovery %
Slightly Brackish	250-500	500-1,000	90	85
Moderately Brackish	500-2000	1,000-4,000	90	80
Highly Brackish	2,000-5,000	4,000-10,000	90	70
Saline	>5,000	>10,000	99	45

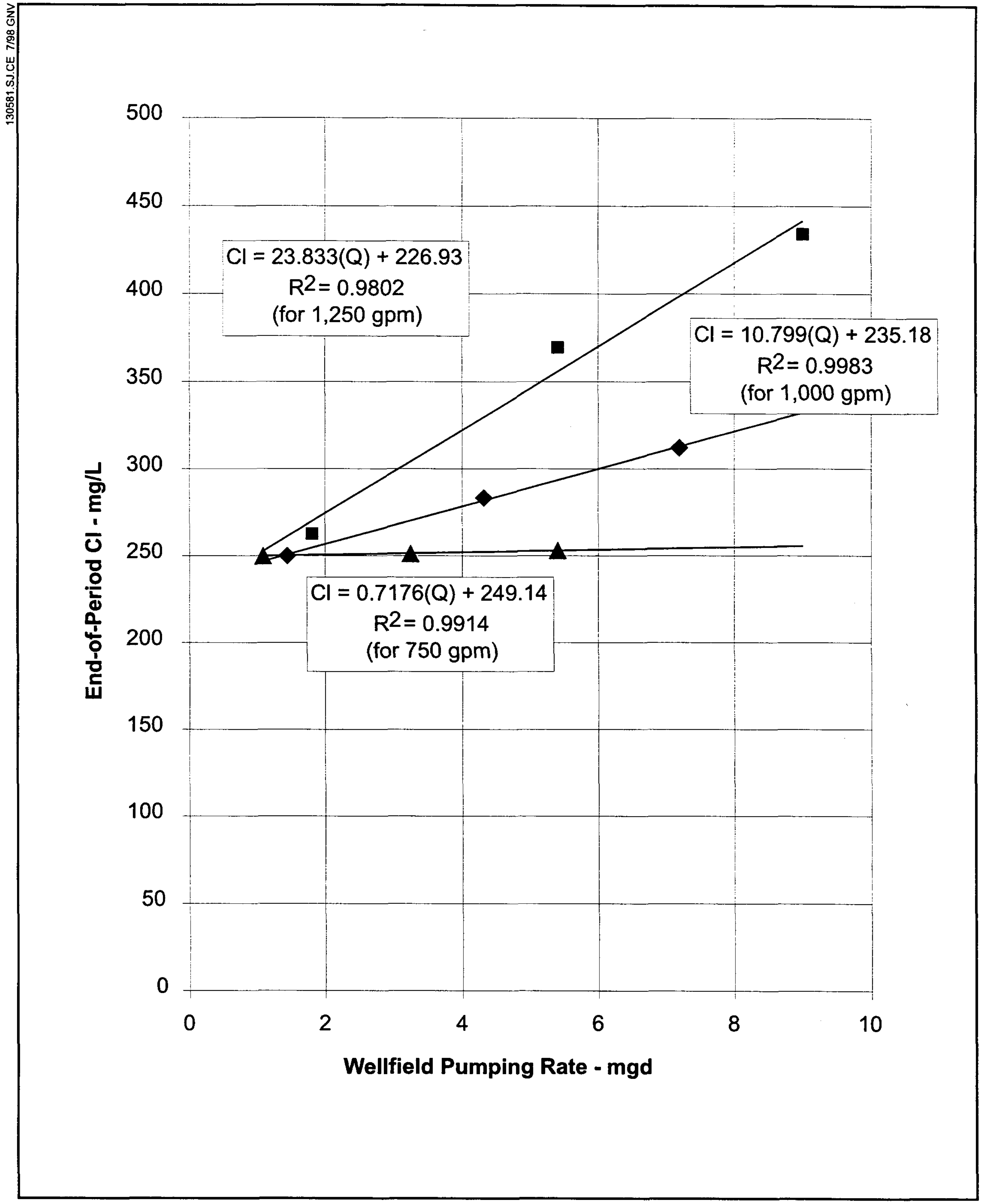

Figure 2. Lake Washington End-of-Period Cl as a Function of Well Pumping Rate and Wellfield Production.

Where:

Cl = Expected feedwater chloride concentration after 20 years of operation, in mg/L

Q = Average wellfield production rate during 20 year operation period, in mgd

For example, consider a wellfield designed to provide an average day yield of 7 mgd. Application of equation 2 indicates that the expected end-of-period Cl concentration will be about 311 mg/L. Application of equation 1 then provides an estimate of end-of-period TDS concentration of about 851 mg/L. These water quality estimates indicate that the design feedwater will be slightly brackish. Therefore, from Table 1, RO salt removal will be 90 percent and finish water recovery will be 85 percent. This means that the 7-mgd feedwater wellfield would produce about 5.95 mgd of finish water and 1.05 mgd of waste concentrate, if completed RO treatment were provided. Feedwater characteristics and RO performance for other production rates can be estimated in a similar manner.

Titusville Site

The end-of-period Cl concentration as a function of well pumping rate and wellfield production for the Titusville site is presented in Figure 3. Like the Lake Washington Site results, the predicted end-of-period Cl concentrations indicate that the primary drinking water standard for chlorides is exceeded for all combinations of wellfield pumping and individual well pumping rates.

Considering the lowest pumping rate evaluated (750 gpm), the predicted end-of-period water quality change with increased wellfield pumping is negligible. Feedwater is currently slightly brackish and is expected to remain slightly brackish in the future. At the 1,000 gpm pumping rate, the feedwater quality is expected to degrade slightly with increased wellfield pumping. For wellfield pumping rates greater than about 6 mgd, moderately brackish feedwater (TDS > 1,000 mg/L) could be expected after 20 years of operation.

Considering the 1,250 gpm pumping rate, the expected change in feedwater quality after 20 years of operation is much greater. Moderately brackish feedwater could be expected for wellfield pumping rates greater than about 3 mgd.

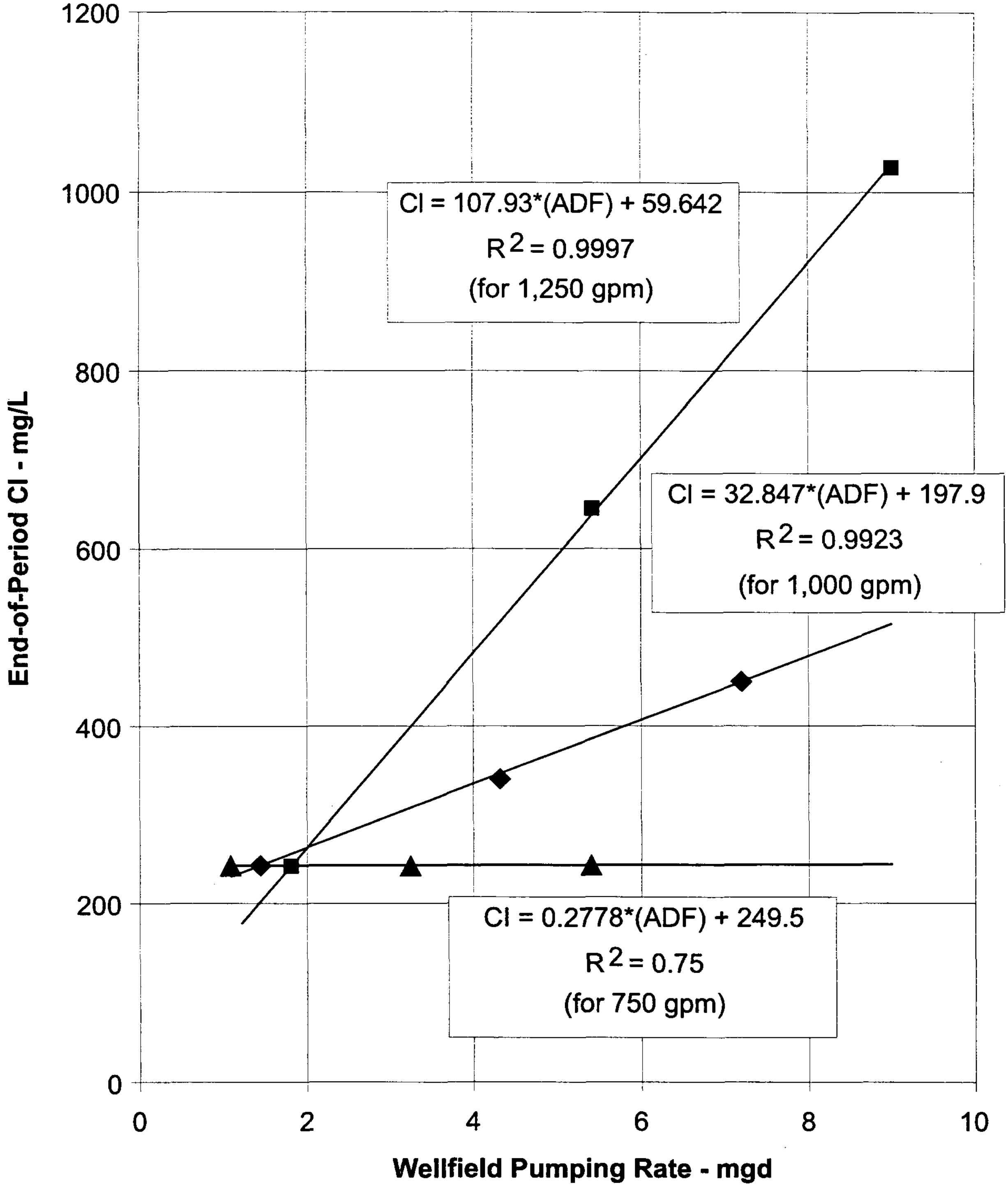

Figure 3. Titusville End-of-Period Cl as a Function of Well Pumping Rate and Wellfield Production.

South Orange County Site

For the South Orange County site, the end-of-period Cl concentration as a function of well pumping rate and wellfield production is presented in Figure 4. In this case, the expected Cl concentration will remain within drinking water standards for small wellfield production rates but will exceed standards as wellfield production rates increase. Expected TDS concentration will exceed secondary drinking water standards at all production rates. Therefore, some desalting would be required to develop this site.

Volusia Site

For the Volusia site, the end-of-period Cl concentration as a function of well pumping rate and wellfield production is presented in Figure 5. At the 750-gpm well pumping rate, the raw water will remain within drinking water standards for both Cl and TDS for production rates of about 8 mgd or less. Beyond that, some desalting would be required.

At the 1,000-gpm average well pumping rate, the end-of-period Cl and TDS concentrations are expected to remain within drinking water standards when the wellfield pumping rate is less than about 3 mgd.

St. Johns Site

The St. Johns County site end-of-period Cl concentration as a function of well pumping rate and wellfield production is presented in Figure 6. Although expected Cl concentrations will remain within drinking water standards for some combination of well pumpage and wellfield production, the expected TDS concentration would exceed secondary drinking water standards at all production rates. Therefore, some desalting would be required to develop this site.

Lake Jessup Site

The Lake Jessup site end-of-period Cl concentration as a function of well pumping rate and wellfield production is presented in Figure 7. The expected water quality response at the Lake Jessup site is similar to the Volusia site.

At the 750-gpm well pumping rate, the raw water will remain within drinking water standards for both Cl and TDS for production rates of about 8 mgd or less. Beyond that some desalting would be required.

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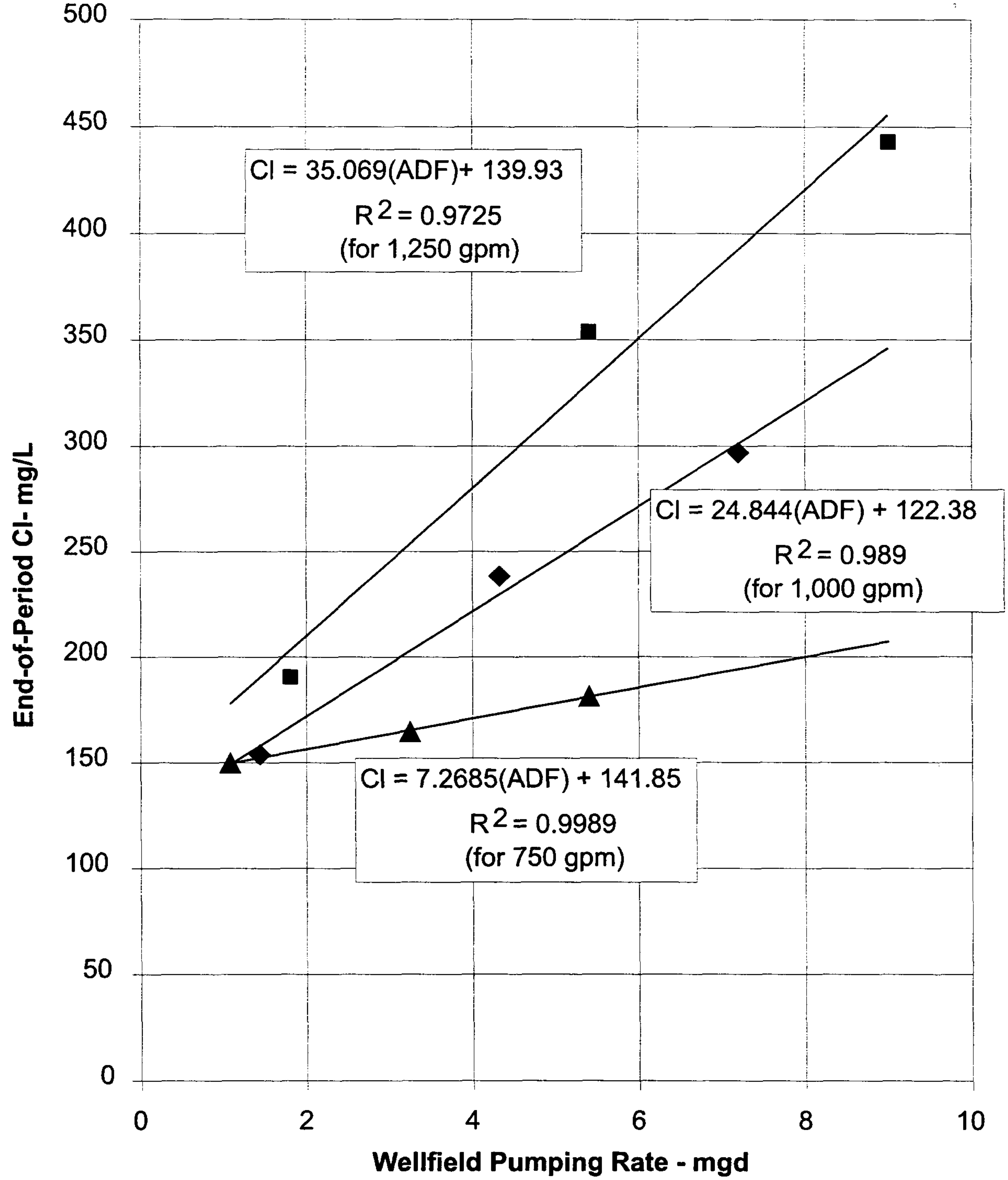

Figure 4. South Orange County End-of-Period Cl as a Function of Well Pumping Rate and Wellfield Production.

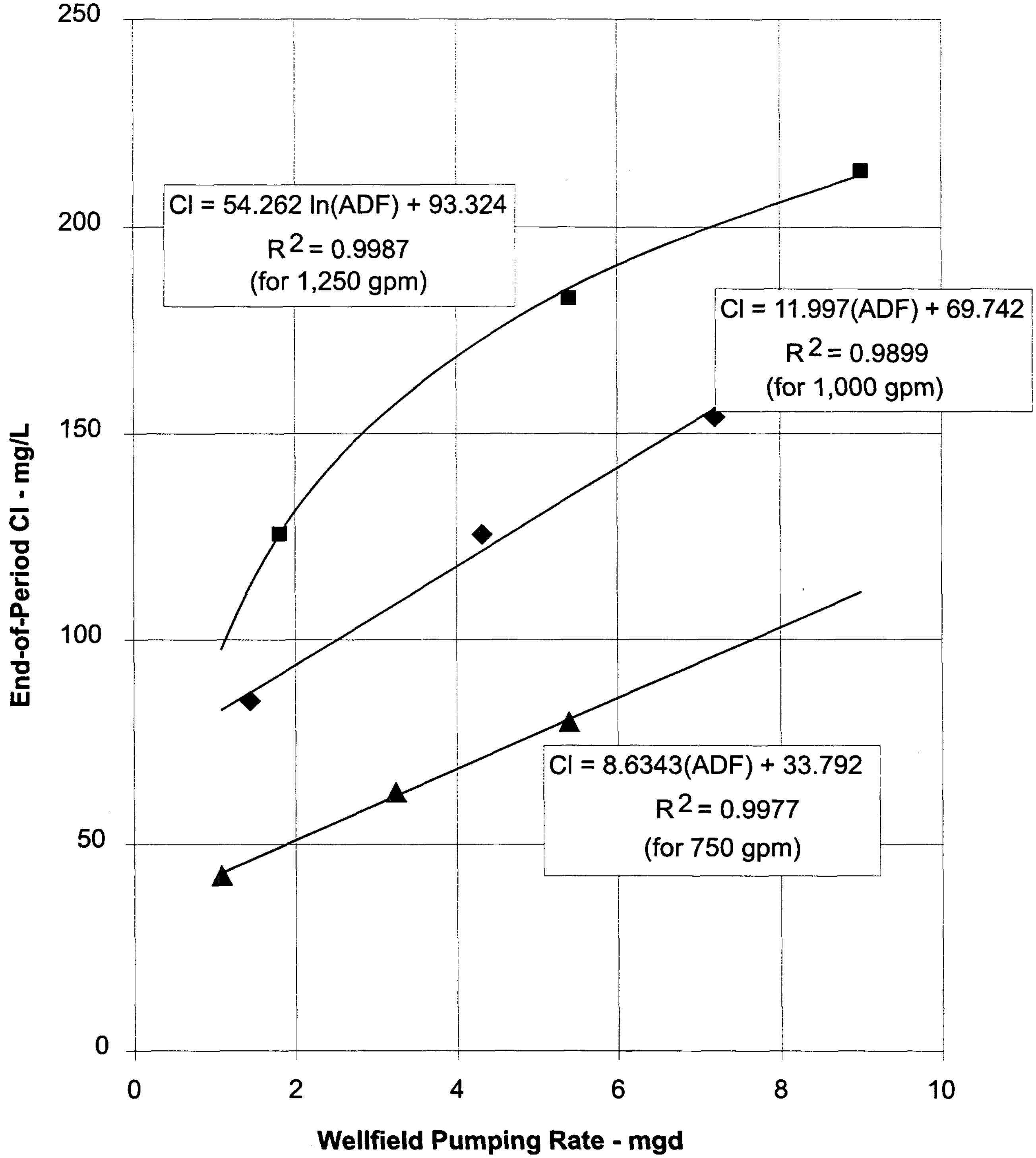

Figure 5. Volusia End-of-Period Cl as a Function of Well Pumping Rate and Wellfield Production.

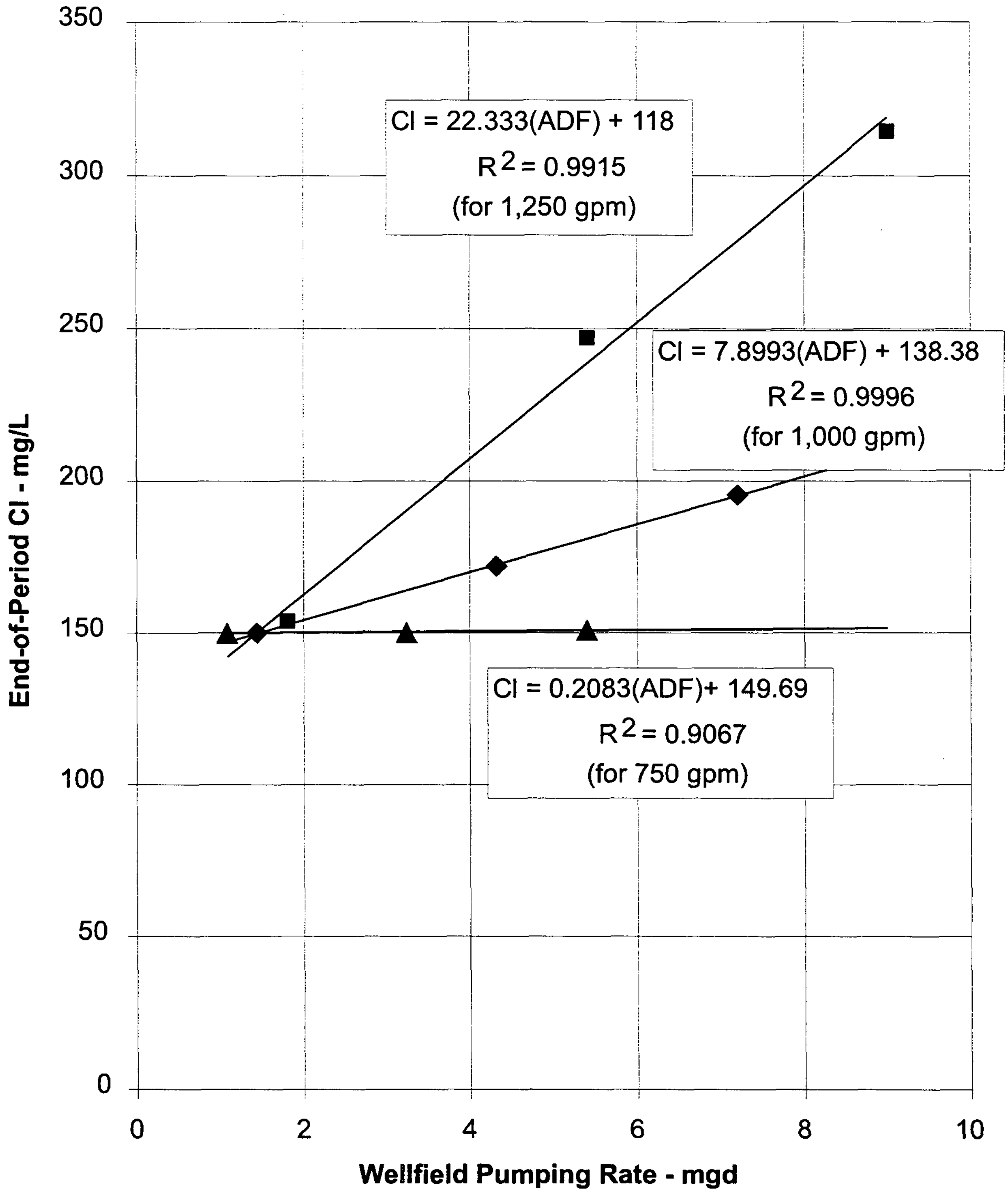

Figure 6. St. Johns End-of-Period Cl as a Function of Well Pumping Rate and Wellfield Production.

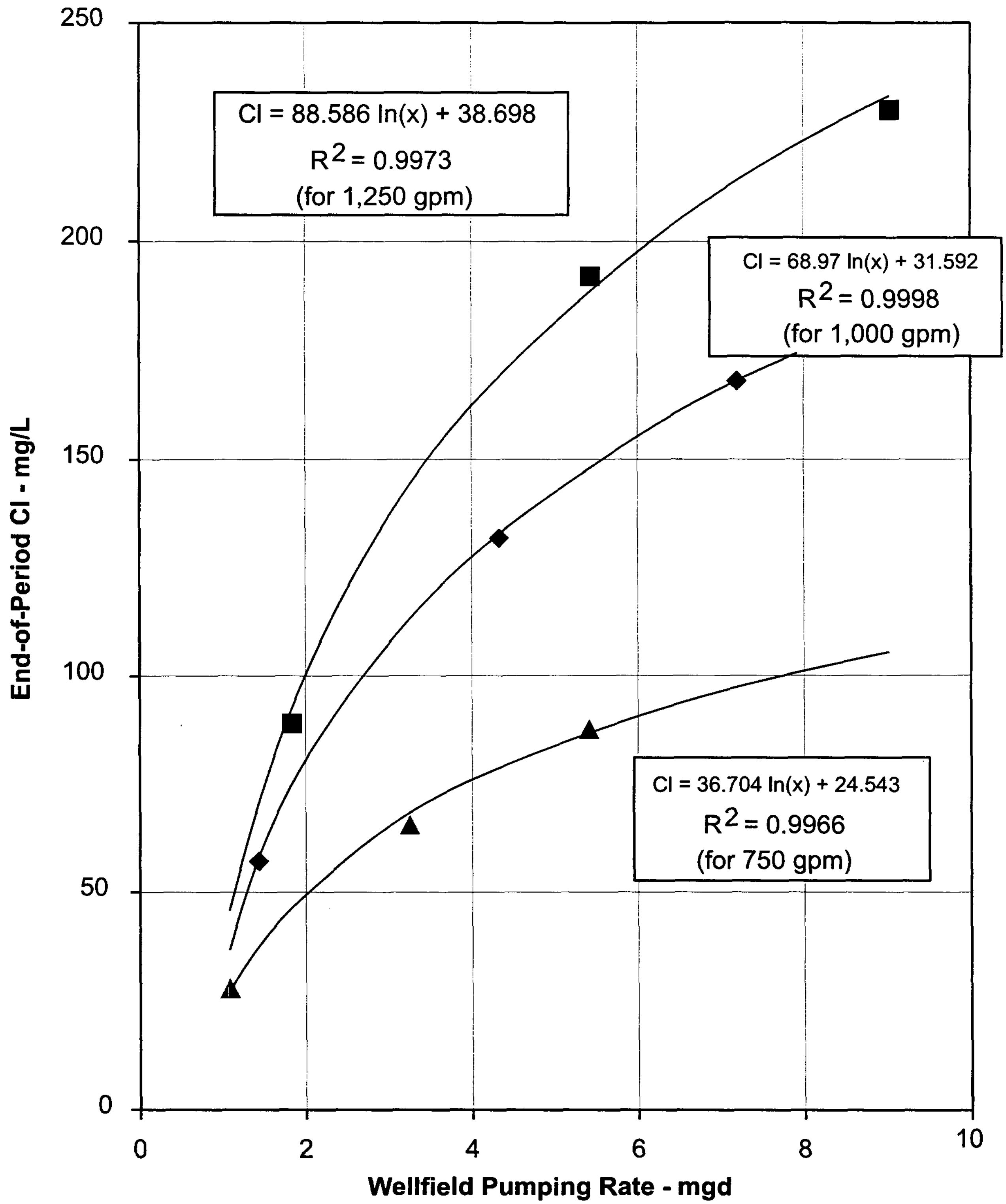

Figure 7. Lake Jessup End-of-Period Cl as a Function of Well Pumping Rate and Wellfield Production.

At the 1,000-gpm average well pumping rate, the end-of-period Cl and TDS concentrations are expected to remain within drinking water standards when the wellfield pumping rate is less than about 3 mgd.

TREATMENT REQUIREMENTS AND COSTS

Brackish ground water cost estimates and equations were developed in a manner similar to the surface water source costs previously developed. A complete set of planning level cost estimates has been developed for each candidate withdrawal site, and each of the cost parameters of interest. Cost parameters include construction cost, capital cost, O&M cost, equivalent annual cost and unit cost. Previously established water supply component cost data (Law Engineering, 1997) were used to the greatest extent possible. All annual cost estimates were developed in accordance with previously established economic criteria, and all costs are expressed in 1996 dollars.

Certain design conditions were held constant at each of the candidate brackish ground water withdrawal sites to ensure that the costs are comparable between candidate withdrawal sites and that the brackish ground water alternative is economically comparable to other water supply alternatives such as surface water. Parameters held constant include the following:

- Maximum Day Flow (MDF) = 1.5 * Average Day Flow (ADF)
- ADF pumping rate = 1,000 gpm/well
- Well spacing = 2,500 feet
- Concentrate disposal via injection well
- Desalting treatment requirements based on expected water quality after 20 years of operation, as established by SJRWMD solute transport modeling

Cost functions relating water supply capacity in terms of ADF to costs were developed from cost estimates of the individual water system. Cost functions are developed for the following costs parameters:

- Construction
- Capital
- O&M
- Equivalent annual
- Unit

All other cost parameters of interest may be computed directly from these cost equations. For example, land cost can be computed from the estimated capital cost and construction cost. Based on the previously established cost estimating and economic analysis criteria, the relationship between construction cost, land cost and capital cost is as follows:

Capital cost = 1.45 * construction cost + 1.25 * land cost

Therefore, given an estimate of capital cost and construction cost, land cost can be computed as follows:

Land cost = (capital cost - 1.45 * construction cost)/1.25

These relationships are applicable for all brackish ground water supply system cost equations developed and presented in this TM. The major component cost equations will be used in the University of Florida Decision Model to represent the costs of the brackish ground water alternative for each of the candidate withdrawal sites.

Cost estimates were developed for an array of water supply yields for each of the six candidate brackish ground water withdrawal sites. Estimates were developed for both blending systems and complete desalting systems. In all cases, a linear cost equation was fit to the cost estimates. These linear cost equations can be used to obtain estimates of the desired cost parameters as a function of the water supply yield or demand met. All cost equations are of the following general form.

$$COST_i = m_i(ADF) + b_i \quad (2)$$

Where:

$COST_i$ = Planning level cost estimate, for cost parameter i

m_i = Slope of linear cost equation, for cost parameter i

b_i = Intercept of linear cost equation, for cost parameter i

The cost equation coefficients for each candidate withdrawal site will be discussed in greater detail later. The individual cost estimates as well as plots of the estimated costs and the cost equations are presented in Appendixes A through F, for each candidate brackish ground water withdrawal site.

BRACKISH GROUND WATER DEVELOPMENT OPTIONS

Brackish ground water can be developed in a variety of ways. The least expensive option is to construct a wellfield and minimum treatment facilities, without desalting, and to blend this treated but highly mineralized water with an existing high-quality water supply so that the blended flow meets all DWS. Such opportunities are utility-specific and depend on the quality of the existing water supply as well as on the quality of the brackish water source. Only limited quantities can be developed in this manner.

The most expensive method for developing a brackish ground water source is complete desalting. In such a system, all feedwater is treated by RO and 90 percent of the feedwater salts are removed from the product water.

A third option is a combination of the above. In this case, brackish ground water is not blended with an existing fresh water source, nor is all feedwater desalted. A combination of blending and RO treatment is used to produce product water that meets all DWS but minimizes the amount of expensive desalting provided.

Given this wide array of brackish ground water development options, cost equations were developed for two different sets of conditions. These are termed blending systems and desalting systems. These cost equations can be used individually or in combination to establish planning level cost estimates for each of the brackish ground water development options.

LAKE WASHINGTON SITE

Table 2 presents design parameters used in developing brackish ground water development cost estimates for the Lake Washington site. The system design parameters are shown as a function of wellfield ADF capacity. For each wellfield capacity considered, the expected feedwater chloride and TDS concentration is shown. These values are computed as previously discussed (from Figure 2 and Equation 1) and represent expected feed water quality at the end of 20 years of operations and an average withdrawal rate of 1,000 gpm per well. The feedwater quality defines the feedwater classification. The design TDS concentration used to develop the cost estimates is then listed, along with expected RO performance, expressed in terms of salt removal and finish water recovery percentage. The final two columns of Table 2 present the expected finish water ADF and TDS concentration based on complete RO treatment.

Using the design and performance parameters given in Table 2 cost estimates for individual blending and desalting systems were developed. The individual estimates were then used to develop the Lake Washington site cost equations. The resulting cost equation coefficients for the Lake Washington site are presented in Table 3.

Table 2. Lake Washington Brackish Ground Water Design Parameters

Wellfield ADF Capacity (mgd)	Feedwater Cl Concentration (mg/L)	Feedwater TDS Concentration* (mg/L)	Feedwater Classification	Design TDS Concentration (mg/L)	Salt Removal (percent)	Recovery (Percent)	Finish Water Yield (ADF) (mgd)	Finish Water TDS (mg/L)
1	246	735	Slightly Brackish	1,000	90	85	0.85	73
2	257	754	Slightly Brackish	1,000	90	85	1.7	75
4	278	792	Slightly Brackish	1,000	90	85	3.4	79
7	311	850	Slightly Brackish	1,000	90	85	5.95	85
15	397	1,004	Moderately Brackish	1,500	90	80	12	100
25	505	1,196	Moderately Brackish	1,500	90	80	20	120
50	775	1,677	Moderately Brackish	2,000	90	80	40	168

* Concentrations after 20 years of operation

Cl = 235 + 10.8*(ADF) (for well flow rate = 1,000 gpm)

Table 3. Brackish Ground Water Cost Equation Coefficients for the Lake Washington Site

Water Supply System Type	Cost Parameter	m	b
Blending	Construction	416,000	1,245,000
	Capital	614,000	1,872,000
	O&M	45,800	52,000
	Equivalent Annual	95,500	214,200
Desalting	Construction	1,420,000	4,144,000
	Capital	2,073,000	6,073,000
	O&M	324,600	477,100
	Equivalent Annual	555,200	1,064,000

m Slope of cost equation

b Intercept of cost equation

These equations are for a production well spacing of 2,500 feet and an average daily flow per well of 1,000 gallons per minute. The desalting system costs include concentrate disposal well(s).

Appendix A presents the individual Lake Washington site cost estimates and linear cost equations. The Lake Washington site is slightly to moderately brackish for all withdrawal rates; therefore, all equations apply throughout their entire range.

TITUSVILLE SITE

The Titusville site brackish ground water design parameters are presented in Table 4. The content and format of this table is the same as Table 2, which presents the Lake Washington site design parameters.

Using the water supply system design and performance parameters given in Table 4, cost estimates for individual blending and desalting systems were developed. The individual estimates were then used to develop the Titusville site cost equations. The resulting cost equation coefficients for the Titusville site are presented in Table 5. These equations are for a production well spacing of 2,500 feet and an average daily flow per well of 1,000 gallons per minute. The desalting system costs include concentrate disposal well(s).

This site is slightly to moderately brackish for all withdrawal rates. Therefore, the Titusville site cost equations, presented in Appendix B and summarized in Table 5, apply throughout their entire range.

SOUTH ORANGE COUNTY SITE

The South Orange County brackish ground water design parameters are presented in Table 6. The design is based on the 1,000 gpm intermediate pumping rate.

Using the water supply system design and performance parameters given in Table 6, cost estimates for individual blending and desalting systems were developed. The individual estimates were then used to develop the South Orange County site cost equations. The resulting cost equation coefficients for the South Orange County site are presented in Table 7.

Table 4. Titusville Brackish Ground Water Design Parameters

Wellfield ADF Capacity (mgd)	Feedwater Cl Concentration* (mg/L)	Feedwater TDS Concentration* (mg/L)	Feedwater Classification	Design TDS Concentration (mg/L)	Salt Removal (Percent)	Recovery (Percent)	Finish Water Yield (ADF) (mgd)	Finish Water TDS (mg/L)
1	231	708	Slightly Brackish	1,000	90	85	0.85	71
2	264	767	Slightly Brackish	1,000	90	85	1.7	77
3	297	825	Slightly Brackish	1,000	90	85	2.55	83
7	428	1,059	Moderately Brackish	1,200	90	80	5.6	106
15	692	1,528	Moderately Brackish	1,700	90	80	12	153
25	1,021	2,113	Moderately Brackish	2,500	90	80	20	211
50	1,843	3,578	Moderately Brackish	4,000	90	80	40	358

* Concentrations after 20 years of operation

Cl = 32.9*(ADF) + 198 (for well flow rate = 1,000 gpm)

Table 5. Brackish Ground Water Cost Equation Coefficients for the Titusville Site

Water Supply System Type	Cost Parameter	m	b
Blending	Construction	403,000	1,219,000
	Capital	596,000	1,835,000
	O&M	45,800	52,000
	Equivalent Annual	94,000	211,200
Desalting	Construction	1,592,000	3,583,000
	Capital	2,321,000	5,286,000
	O&M	318,200	655,200
	Equivalent Annual	578,800	1,152,000

Table 6. South Orange County Brackish Ground Water Design Parameters

Wellfield ADF Capacity (mgd)	Feedwater Cl Concentration* (mgd)	Feedwater TDS Concentration* (mgd)	Feedwater Classification	Design TDS Concentration (mgd)	Salt Removal (percent)	Recovery (percent)	Finish Water Yield (ADF) (mgd)	Finish Water TDS (mgd)
1	147	559	Slightly Brackish	1,000	90	85	0.85	56
2	172	603	Slightly Brackish	1,000	90	85	1.7	60
4	222	691	Slightly Brackish	1,000	90	85	3.4	69
7	296	824	Slightly Brackish	1,000	90	85	5.95	82
15	494	1,177	Moderately Brackish	1,500	90	80	12	118
25	742	1,618	Moderately Brackish	2,000	90	80	20	162
50	1,362	2,722	Moderately Brackish	3,000	90	80	40	272

* Concentrations after 20 years of operation

Cl = 24.8(ADF) + 122.4 (for well flow rate = 1,000 gpm)

Table 7. Brackish Ground Water Cost Equation Coefficients for the South Orange County Site

Water Supply System Type	Cost Parameter	m	b
Blending	Construction	404,600	1,222,000
	Capital	598,000	1,839,000
	O&M	45,800	52,000
	Equivalent Annual	94,200	211,500
Desalting	Construction	1,517,000	3,629,000
	Capital	2,214,000	5,326,000
	O&M	324,600	477,100
	Equivalent Annual	572,500	977,100

These equations are for a production well spacing of 2,500 feet and an average daily flow per well of 1,000 gpm. The desalting system costs include concentrate disposal well(s).

Appendix C presents the South Orange County site cost estimates and linear cost equations. This site is also slightly to moderately brackish for all withdrawal rates; therefore, all equations apply throughout their entire range.

VOLUSIA SITE

The Volusia site brackish ground water design parameters are presented in Table 8. The design is based on the 1,000 gpm intermediate pumping rate.

Using the water supply system design and performance parameters given in Table 8, cost estimates for individual blending and desalting systems were developed. The individual estimates were then used to develop the Volusia site cost equations. The resulting cost equation coefficients for the Volusia site are presented in Table 9.

These equations are for a production well spacing of 2,500 feet and an average daily flow per well of 1,000 gpm. The desalting system costs include concentrate disposal well(s).

Appendix D presents the Volusia site cost estimates and linear cost equations. In this case, for small yields (less than about 3 mgd), and a 1,000 gpm average pumping rate, the feedwater will meet DWS with no desalting required. Therefore, the desalting equations are applicable only for water supply yields greater than about 3 mgd. The blending system cost equations are applicable over their entire range.

ST. JOHNS COUNTY SITE

The St. Johns County site brackish ground water design parameters are presented in Table 10. The design is based on the 1,000 gpm intermediate pumping rate.

Using the water supply system design and performance parameters given in Table 10, cost estimates for individual blending and desalting systems were developed. The individual estimates were then used to develop the St. Johns County site cost equations. The resulting cost equation coefficients for the St. Johns County site are presented in Table 11.

Table 8. Volusia Brackish Ground Water Design Parameters

Wellfield ADF Capacity (mg/L)	Feedwater Cl Concentration* (mg/L)	Feedwater TDS Concentration* (mg/L)	Feedwater Classification	Design TDS Concentration (mg/L)	Salt Removal (percent)	Recovery (percent)	Finish Water Yield (ADF) (mg/L)	Finish Water TDS (mg/L)
1	82	442	Fresh	na	Na	95	0.95	442
2	94	464	Fresh	na	Na	95	1.9	464
4	118	507	Slightly Brackish	1,000	90	85	3.4	51
7	154	571	Slightly Brackish	1,000	90	85	5.95	57
15	250	741	Slightly Brackish	1,000	90	85	12.75	74
25	370	955	Slightly Brackish	1,000	90	85	21.25	96
50	670	1,489	Moderately Brackish	1,500	90	80	40	149

* Concentrations after 20 years of operation

Cl = 12(ADF) + 69.7 (for well flow rate = 1,000 gpm)

Table 9. Brackish Ground Water Cost Equation Coefficients for the Volusia Site

Water Supply System Type	Cost Parameter	m	b
Blending	Construction	401,300	1,216,000
	Capital	593,000	1,831,000
	O&M	45,800	52,000
	Equivalent Annual	93,800	210,800
Desalting	Construction	1,301,000	4,578,000
(for ADF> 3mgd)	Capital	1,899,000	6,720,000
	O&M	317,100	673,100
	Equivalent Annual	528,100	1,349,000

Table 10. St. Johns County Brackish Ground Water Design Parameters

Wellfield ADF Capacity (mgd)	Feedwater Cl Concentration* (mgd)	Feedwater TDS Concentration* (mgd)	Feedwater Classification	Design TDS Concentration (mgd)	Salt Removal (Percent)	Recovery (Percent)	Finish Water Yield (ADF) (mgd)	Finish Water TDS (mgd)
1	146	557	Slightly Brackish	1,000	90	85	0.85	56
2	154	571	Slightly Brackish	1,000	90	85	1.7	57
3	162	586	Slightly Brackish	1,000	90	85	2.55	59
7	194	642	Slightly Brackish	1,000	90	85	5.95	64
15	257	754	Slightly Brackish	1,000	90	85	12.75	75
25	336	895	Slightly Brackish	1,000	90	85	21.25	89
50	533	1,246	Moderately Brackish	1,500	90	80	40	125

* Concentrations after 20 years of operation
Cl = 7.9(ADF)+138.4 (for well flow rate 1,000 gpm)

Table 11. Brackish Ground Water Cost Equation Coefficients for the Volusia Site

Water Supply System Type	Cost Parameter	m	b
Blending	Construction	412,700	1,239,000
	Capital	609,800	1,864,000
	O&M	45,800	52,000
	Equivalent Annual	95,100	213,500
Desalting	Construction	1,331,000	4,131,000
	Capital	1,945,000	6,053,000
	O&M	324,500	464,500
	Equivalent Annual	540,600	1,052,000

These equations are for a production well spacing of 2,500 feet and an average daily flow per well of 1,000 gallons per minute. The desalting system costs include concentrate disposal well(s).

Appendix E presents the St. Johns County site cost estimates and linear cost equations. Like Lake Washington, Titusville, and South Orange County, this site is slightly to moderately brackish for all withdrawal rates; therefore, all equations apply throughout their entire range.

LAKE JESSUP SITE

The Lake Jessup site brackish ground water design parameters are presented in Table 12. The design is based on the 1,000 gpm intermediate pumping rate.

Using the water supply system design and performance parameters given in Table 12, cost estimates for individual blending and desalting systems were developed. The individual estimates were then used to develop the Lake Jessup site cost equations. The resulting cost equation coefficients for the Lake Jessup site are presented in Table 13.

These equations are for a production well spacing of 2,500 feet and an average daily flow per well of 1,000 gpm. The desalting system costs include concentrate disposal well(s).

Appendix F presents the Lake Jessup site cost estimates and linear cost equations. In this case, for small yields (less than about 3 mgd), the feedwater will meet DWS with no desalting required. Therefore, like the Volusia site, the desalting equations are applicable only for water supply yields greater than about 3 mgd. The blending system cost equations are applicable over their entire range.

CONCENTRATE DISPOSAL

For the purpose of developing complete planning level cost equations, it was assumed that waste concentrate disposal would be accomplished by deep well injection. However, deep wells may not be permissible in all situations, and other options may be more appropriate. Other options, including ocean outfalls or surface water discharge, are opportunity specific and cannot be evaluated at the area-wide planning and alternatives evaluation level. Such options can only be evaluated at the sub-regional or individual utility level.

Table 12. Lake Jessup Brackish Ground Water Design Parameters

Wellfield ADF Capacity (mgd)	Feedwater Cl Concentration* (mgd)	Feedwater TDS Concentration* (mgd)	Feedwater Classification	Design TDS Concentration (mgd)	Salt Removal (percent)	Recovery (percent)	Finish Water Yield (ADF) (mgd)	Finish Water TDS (mgd)
1	32	353	Fresh	na	na	95	0.95	353
2	79	438	Fresh	na	na	95	1.9	438
4	127	524	Slightly Brackish	1,000	90	85	3.4	52
7	166	592	Slightly Brackish	1,000	90	85	5.95	59
15	218	686	Slightly Brackish	1,000	90	85	12.75	69
25	254	749	Slightly Brackish	1,000	90	85	21.25	75
50	302	834	Slightly Brackish	1,000	90	85	42.5	83

* Concentrations after 20 years of operation

Cl = 69*ln(ADF) + 31.6 (for well flow rate 1,000 gpm)

Table 13. Brackish Ground Water Cost Equation Coefficients for the Lake Jessup Site

Water Supply System Type	Cost Parameter	m	b
Blending	Construction	406,200	1,226,000
	Capital	600,500	1,844,000
	O&M	45,800	52,000
	Equivalent Annual	94,400	211,900
Desalting	Construction	1,178,000	5,778,000
(for ADF>3 mgd)	Capital	1,722,000	8,463,000
	O&M	312,000	722,500
	Equivalent Annual	503,000	1,593,000

To adjust cost estimates for other concentrate disposal options, cost equations that relate concentrate disposal well costs as a function of the average concentrate disposal rate (ADF concentrate) were developed. These equations represent the concentrate disposal allowance included in each of the desalting system cost equations.

To evaluate a different concentrate disposal option, the concentrate disposal well costs can then be subtracted from the complete systems costs and the cost of an alternative concentrate disposal option can be added. The format of the concentrate disposal cost equation is as follows:

Cost = m (ADF concentrate) + b

Where:

ADF concentrate = 0.177*ADF for feedwater TDS<1,000 mg/L

ADF concentrate = 0.250*ADF for feedwater TDS>1,000 mg/L

The concentrate disposal cost equation coefficients are presented in Table 14.

As can be seen from the cost equations for each individual candidate brackish ground water withdrawal site, the initial costs of a desalting system are quite large. For example, considering the construction cost of a desalting system for Titusville, the intercept of the linear estimating equation is $3.58 million. Much of this large initial cost is associated with the allowance for a concentrate disposal well. From the Table 14, estimated disposal well construction costs begin at about $2.37 million.

Table 14. Concentrate Disposal Cost Equation Coefficients

Cost Parameter	m	b
Construction	96,100	2,369,000
Capital	139,400	3,435,000
O&M	18,300	0
Equivalent Annual	29,500	276,800

EXAMPLE APPLICATIONS

Two hypothetical brackish ground water supply systems are defined and evaluated in this section to illustrate the correct application of the planning level-cost equations. These examples are derived for illustrative purposes only and are not intended to represent actual alternatives to be evaluated for regional water supply plan development.

Two example applications of the planning cost equations are presented in Tables 15 and 16. Both examples are based on providing a 5-mgd brackish ground water supply at the Lake Washington site.

In the first example (Table 15), a complete desalting system using RO is illustrated. This example is a straightforward application of the linear Lake Washington desalting system cost equations described previously. This application yields an estimated capital cost of $16.4 million and an equivalent annual cost of $3.84 million per year, of which $2.1 million per year is for O&M. The total production cost is about $2.10 per 1,000 gallons.

In this first example, the expected feedwater TDS is 823 mg/L, only slightly brackish. Product water TDS would be 83 mg/L, well within the secondary DWS.

The second example (Table 16) is based on the results of the first. In this case, desalting is provided for only a portion of the raw water supply and a blending system is provided for the remainder. A target TDS concentration of 450 mg/L (90 percent of the secondary DWS) is selected for the combined product water. Assuming a TDS of 83 mg/L for the desalted portion, a TDS of 828 mg/L for the blending portion, and a target product water quality of 450 mg/L, the required blending ratio (fraction of product water treated by RO) is estimated to be 0.51. That is, 51 percent of the raw water will be treated by RO and 49 percent will be blended.

The cost of this system will be lower than the complete desalting system. Capital cost is estimated to be $14.7 million (a $1.7 million reduction). The annual cost drops to $2.93 million per year largely because the O&M requirements are reduced to about $1.47 million per year. The total production cost is $1.60 per 1,000 gallons, a savings of $0.50 per 1,000 gallons. These are significant savings compared to the complete desalting option.

Table 15. Lake Washington Example Cost Estimates—Complete Desalting System Example 1—Cost of a 5-mgd RO System

Facility Costs	
Capital Cost = 2,073,000*ADF + 6,073,000 =	$16,438,000
Annual Cost = 555,200*ADF + 1,064,000 =	$ 3,840,000
O&M Cost = 324,600*ADF + 477,100 =	$ 2,100,100
Total Production cost =	$2.104 per 1,000 gallons
Unit Costs =	$0.32 per 1,000 gallons
Water Quality	
Feedwater	
Cl = 10.8* (wellfield ADF) + 235 TDS = 1.78*(Cl) + 297	
Assumed RO Recovery = 85 percent (Slightly Brackish) Wellfield ADF = Product ADF/0.85 = 5.88 mgd Cl = 299 mg/L = > Slightly Brackish TDS = 828 mg/L = > Slightly Brackish	OK
Product Water	
Salt Reject = 90 percent	
Cl = 30 mg/L	
TDS = 83 mg/L	

ADF = 5 mgd

Table 16. Lake Washington Example Cost Estimates—Partial Desalting System Example 1—Cost of a 5-mgd RO System

Trial 1 Assumptions:		
Slightly Brackish Feedwater		
	RO Recovery = 85 percent Salt Reject = 90 percent	
	BR = Blending Ratio (fraction of product water treated by RO)	
	BR = (Product Water CL – Feedwater CL) (RO Cl – Feedwater Cl)	
	BR = (450-828) (83-828) = 0.51	
Capacities and Cost		
	RO Plant – ADF = 0.51*(5) =	2.55 mgd
	Blending (Bypass – ADF = 0.49*(5) =	2.45 mgd
	RO Plant	
	Capital Cost = 2,073,000*ADF + 6,073,000 =$11,359,150	
	Annual Cost = 555,200*ADF + 1,064,000 =	$ 2,479,760
	O&M Cost = 324,600*ADF + 477,100	$ 1,304,830
	Bypass (Blending) Plant	
	Capital Cost = 614,000*ADF + 1,872,000 =	$ 3,376,300
	Annual Cost = 95,500*ADF + 214,200 =	$ 448,175
	O&M Cost = 45,800*ADF + 52,000 =	$ 164,210
	Total Facilities Cost	
	Capital Cost =	$14,735,450
	Annual Cost =	$ 2,927,935
	O&M Cost =	$ 1,469,040
	Total Production Cost =	$1.604 per 1,000 gallons
	Unit Cost =	$0.22 per 1,000 gallons
	Assumptions Creek	
	Wellfield ADF = 2.55/0.85 + 2.45 = 5.45 mgd	
	Feedwater Cl = 294 mg/L	
	Feedwater TDS = 820 mg/L	
	Product water TDS = 0.51*820 + (1-.51)*820 = 444 mg/L OK	
	Savings—Compared to Complete RO Treatment	
	Capital Cost = $1,702,550	
	Annual Cost = $ 912,065 per year	
	O&M Cost = $ 631,060 per year	
	Total Production Cost $0.50 per 1,000 gallons	
	Unit Cost = $0.10 per 1,000 gallons	

ADF = 5 mgd
TDS (product) = 450 mg/L

The equations summarized in this TM can be used to estimate the cost of a wide variety of desalting and blending scenarios at each of the candidate brackish ground water withdrawal sites.

SUMMARY AND RECOMMENDATIONS

SUMMARY

A complete set of planning-level brackish ground water supply cost estimating equations has been developed for SJRWMD's Water Supply Alternatives Evaluation Program. The cost equations are applicable to SJRWMD's alternative water supply planning area and include cost equations for complete desalting systems, as well as equations for minimal treatment or blending systems.

The cost equations are applicable only for preliminary area-wide planning, for which they were derived. The treatment cost equations apply to the six selected brackish ground water withdrawal sites and are not directly transferable to other withdrawal sites.

These cost equations can then be used to rapidly develop cost estimates for several brackish ground water alternatives, which can be used to define brackish ground water development costs in the University of Florida Decision Model in subsequent phases of this investigation.

The cost equations presented in this TM can also be used to investigate brackish ground water supply options independent of the University of Florida Decision Model application. Two hypothetical brackish ground water development examples are presented to illustrate proper application of these equations.

All cost estimates and cost equations presented in this TM are planning-level or "cost curve" estimates. These estimates will vary from actual project costs, which are based on detailed designs. Planning-level cost estimates are generally accurate to within plus or minus 50 percent of actual costs for the same design conditions and design criteria.

RECOMMENDATIONS

It is recommended that the cost equations presented in this TM be used as the basis for estimating the cost of brackish ground water supply development in the University of Florida Decision Model application and other area-wide water supply alternative evaluations, where applicable.

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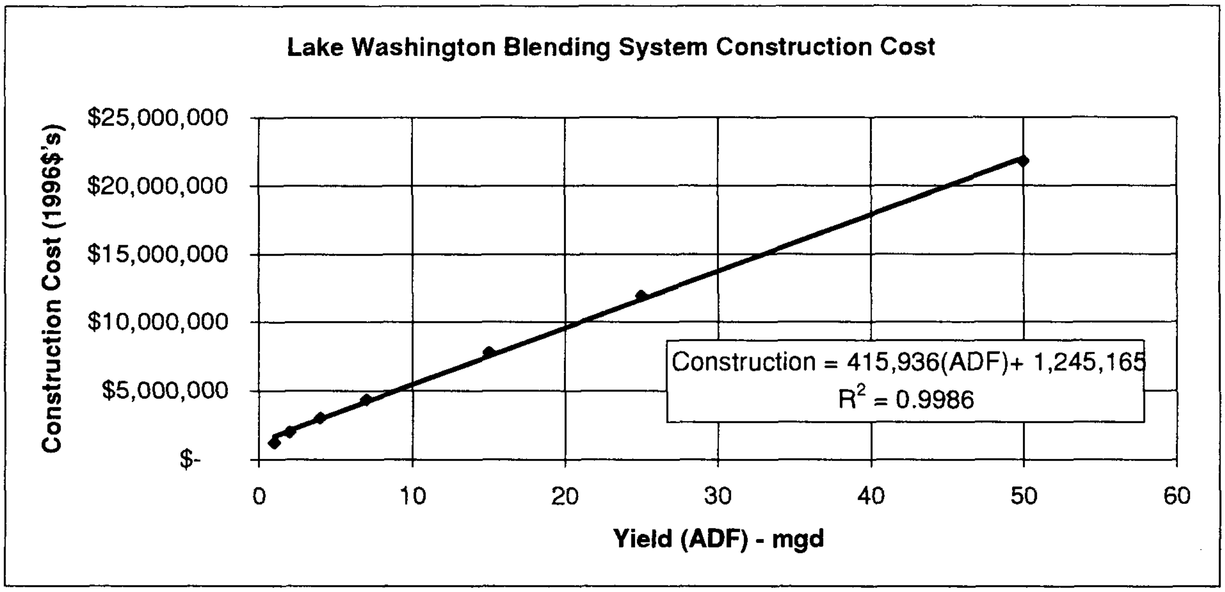
Appendix A
Cost Estimates and Equations for Lake Washington Site

Table A1 - Lake Washington Brackish Ground Water Cost Summary -- Blending System (Wellfield plus Plant)

Yield	Cl	TDS	Construction Cost	Capital Cost	Annual Cost	Production Cost $/1000 gal.	O&M Cost $/year	Unit Cost $/1000 gal
1	246	735	$ 1,225,662	$ 1,826,438	$ 249,712	$ 0.684	$ 97,926	$ 0.115
2	257	754	$ 1,951,666	$ 2,904,853	$ 385,871	$ 0.529	$ 144,087	$ 0.115
4	278	793	$ 2,977,356	$ 4,420,566	$ 604,065	$ 0.414	$ 235,716	$ 0.115
7	311	850	$ 4,326,826	$ 6,431,468	$ 906,733	$ 0.355	$ 372,446	$ 0.115
15	397	1004	$ 7,776,204	$ 11,590,398	$ 1,691,776	$ 0.309	$ 737,919	$ 0.115
25	505	1196	$ 11,910,486	$ 17,597,238	$ 2,636,063	$ 0.289	$ 1,196,241	$ 0.115
50	775	1677	$ 21,805,404	$ 32,243,791	$ 4,955,213	$ 0.272	$ 2,342,046	$ 0.115



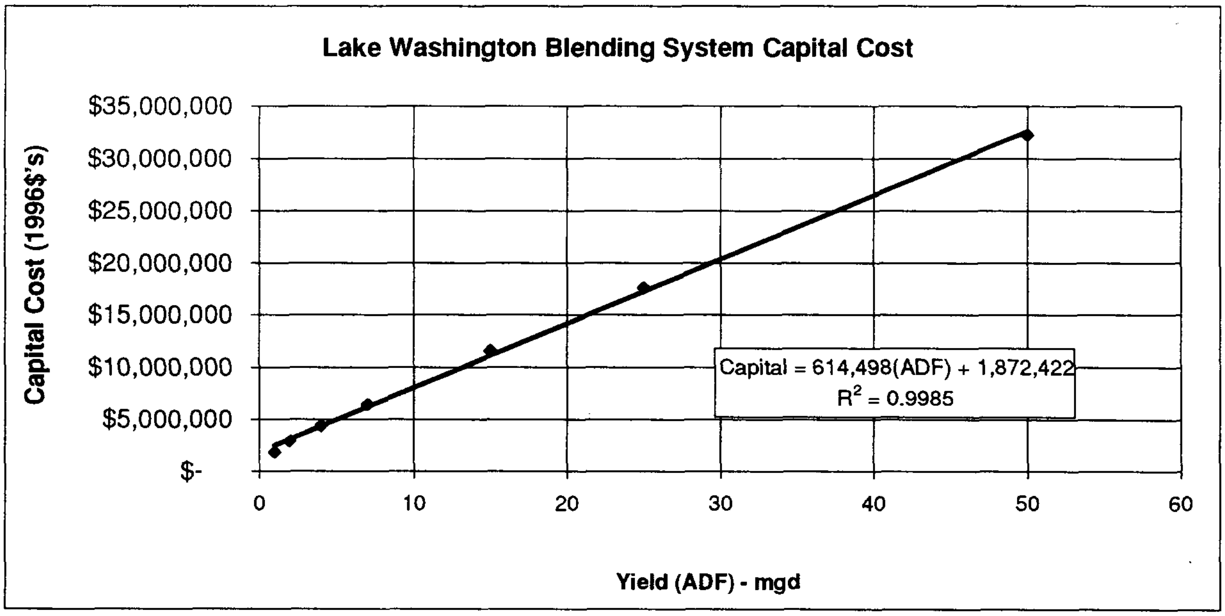
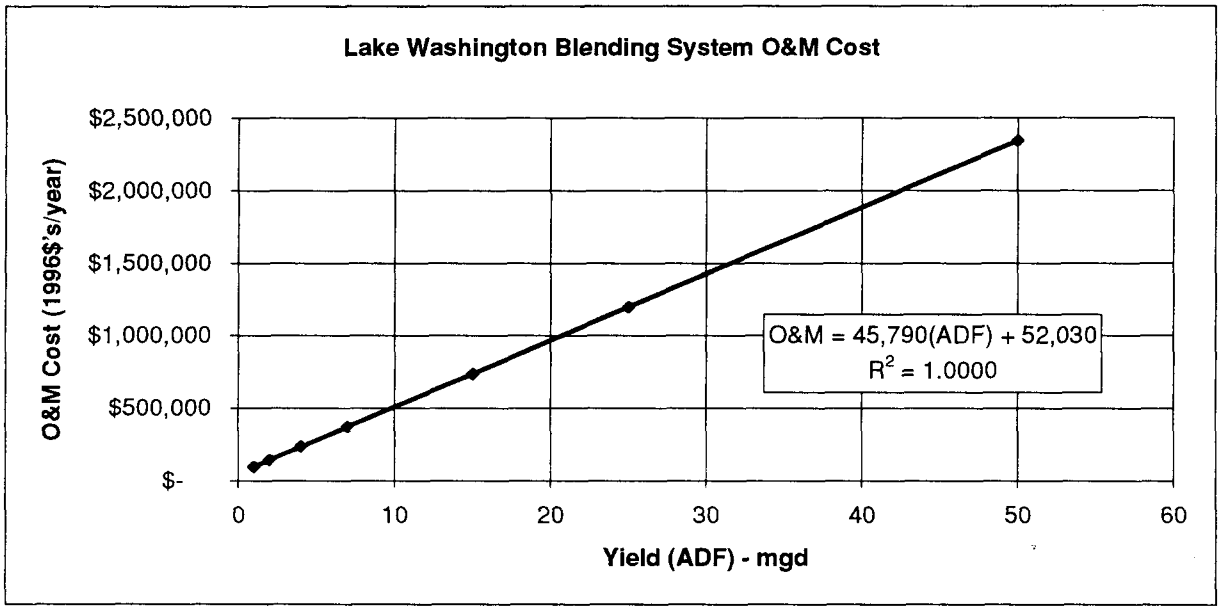


Table A1 - Lake Washington Brackish Ground Water Cost Summary -- Blending System (Wellfield plus Plant)

Yield	Cl	TDS	Construction Cost	Capital Cost	Annual Cost	Production Cost $/1000 gal.	O&M Cost $/year	Unit Cost $/1000 gal
1	246	735	$ 1,225,662	$ 1,826,438	$ 249,712	$ 0.684	$ 97,926	$ 0.115
2	257	754	$ 1,951,666	$ 2,904,853	$ 385,871	$ 0.529	$ 144,087	$ 0.115
4	278	793	$ 2,977,356	$ 4,420,566	$ 604,065	$ 0.414	$ 235,716	$ 0.115
7	311	850	$ 4,326,826	$ 6,431,468	$ 906,733	$ 0.355	$ 372,446	$ 0.115
15	397	1004	$ 7,776,204	$ 11,590,398	$ 1,691,776	$ 0.309	$ 737,919	$ 0.115
25	505	1196	$ 11,910,486	$ 17,597,238	$ 2,636,063	$ 0.289	$ 1,196,241	$ 0.115
50	775	1677	$ 21,805,404	$ 32,243,791	$ 4,955,213	$ 0.272	$ 2,342,046	$ 0.115



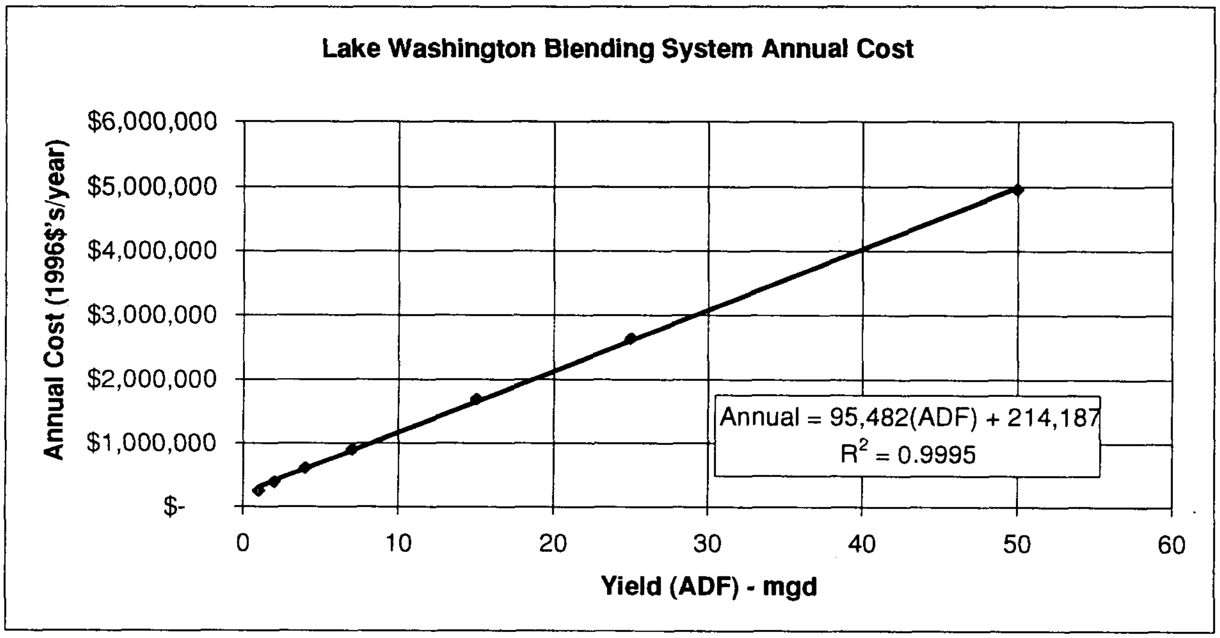
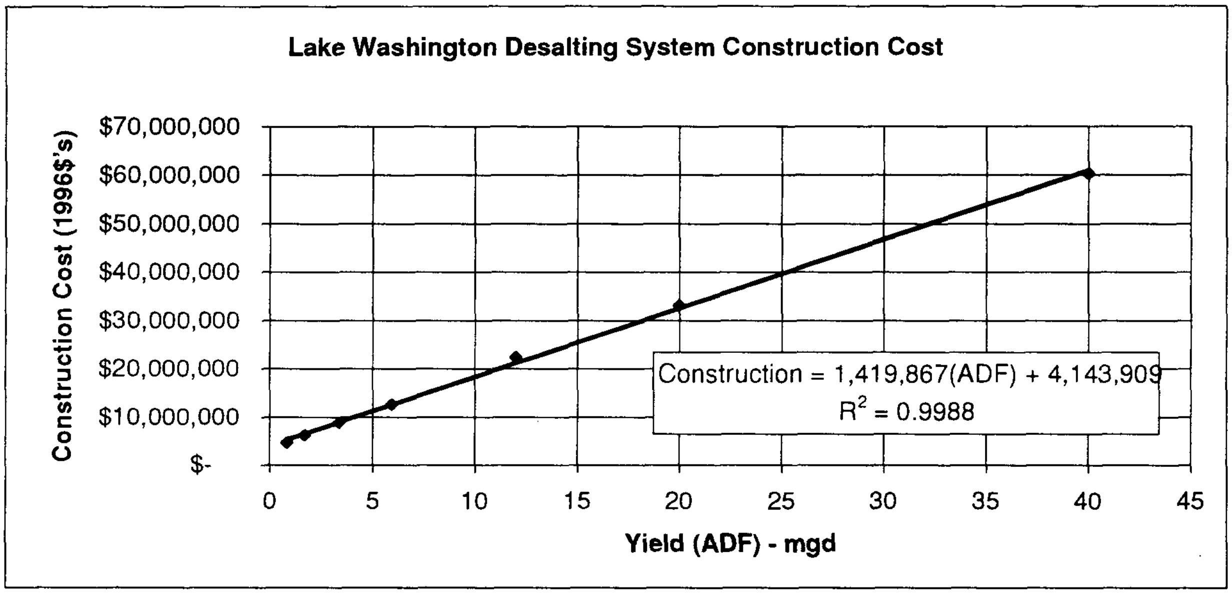


Table A2 - Lake Washington Brackish Ground Water Cost Summary -- Desalting System (Wellfield plus RO Plant plus Concentrate Disposal Well)

Yield	Cl	TDS	Construction Cost	Capital Cost	Annual Cost	Production Cost $/1000 gal.	O&M Cost $/year	Unit Cost $/1000 gal
0.85	25	73	$ 4,576,236	$ 6,684,771	$ 1,115,638	$ 3.596	$ 475,685	$ 0.325
1.7	26	75	$ 6,180,694	$ 9,036,944	$ 1,766,051	$ 2.846	$ 860,720	$ 0.325
3.4	28	79	$ 8,902,130	$ 13,011,488	$ 2,920,587	$ 2.353	$ 1,561,509	$ 0.325
5.95	31	85	$ 12,653,153	$ 18,504,642	$ 4,507,845	$ 2.076	$ 2,528,917	$ 0.325
12	40	100	$ 22,409,565	$ 32,808,772	$ 8,238,185	$ 1.881	$ 4,663,136	$ 0.330
20	51	120	$ 33,084,215	$ 48,299,145	$ 12,553,081	$ 1.720	$ 7,254,828	$ 0.330
40	78	168	$ 60,328,251	$ 88,101,919	$ 22,928,383	$ 1.570	$ 13,225,463	$ 0.330



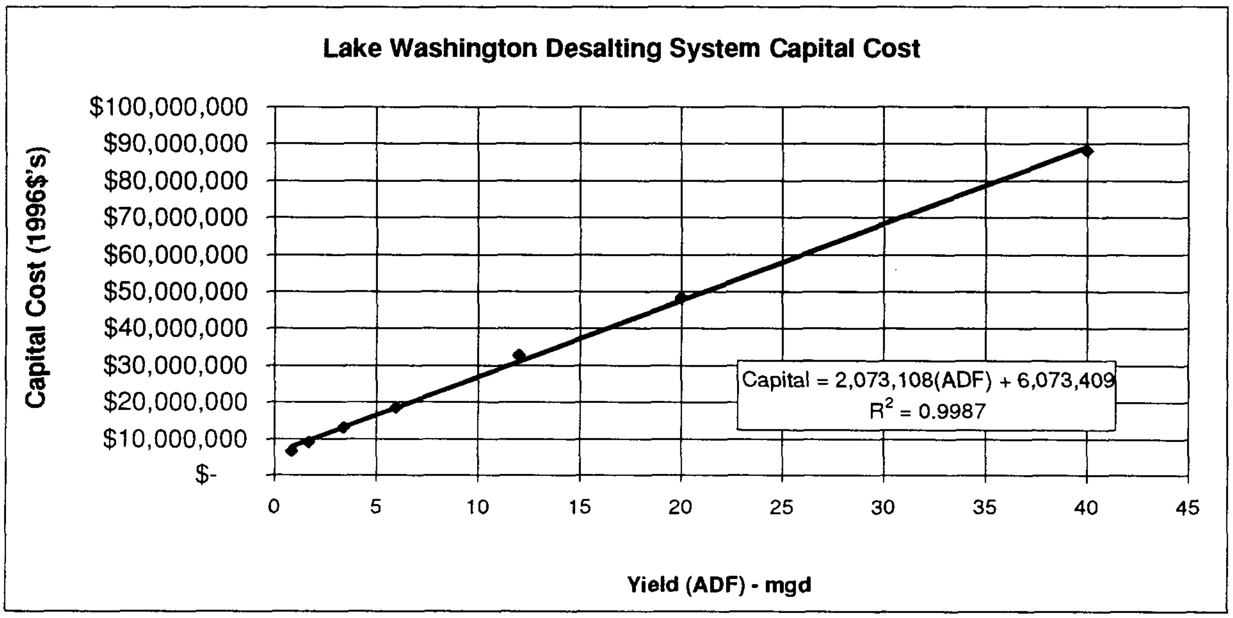


Table A2 - Lake Washington Brackish Ground Water Cost Summary -- Desalting System (Wellfield plus RO Plant plus Concentrate Disposal Well)

Yield	Cl	TDS	Construction Cost	Capital Cost	Annual Cost	Production Cost $/1000 gal.	O&M Cost $/year	Unit Cost $/1000 gal
0.85	25	73	$ 4,576,236	$ 6,684,771	$ 1,115,638	$ 3.596	$ 475,685	$ 0.325
1.7	26	75	$ 6,180,694	$ 9,036,944	$ 1,766,051	$ 2.846	$ 860,720	$ 0.325
3.4	28	79	$ 8,902,130	$ 13,011,488	$ 2,920,587	$ 2.353	$ 1,561,509	$ 0.325
5.95	31	85	$ 12,653,153	$ 18,504,642	$ 4,507,845	$ 2.076	$ 2,528,917	$ 0.325
12	40	100	$ 22,409,565	$ 32,808,772	$ 8,238,185	$ 1.881	$ 4,663,136	$ 0.330
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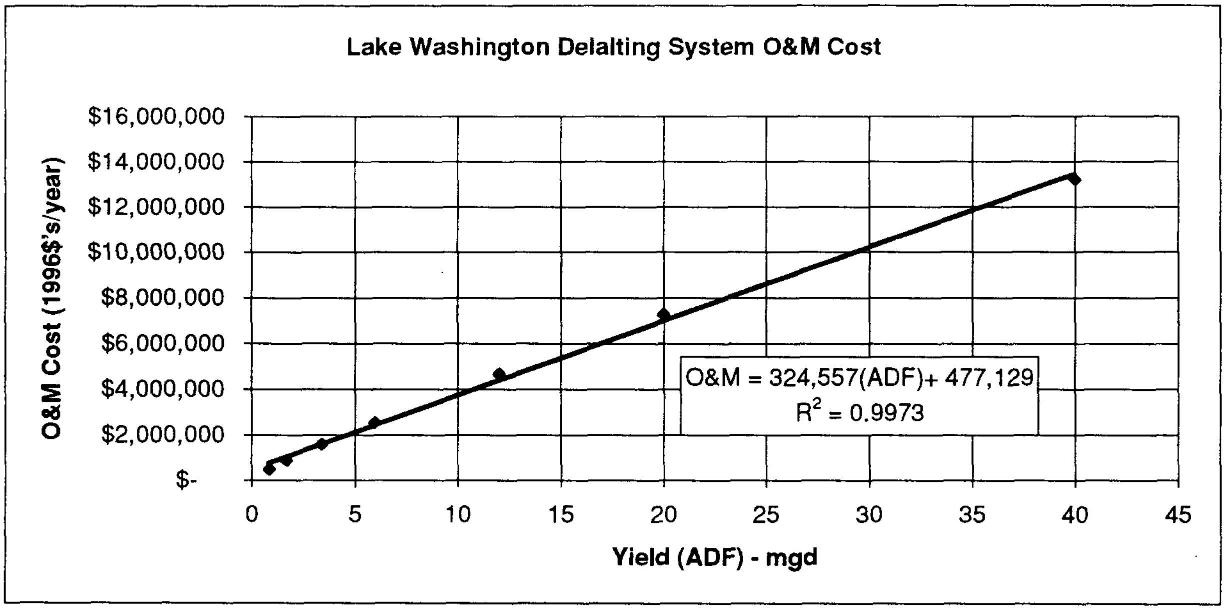
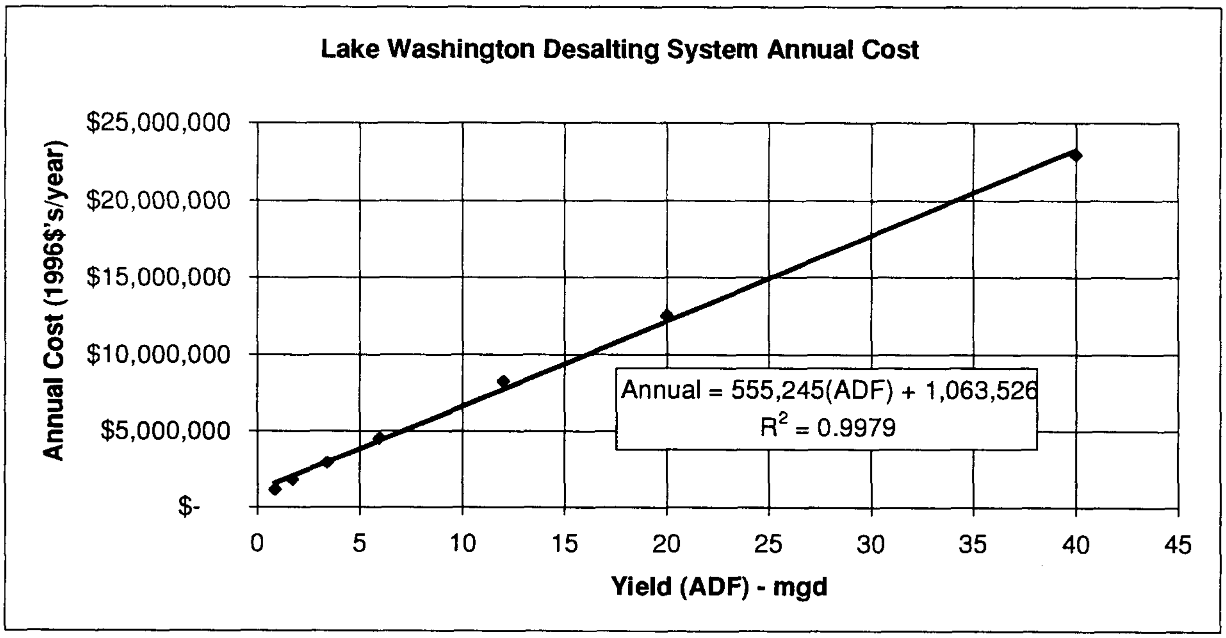
40	78	168	$ 60,328,251	$ 88,101,919	$ 22,928,383	$ 1.570	$ 13,225,463	$ 0.330

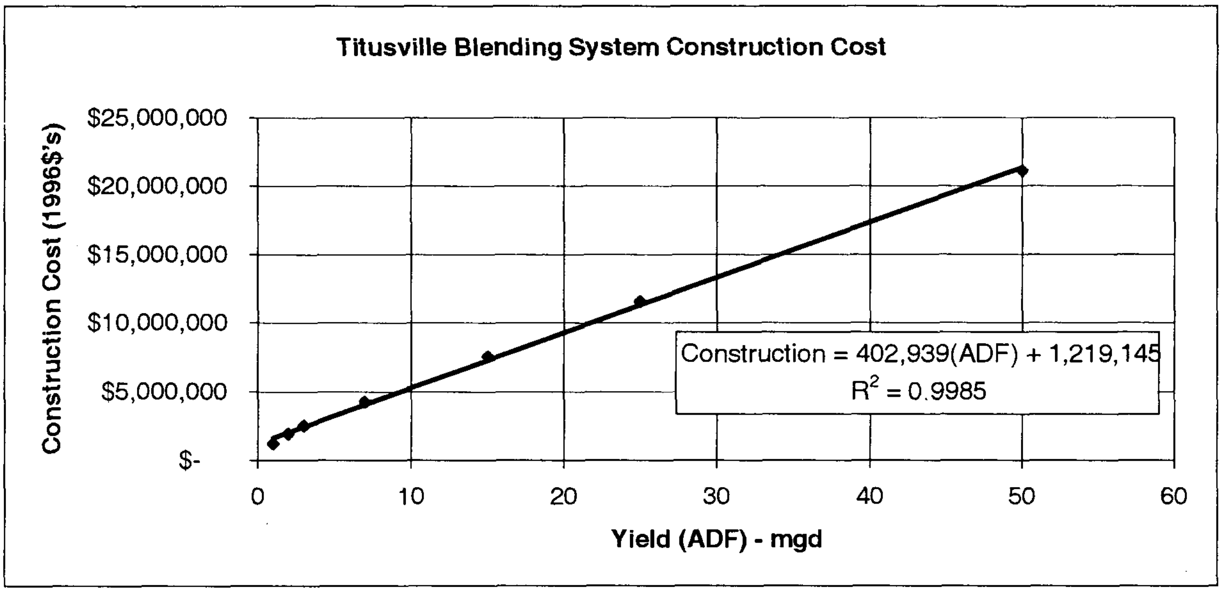




Appendix B
Cost Estimates and Equations for Titusville Site

Table B1 - Titusville Brackish Ground Water Cost Summary -- Blending System (Wellfield plus Plant)

Yield	Cl	TDS	Construction Cost	Capital Cost	Annual Cost	Production Cost $/1000 gal.	O&M Cost $/year	Unit Cost $/1000 gal
1	231	708	$ 1,188,250	$ 1,772,191	$ 245,341	$ 0.672	$ 97,926	$ 0.115
2	264	767	$ 1,895,547	$ 2,823,482	$ 379,313	$ 0.520	$ 144,087	$ 0.115
3	297	826	$ 2,491,618	$ 3,713,493	$ 498,871	$ 0.456	$ 189,976	$ 0.115
7	428	1,059	$ 4,214,589	$ 6,267,592	$ 893,539	$ 0.350	$ 372,446	$ 0.115
15	692	1,529	$ 7,551,731	$ 11,264,912	$ 1,665,546	$ 0.304	$ 737,919	$ 0.115
25	1,021	2,114	$ 11,555,071	$ 17,081,886	$ 2,594,533	$ 0.284	$ 1,196,241	$ 0.115
50	1,843	3,578	$ 21,131,985	$ 31,267,333	$ 4,876,524	$ 0.267	$ 2,342,046	$ 0.115



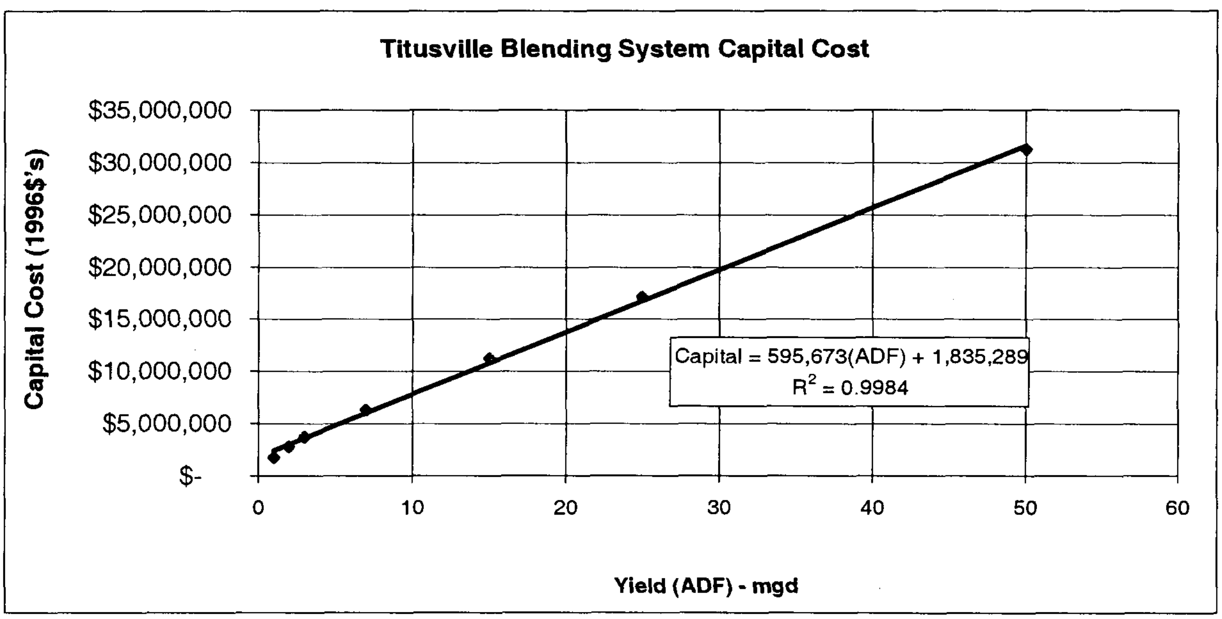
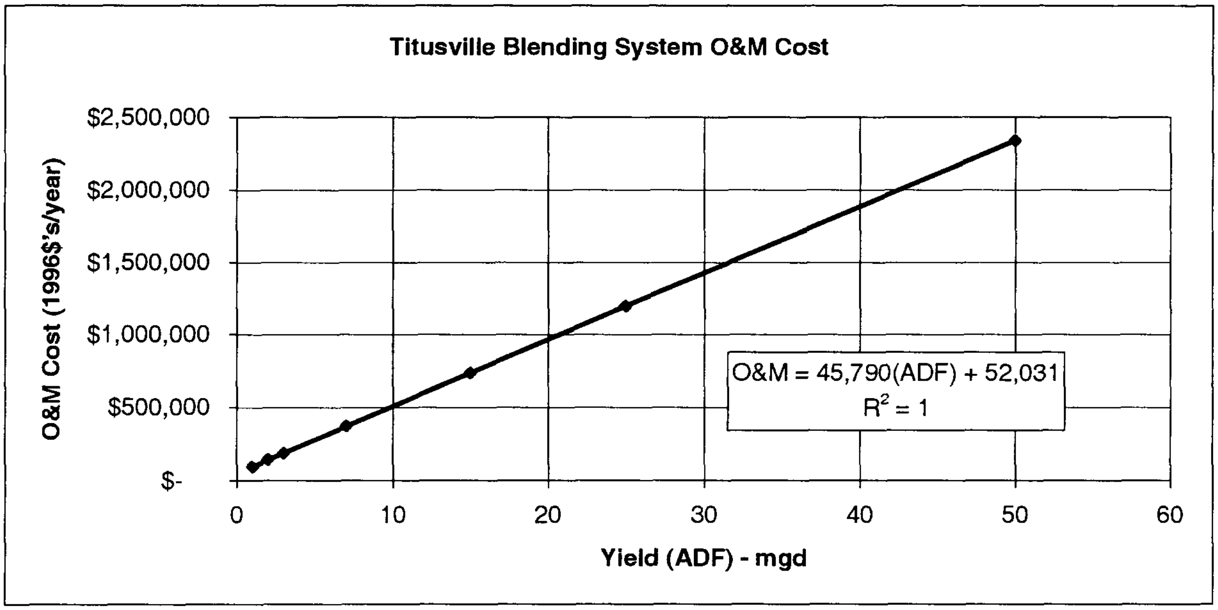


Table B1 - Titusville Brackish Ground Water Cost Summary -- Blending System (Wellfield plus Plant)

Yield	Cl	TDS	Construction Cost	Capital Cost	Annual Cost	Production Cost $/1000 gal.	O&M Cost $/year	Unit Cost $/1000 gal
1	231	708	$ 1,188,250	$ 1,772,191	$ 245,341	$ 0.672	$ 97,926	$ 0.115
2	264	767	$ 1,895,547	$ 2,823,482	$ 379,313	$ 0.520	$ 144,087	$ 0.115
3	297	826	$ 2,491,618	$ 3,713,493	$ 498,871	$ 0.456	$ 189,976	$ 0.115
7	428	1,059	$ 4,214,589	$ 6,267,592	$ 893,539	$ 0.350	$ 372,446	$ 0.115
15	692	1,529	$ 7,551,731	$ 11,264,912	$ 1,665,546	$ 0.304	$ 737,919	$ 0.115
25	1,021	2,114	$ 11,555,071	$ 17,081,886	$ 2,594,533	$ 0.284	$ 1,196,241	$ 0.115
50	1,843	3,578	$ 21,131,985	$ 31,267,333	$ 4,876,524	$ 0.267	$ 2,342,046	$ 0.115



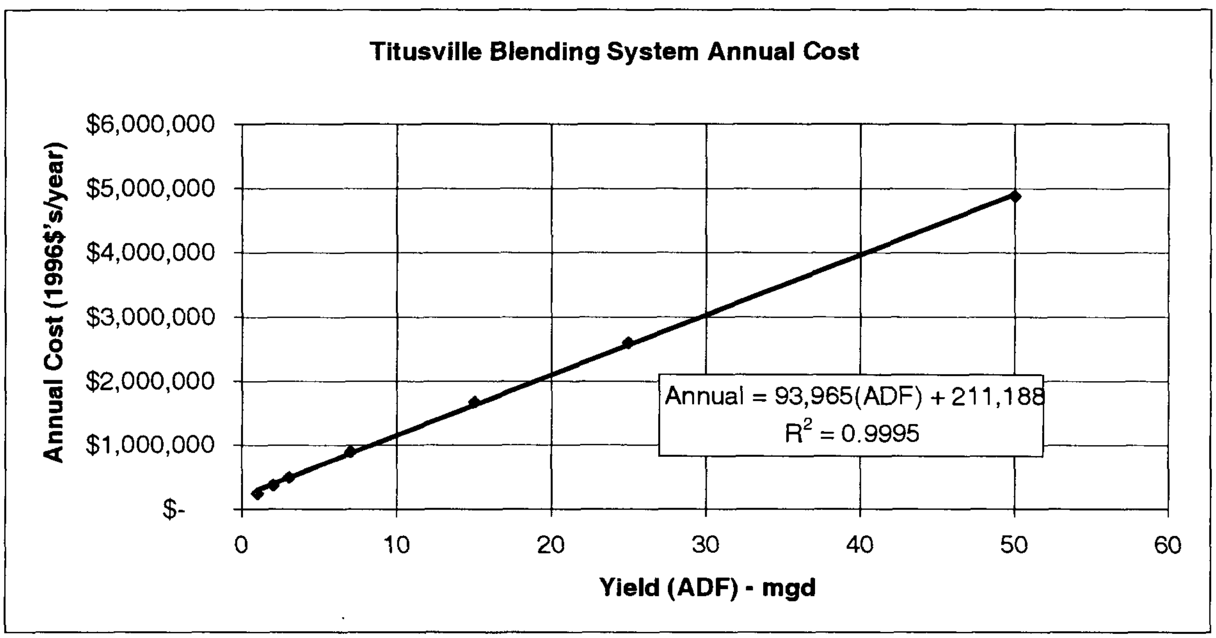
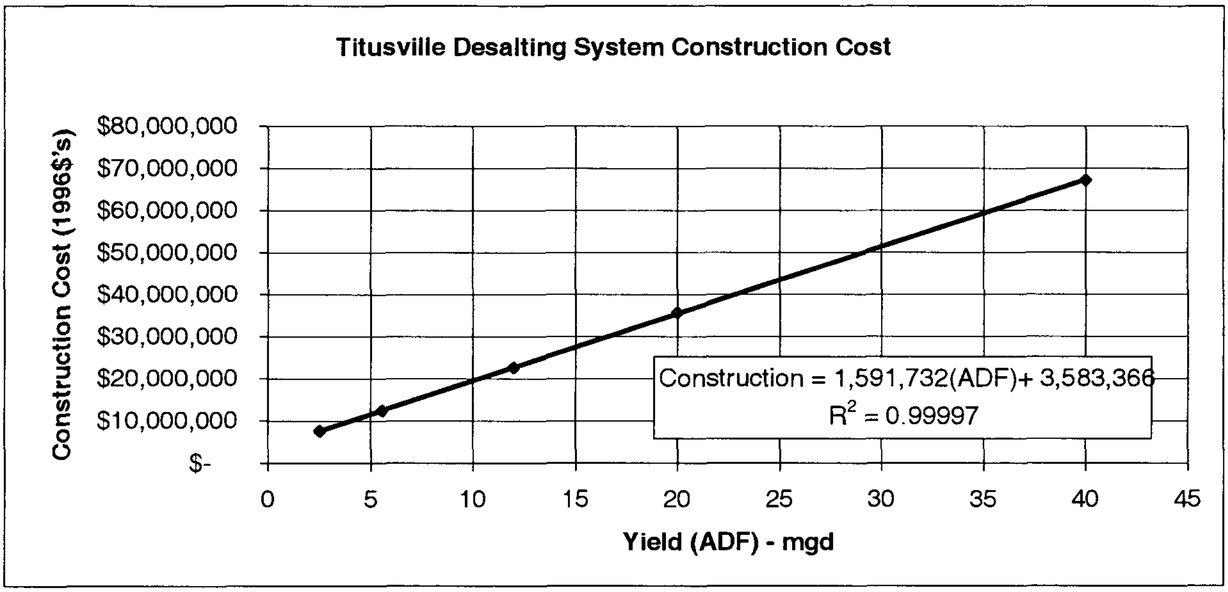


Table B2 - Titusville Brackish Ground Water Cost Summary-- Desalting System (Wellfield plus RO Plan plus Concentrate Disposal Well)

Yield	Cl	TDS	Construction Cost	Capital Cost	Annual Cost	Production Cost $/1000 gal.	O&M Cost $/year	Unit Cost $/1000 gal
2.55	30	83	$ 7,579,757	$ 11,091,295	$ 2,358,496	$ 2.534	$ 1,219,201	$ 0.325
5.6	43	106	$ 12,464,456	$ 18,229,898	$ 4,364,946	$ 2.135	$ 2,413,994	$ 0.330
12	69	153	$ 22,640,730	$ 33,143,961	$ 8,289,390	$ 1.893	$ 4,663,136	$ 0.330
20	102	211	$ 35,651,962	$ 52,022,378	$ 13,008,340	$ 1.782	$ 7,254,828	$ 0.330
40	184	358	$ 67,157,246	$ 98,003,962	$ 24,124,723	$ 1.652	$ 13,225,463	$ 0.330



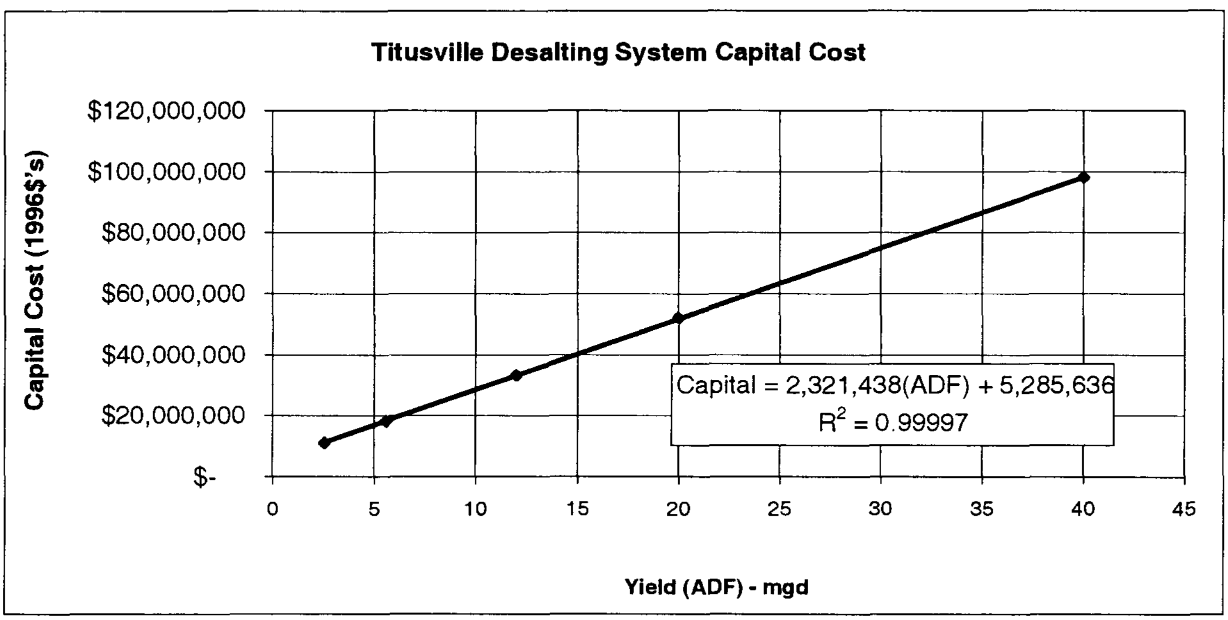
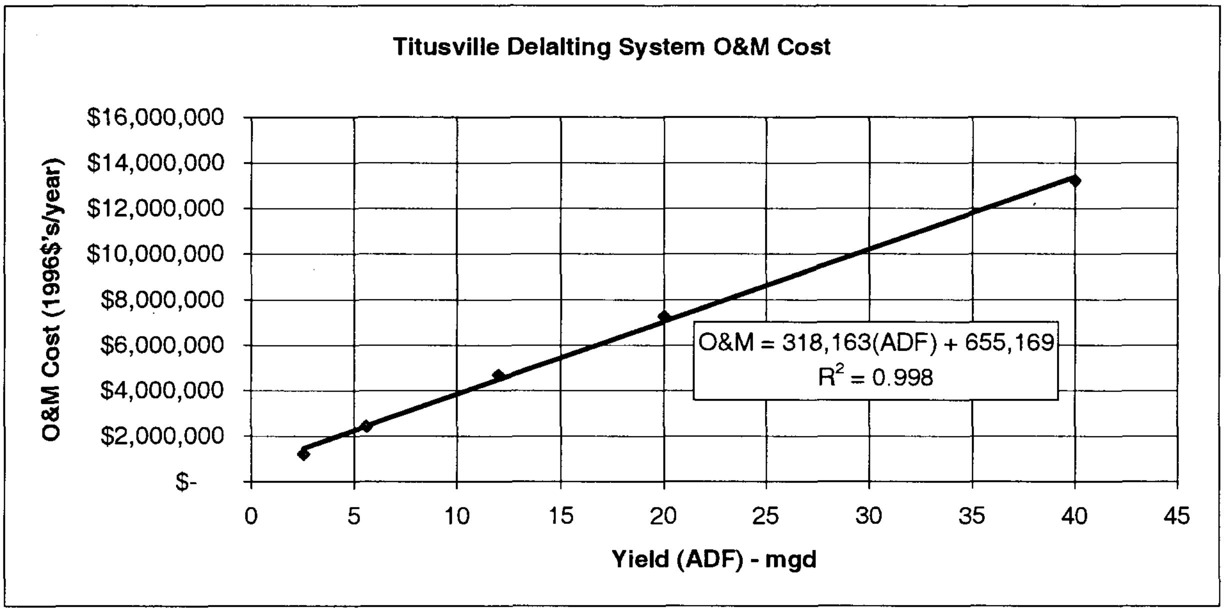
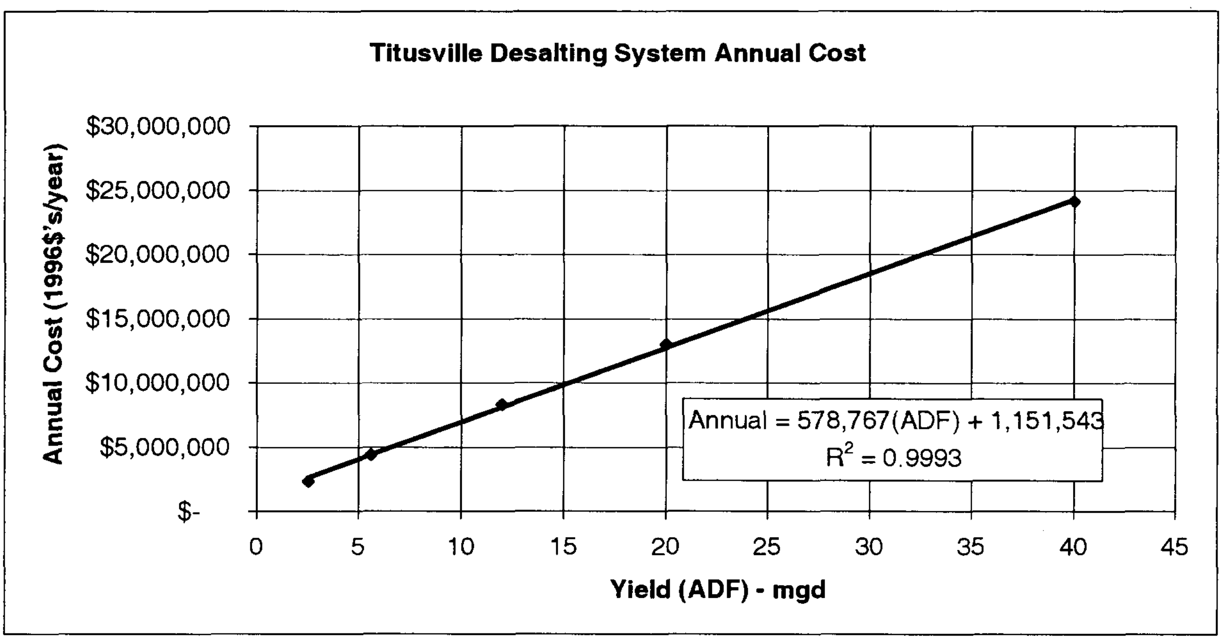


Table B2 - Titusville Brackish Ground Water Cost Summary-- Desalting System (Wellfield plus RO Plant plus Concentrate Disposal Well)

Yield	Cl	TDS	Construction Cost	Capital Cost	Annual Cost	Production Cost $/1000 gal.	O&M Cost $/year	Unit Cost $/1000 gal
2.55	30	83	$ 7,579,757	$ 11,091,295	$ 2,358,496	$ 2.534	$ 1,219,201	$ 0.325
5.6	43	106	$ 12,464,456	$ 18,229,898	$ 4,364,946	$ 2.135	$ 2,413,994	$ 0.330
12	69	153	$ 22,640,730	$ 33,143,961	$ 8,289,390	$ 1.893	$ 4,663,136	$ 0.330
20	102	211	$ 35,651,962	$ 52,022,378	$ 13,008,340	$ 1.782	$ 7,254,828	$ 0.330
40	184	358	$ 67,157,246	$ 98,003,962	$ 24,124,723	$ 1.652	$ 13,225,463	$ 0.330

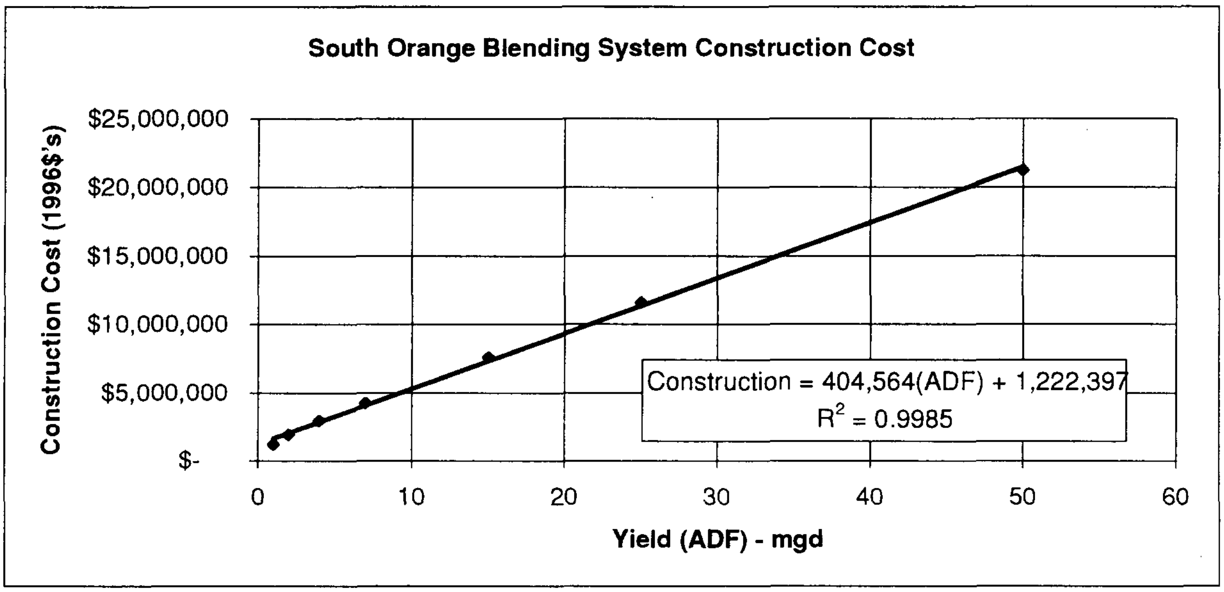




Appendix C
Cost Estimates and Equations for South Orange County Site

Table C1 - South Orange Brackish Ground Water Cost Summary -- Blending System (Wellfield plus Plant)

Yield	Cl	TDS	Construction Cost	Capital Cost	Annual Cost	Production Cost $/1000 gal.	O&M Cost $/year	Unit Cost $/1000 gal
1	147.2	559	$ 1,192,926	$ 1,778,972	$ 245,887	$ 0.674	$ 97,926	$ 0.115
2	172	603	$ 1,902,562	$ 2,833,653	$ 380,133	$ 0.521	$ 144,087	$ 0.115
4	222	691	$ 2,911,885	$ 4,325,633	$ 596,414	$ 0.409	$ 235,716	$ 0.115
7	296	824	$ 4,228,619	$ 6,289,068	$ 895,258	$ 0.350	$ 372,446	$ 0.115
15	494	1177	$ 7,579,790	$ 11,305,598	$ 1,668,825	$ 0.305	$ 737,919	$ 0.115
25	743	1619	$ 11,599,498	$ 17,146,305	$ 2,599,724	$ 0.285	$ 1,196,241	$ 0.115
50	1362	2722	$ 21,216,162	$ 31,389,390	$ 4,886,360	$ 0.268	$ 2,342,046	$ 0.115



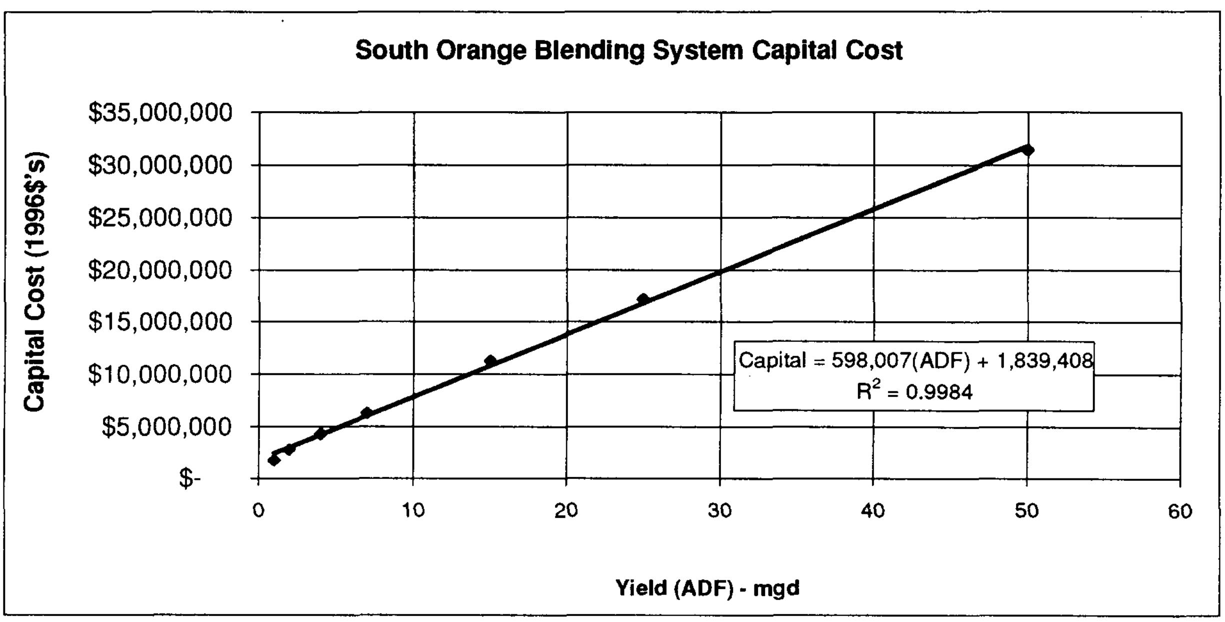
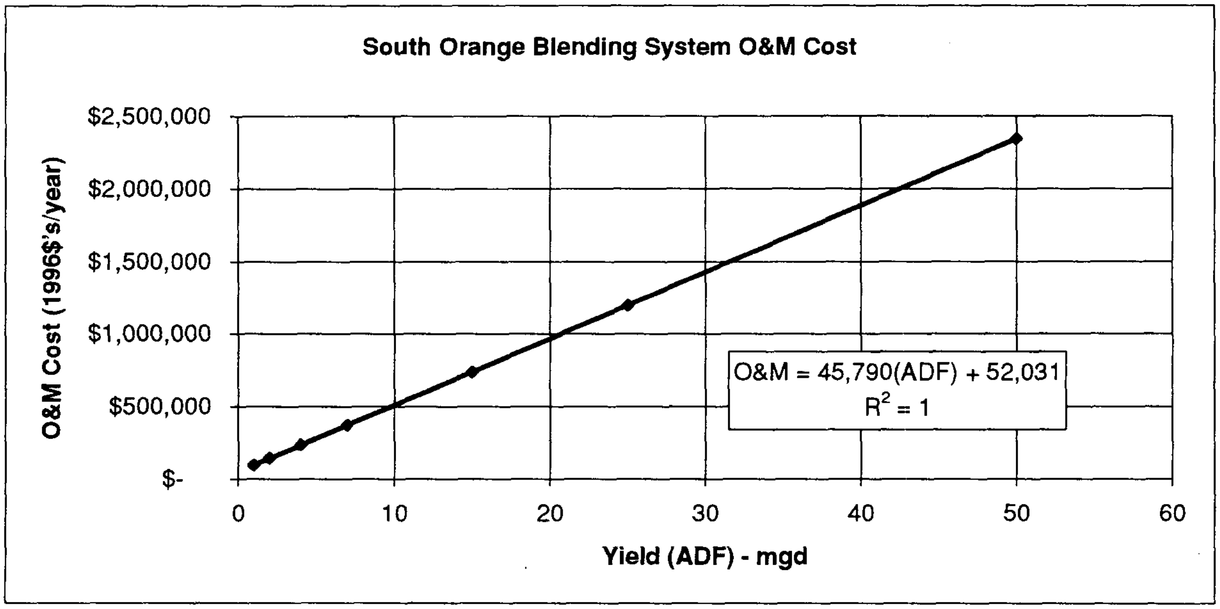


Table C1 - South Orange Brackish Ground Water Cost Summary -- Blending System (Wellfield plus Plant)

Yield	Cl	TDS	Construction Cost	Capital Cost	Annual Cost	Production Cost $/1000 gal.	O&M Cost $/year	Unit Cost $/1000 gal
1	147	559	$ 1,192,926	$ 1,778,972	$ 245,887	$ 0.674	$ 97,926	$ 0.115
2	172	603	$ 1,902,562	$ 2,833,653	$ 380,133	$ 0.521	$ 144,087	$ 0.115
4	222	691	$ 2,911,885	$ 4,325,633	$ 596,414	$ 0.409	$ 235,716	$ 0.115
7	296	824	$ 4,228,619	$ 6,289,068	$ 895,258	$ 0.350	$ 372,446	$ 0.115
15	494	1177	$ 7,579,790	$ 11,305,598	$ 1,668,825	$ 0.305	$ 737,919	$ 0.115
25	743	1619	$ 11,599,498	$ 17,146,305	$ 2,599,724	$ 0.285	$ 1,196,241	$ 0.115
50	1362	2722	$ 21,216,162	$ 31,389,390	$ 4,886,360	$ 0.268	$ 2,342,046	$ 0.115



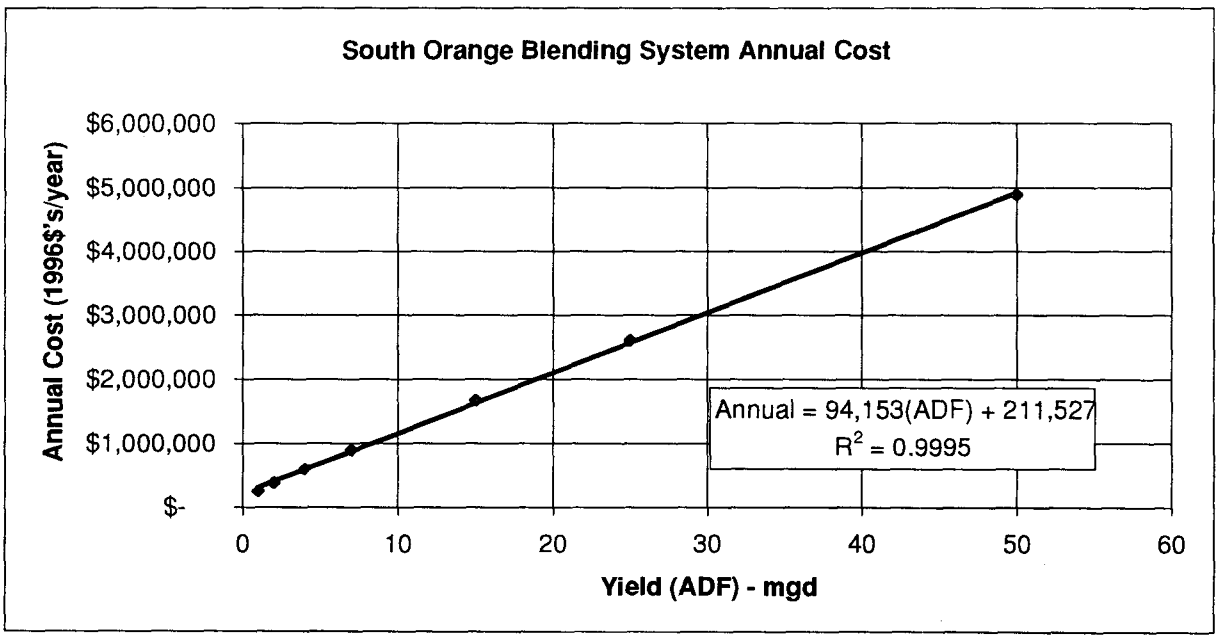
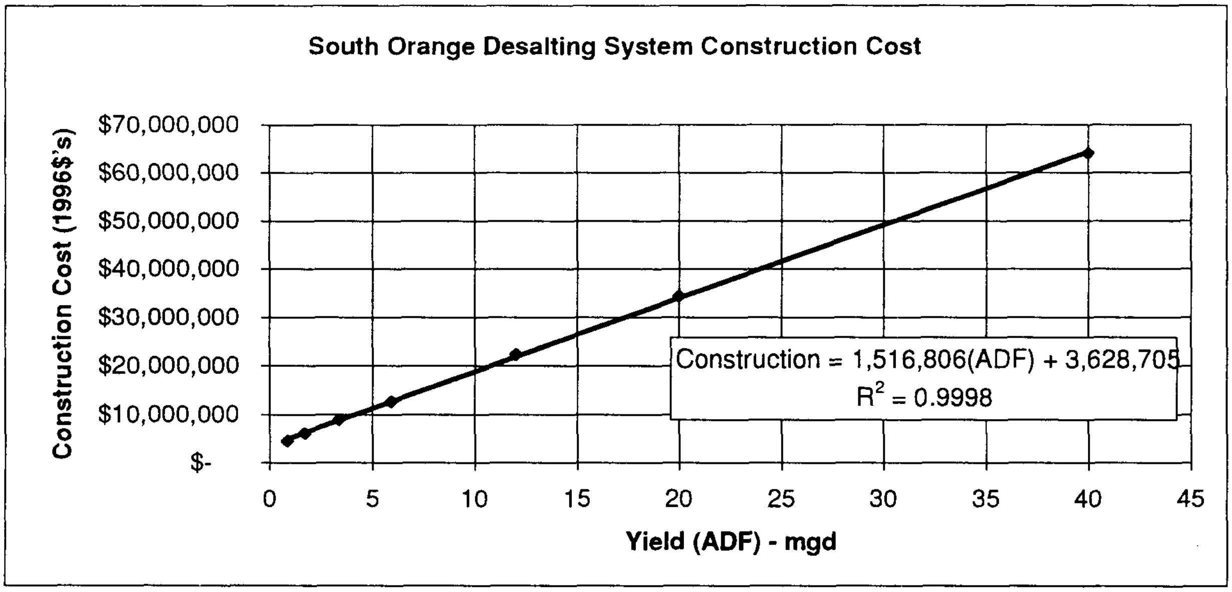


Table C2 - South Orange Brackish Ground Water Cost Summary -- Desalting System (Wellfield plus RO Plant plus Concentrate Disposal Well)

Yield	Cl	TDS	Construction Cost	Capital Cost	Annual Cost	Production Cost $/1000 gal.	O&M Cost $/year	Unit Cost $/1000 gal
0.85	15	56	$ 4,543,501	$ 6,637,305	$ 1,111,813	$ 3.584	$ 475,685	$ 0.325
1.7	17	60	$ 6,131,590	$ 8,965,744	$ 1,760,313	$ 2.837	$ 860,720	$ 0.325
3.4	22	69	$ 8,836,659	$ 12,916,555	$ 2,912,937	$ 2.347	$ 1,561,509	$ 0.325
5.95	30	82	$ 12,554,946	$ 18,362,242	$ 4,496,369	$ 2.070	$ 2,528,917	$ 0.325
12	49	118	$ 22,213,152	$ 32,523,972	$ 8,215,234	$ 1.876	$ 4,663,136	$ 0.330
20	74	162	$ 34,382,107	$ 50,181,089	$ 12,790,170	$ 1.752	$ 7,254,828	$ 0.330
40	136	272	$ 63,999,034	$ 93,424,555	$ 23,583,518	$ 1.615	$ 13,225,463	$ 0.330



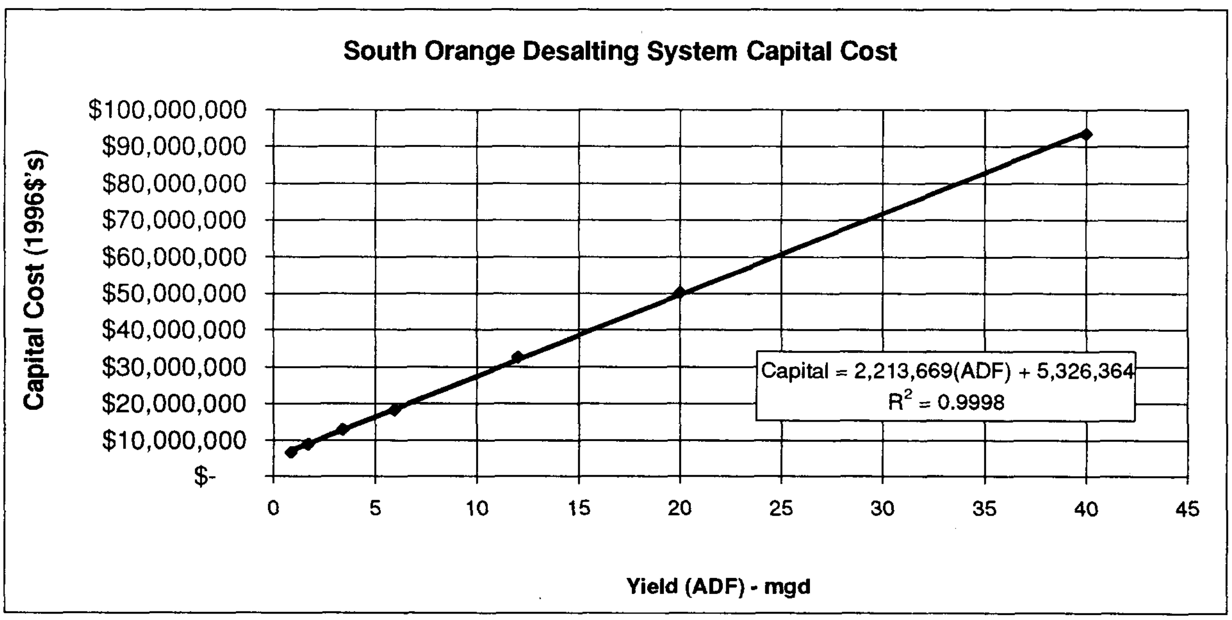
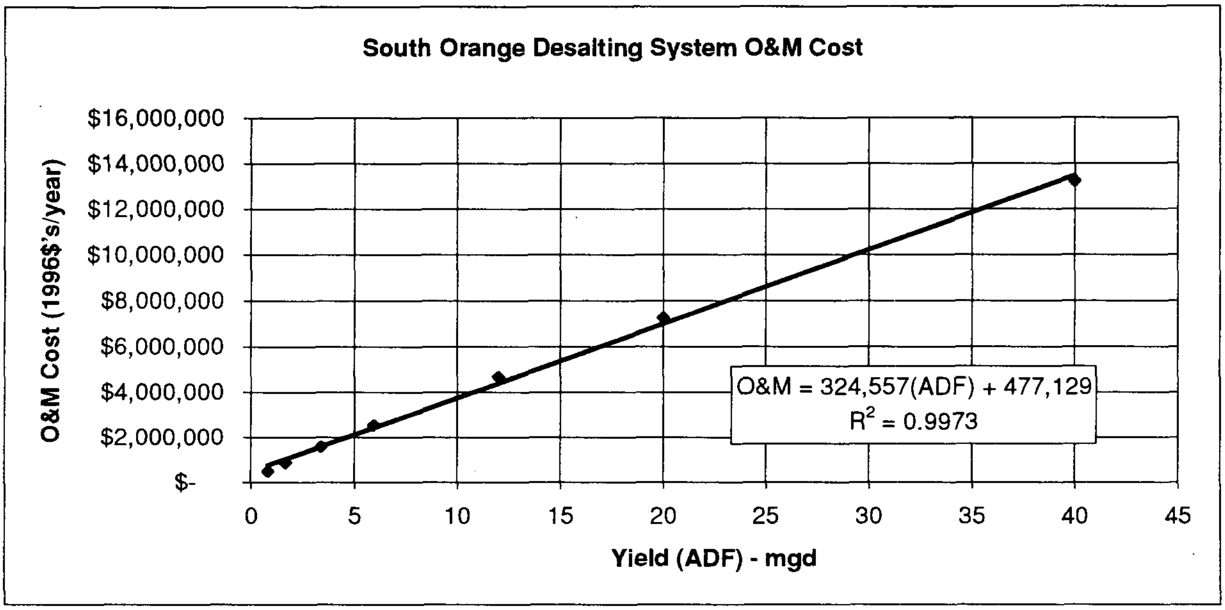
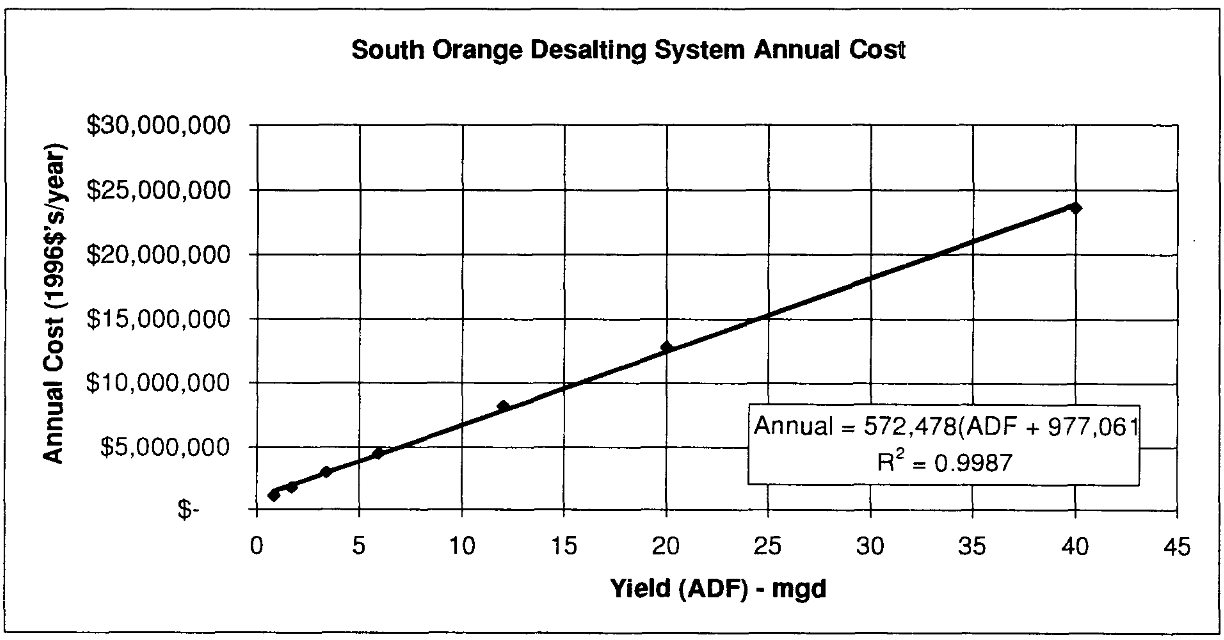


Table C2 - South Orange Brackish Ground Water Cost Summary -- Desalting System (Wellfield plus RO Plant plus Concentrate Disposal Well)

Yield	Cl	TDS	Construction Cost	Capital Cost	Annual Cost	Production Cost $/1000 gal.	O&M Cost $/year	Unit Cost $/1000 gal
0.85	15	56	$ 4,543,501	$ 6,637,305	$ 1,111,813	$ 3.584	$ 475,685	$ 0.325
1.7	17	60	$ 6,131,590	$ 8,965,744	$ 1,760,313	$ 2.837	$ 860,720	$ 0.325
3.4	22	69	$ 8,836,659	$ 12,916,555	$ 2,912,937	$ 2.347	$ 1,561,509	$ 0.325
5.95	30	82	$ 12,554,946	$ 18,362,242	$ 4,496,369	$ 2.070	$ 2,528,917	$ 0.325
12	49	118	$ 22,213,152	$ 32,523,972	$ 8,215,234	$ 1.876	$ 4,663,136	$ 0.330
20	74	162	$ 34,382,107	$ 50,181,089	$ 12,790,170	$ 1.752	$ 7,254,828	$ 0.330
40	136	272	$ 63,999,034	$ 93,424,555	$ 23,583,518	$ 1.615	$ 13,225,463	$ 0.330

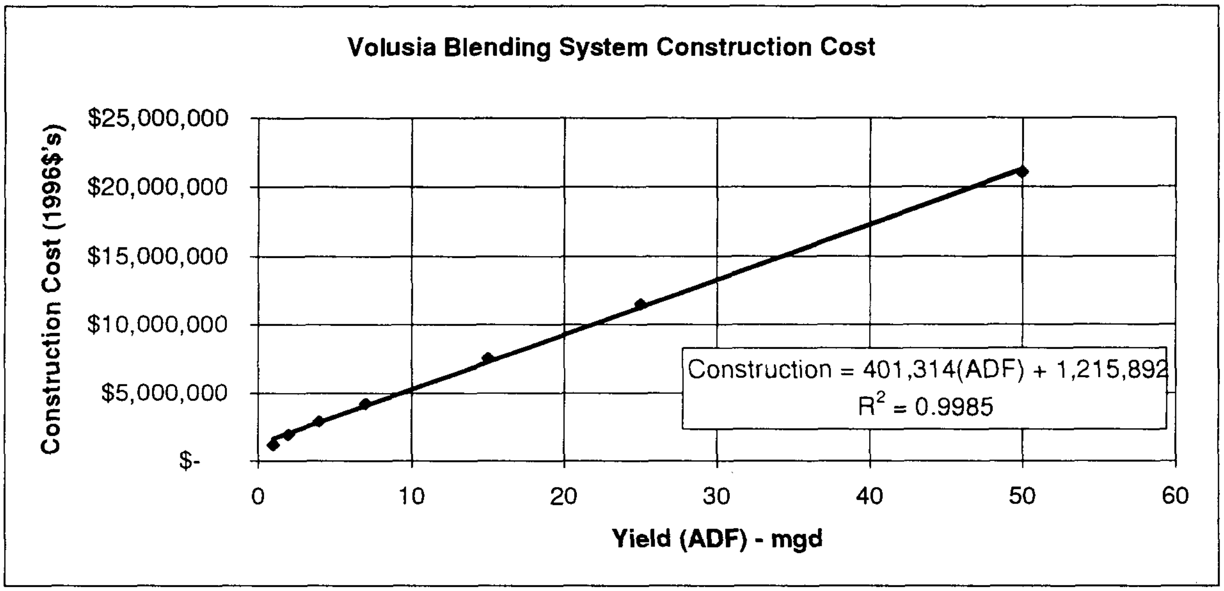




Appendix D
Cost Estimates and Equations for Volusia Site

Table D1 - Volusia Brackish Ground Water Cost Summary -- Blending System (Wellfield plus Plant)

Yield	Cl	TDS	Construction Cost	Capital Cost	Annual Cost	Production Cost $/1000 gal.	O&M Cost $/year	Unit Cost $/1000 gal
1	81.7	442	$ 1,183,573	$ 1,765,410	$ 244,794	$ 0.671	$ 97,926	$ 0.115
2	94	464	$ 1,888,533	$ 2,813,310	$ 378,493	$ 0.518	$ 144,087	$ 0.115
4	118	506	$ 2,893,179	$ 4,298,509	$ 594,229	$ 0.407	$ 235,716	$ 0.115
7	154	571	$ 4,200,560	$ 6,248,382	$ 891,979	$ 0.349	$ 372,446	$ 0.115
15	250	741	$ 7,523,672	$ 11,226,655	$ 1,662,438	$ 0.304	$ 737,919	$ 0.115
25	370	955	$ 11,510,644	$ 17,021,514	$ 2,589,625	$ 0.284	$ 1,196,241	$ 0.115
50	670	1489	$ 21,047,808	$ 31,145,276	$ 4,866,688	$ 0.267	$ 2,342,046	$ 0.115



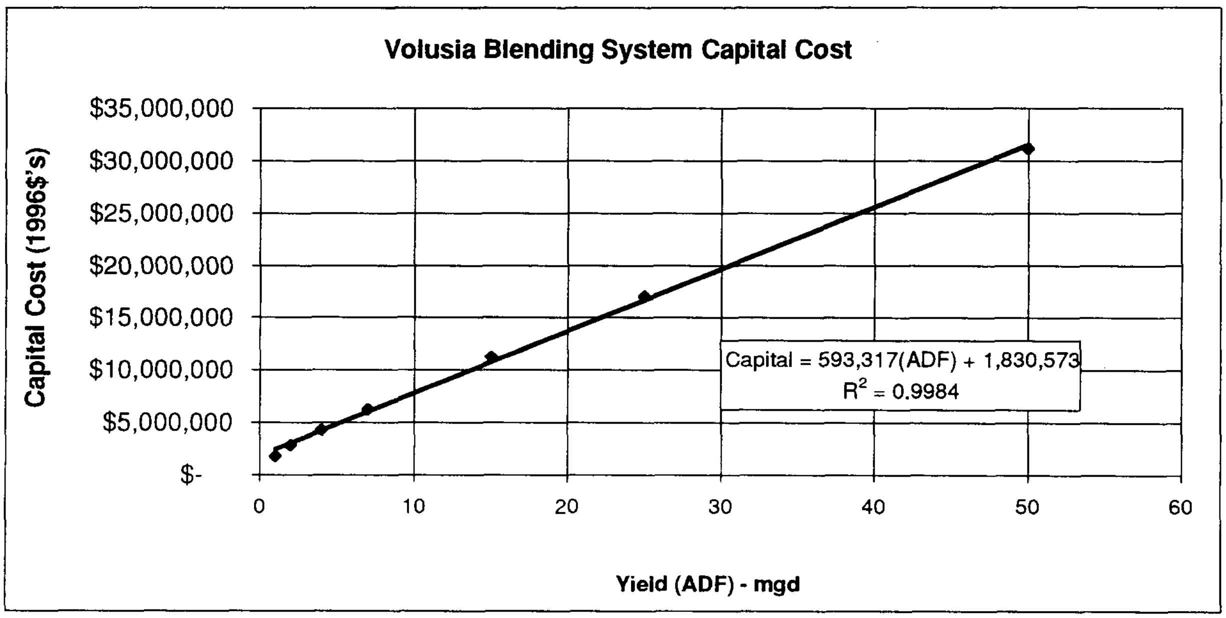
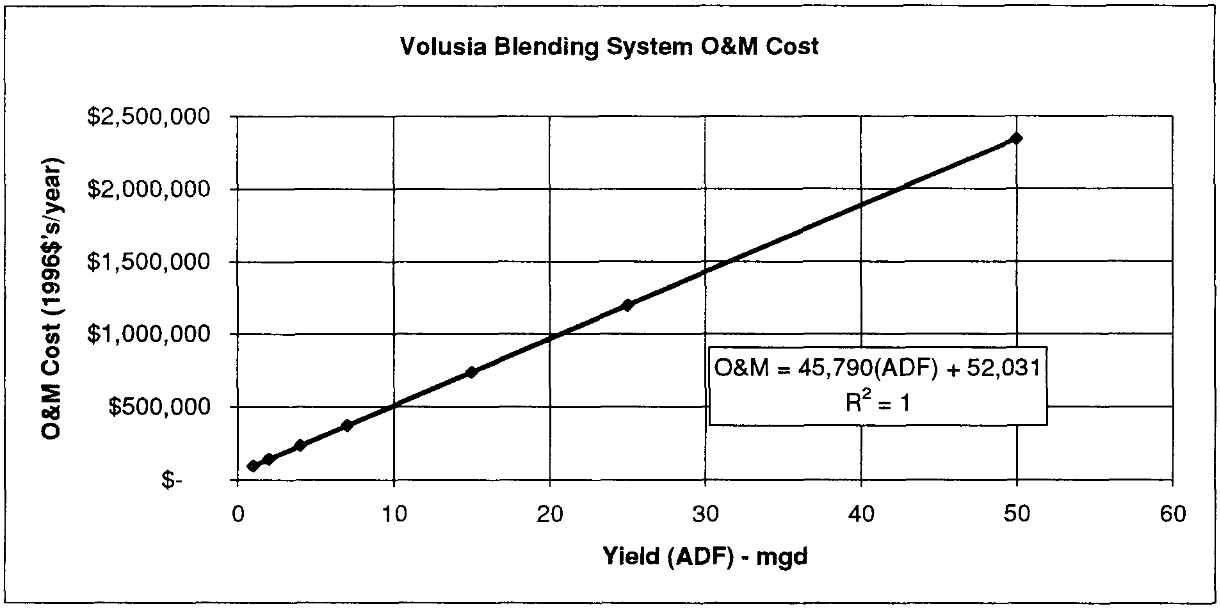


Table D1 - Volusia Brackish Ground Water Cost Summary -- Blending System (Wellfield plus Plant)

Yield	Cl	TDS	Construction Cost	Capital Cost	Annual Cost	Production Cost $/1000 gal.	O&M Cost $/year	Unit Cost $/1000 gal
1	82	442	$ 1,183,573	$ 1,765,410	$ 244,794	$ 0.671	$ 97,926	$ 0.115
2	94	464	$ 1,888,533	$ 2,813,310	$ 378,493	$ 0.518	$ 144,087	$ 0.115
4	118	506	$ 2,893,179	$ 4,298,509	$ 594,229	$ 0.407	$ 235,716	$ 0.115
7	154	571	$ 4,200,560	$ 6,248,382	$ 891,979	$ 0.349	$ 372,446	$ 0.115
15	250	741	$ 7,523,672	$ 11,226,655	$ 1,662,438	$ 0.304	$ 737,919	$ 0.115
25	370	955	$ 11,510,644	$ 17,021,514	$ 2,589,625	$ 0.284	$ 1,196,241	$ 0.115
50	670	1489	$ 21,047,808	$ 31,145,276	$ 4,866,688	$ 0.267	$ 2,342,046	$ 0.115



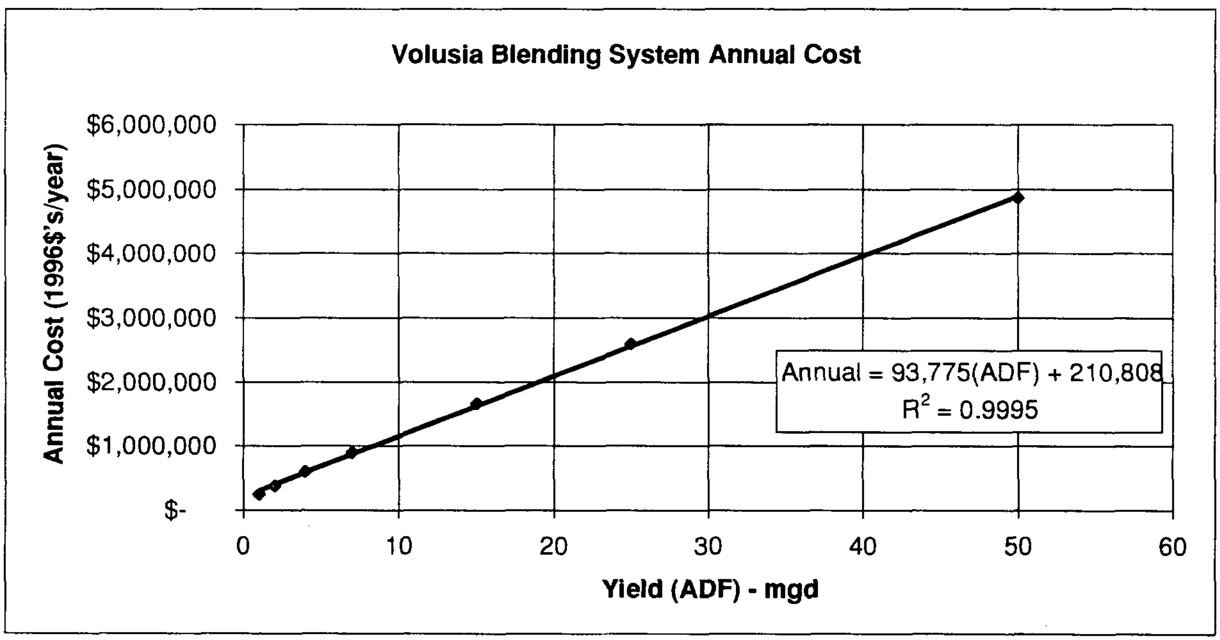
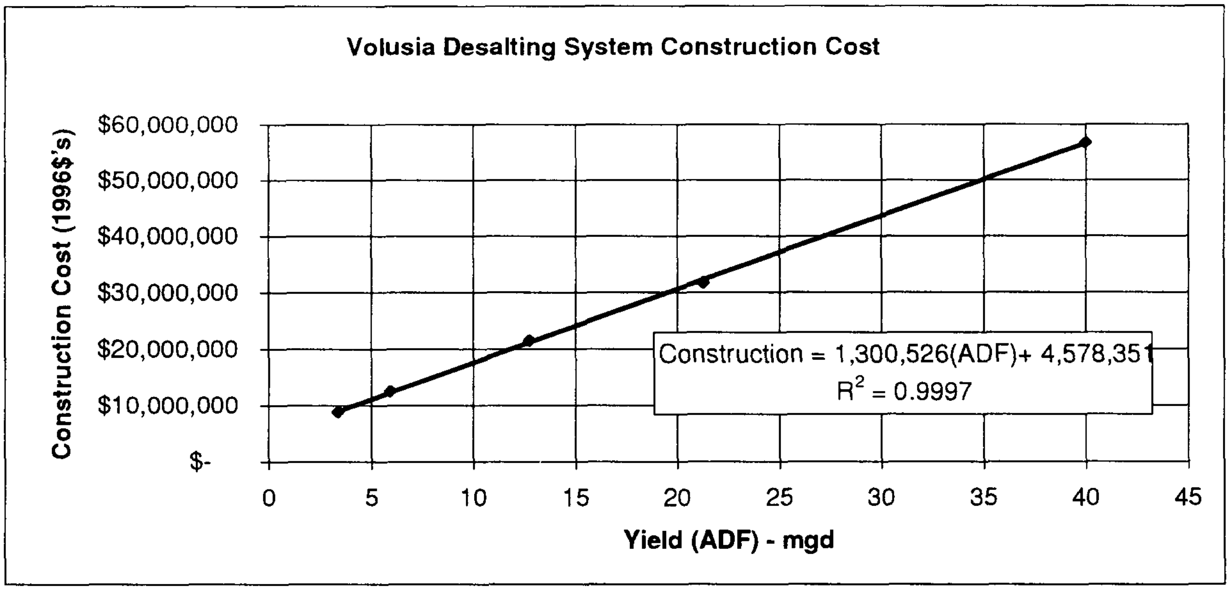


Table D2 - Volusia Brackish Ground Water Cost Summary -- Desalting System (Wellfield plus RO Plant plus Concentrate Disposal Well)

Yield	Cl	TDS	Construction Cost	Capital Cost	Annual Cost	Production Cost $/1000 gal.	O&M Cost $/year	Unit Cost $/1000 gal
3.4	12	51	$ 8,817,953	$ 12,889,431	$ 2,910,751	$ 2.345	$ 1,561,509	$ 0.325
5.95	15	57	$ 12,526,887	$ 18,321,556	$ 4,493,090	$ 2.069	$ 2,528,917	$ 0.325
12.75	25	74	$ 21,504,607	$ 31,499,011	$ 8,321,200	$ 1.788	$ 4,882,541	$ 0.325
21.25	37	96	$ 31,687,355	$ 46,277,745	$ 12,681,870	$ 1.635	$ 7,593,118	$ 0.325
40	67	149	$ 56,753,855	$ 82,919,044	$ 22,361,144	$ 1.532	$ 13,225,463	$ 0.330



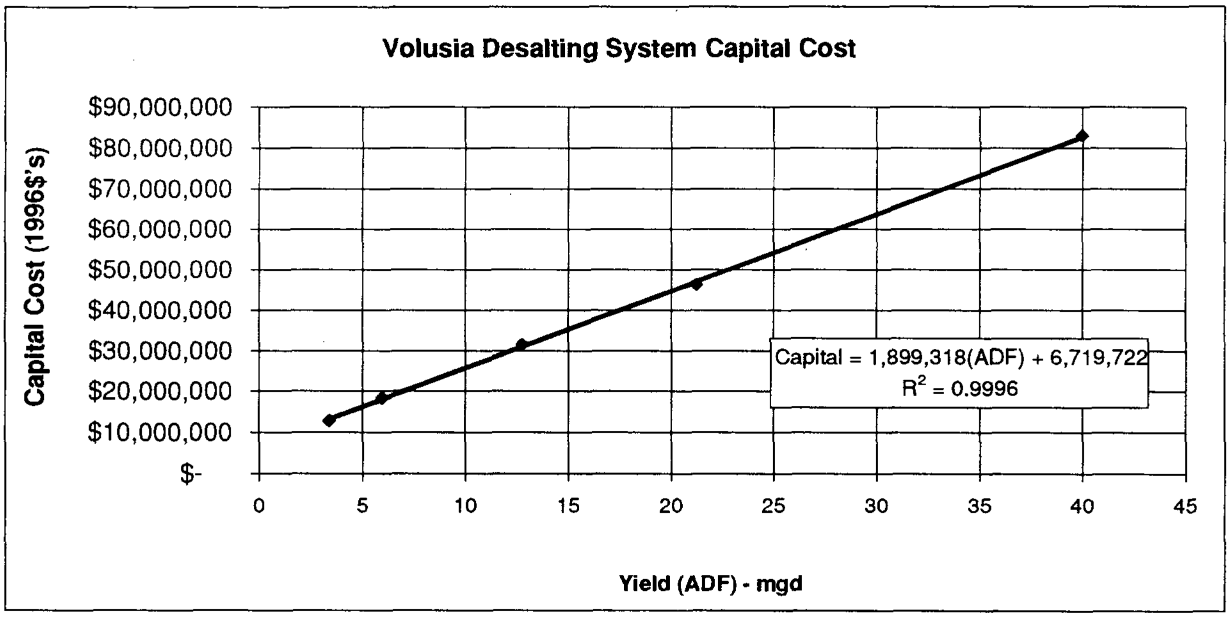
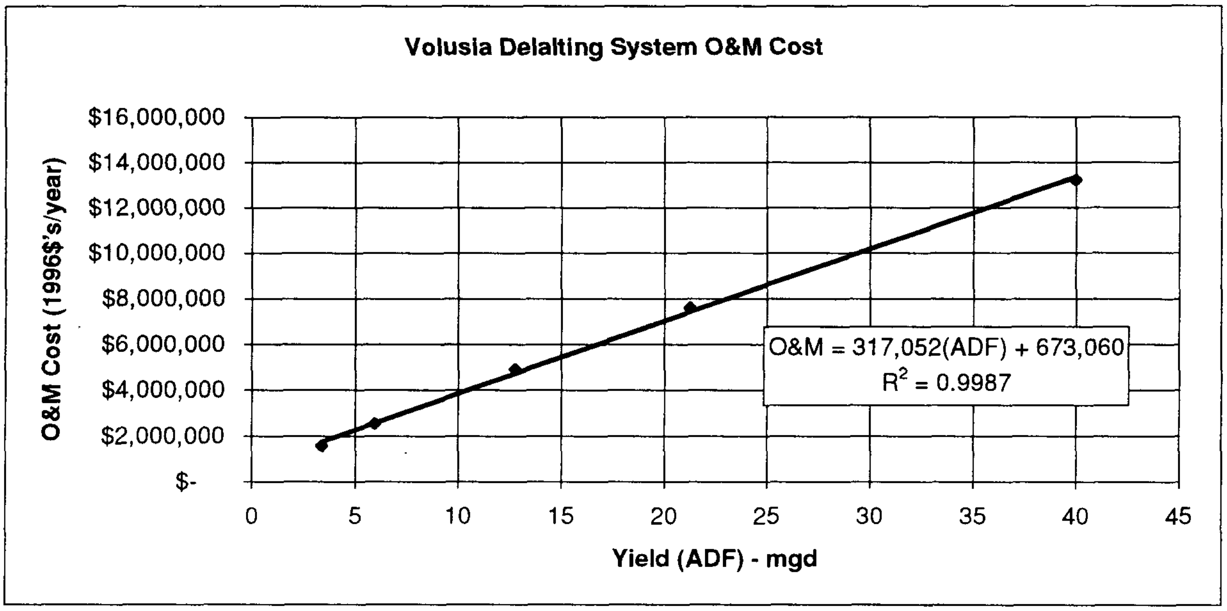
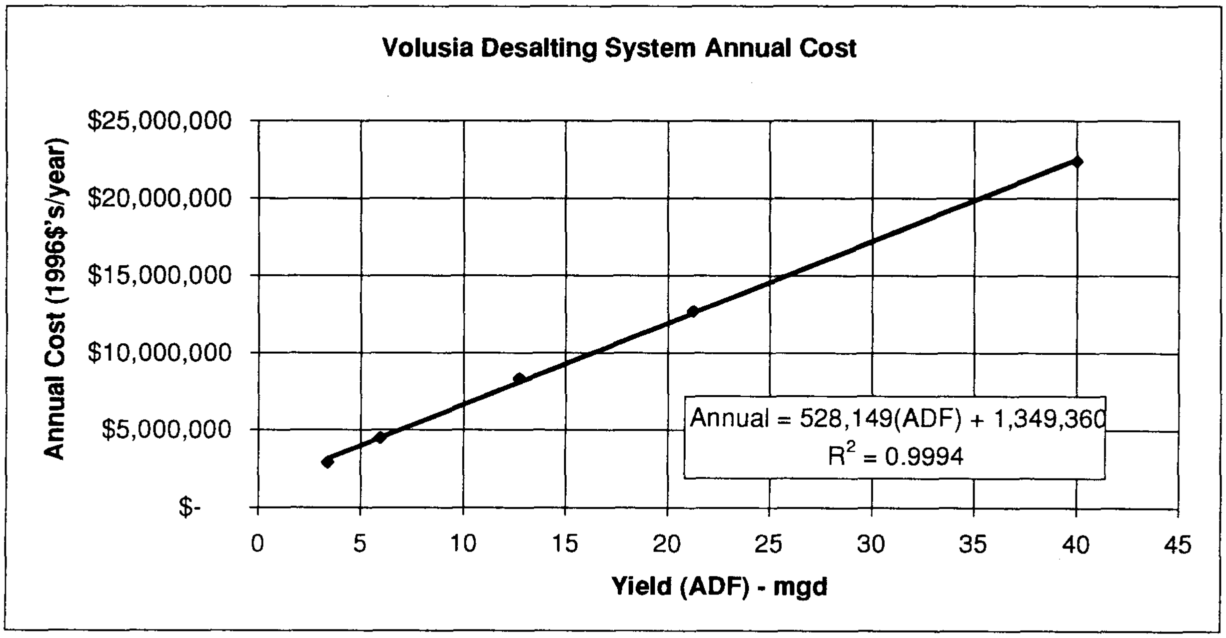


Table D2 - Volusia Brackish Ground Water Cost Summary -- Desalting System (Wellfield plus RO Plant plus Concentrate Disposal Well)

Yield	Cl	TDS	Construction Cost	Capital Cost	Annual Cost	Production Cost $/1000 gal.	O&M Cost $/year	Unit Cost $/1000 gal
3.4	12	51	$ 8,817,953	$ 12,889,431	$ 2,910,751	$ 2.345	$ 1,561,509	$ 0.325
5.95	15	57	$ 12,526,887	$ 18,321,556	$ 4,493,090	$ 2.069	$ 2,528,917	$ 0.325
12.75	25	74	$ 21,504,607	$ 31,499,011	$ 8,321,200	$ 1.788	$ 4,882,541	$ 0.325
21.25	37	96	$ 31,687,355	$ 46,277,745	$ 12,681,870	$ 1.635	$ 7,593,118	$ 0.325
40	67	149	$ 56,753,855	$ 82,919,044	$ 22,361,144	$ 1.532	$ 13,225,463	$ 0.330

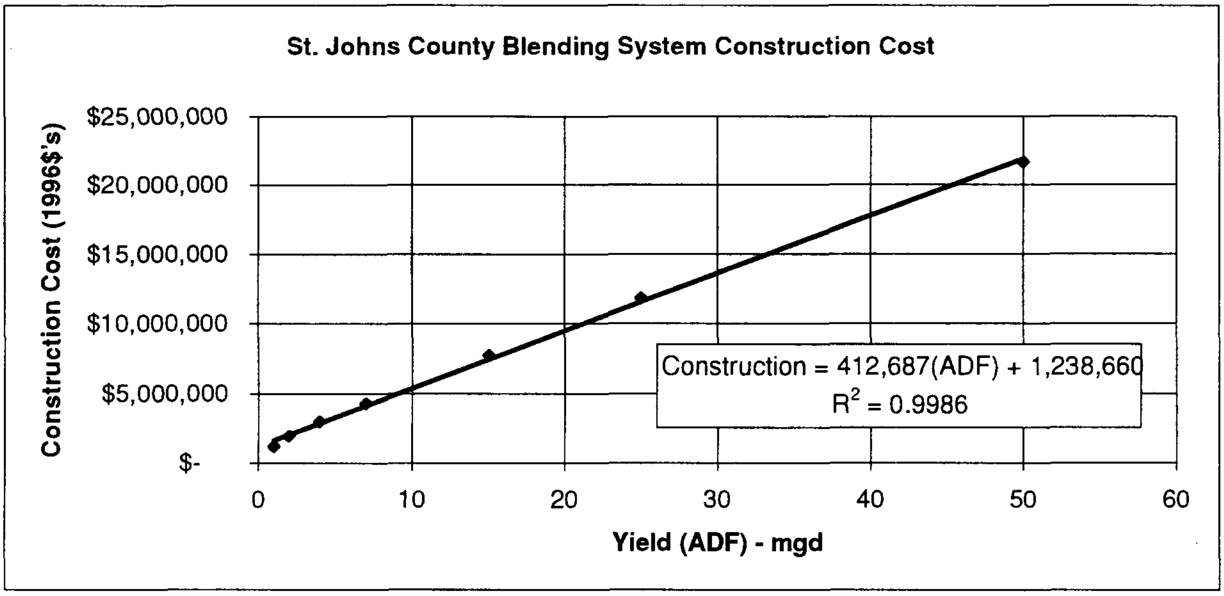




Appendix E
Cost Estimates and Equations for St. Johns County Site

Table E1 - St. Johns County Brackish Ground Water Cost Summary -- Blending System (Wellfield plus Plant)

Yield	Cl	TDS	Construction Cost	Capital Cost	Annual Cost	Production Cost $/1000 gal.	O&M Cost $/year	Unit Cost $/1000 gal
1	146.3	557	$ 1,216,309	$ 1,812,876	$ 248,619	$ 0.681	$ 97,926	$ 0.115
2	154	571	$ 1,937,636	$ 2,884,510	$ 384,231	$ 0.526	$ 144,087	$ 0.115
4	170	600	$ 2,958,650	$ 4,393,443	$ 601,879	$ 0.412	$ 235,716	$ 0.115
7	194	642	$ 4,298,767	$ 6,390,782	$ 903,454	$ 0.354	$ 372,446	$ 0.115
15	257	754	$ 7,720,086	$ 11,511,455	$ 1,685,389	$ 0.308	$ 737,919	$ 0.115
25	336	895	$ 11,821,633	$ 17,472,448	$ 2,625,964	$ 0.288	$ 1,196,241	$ 0.115
50	533	1246	$ 21,637,049	$ 31,999,676	$ 4,935,541	$ 0.270	$ 2,342,046	$ 0.115



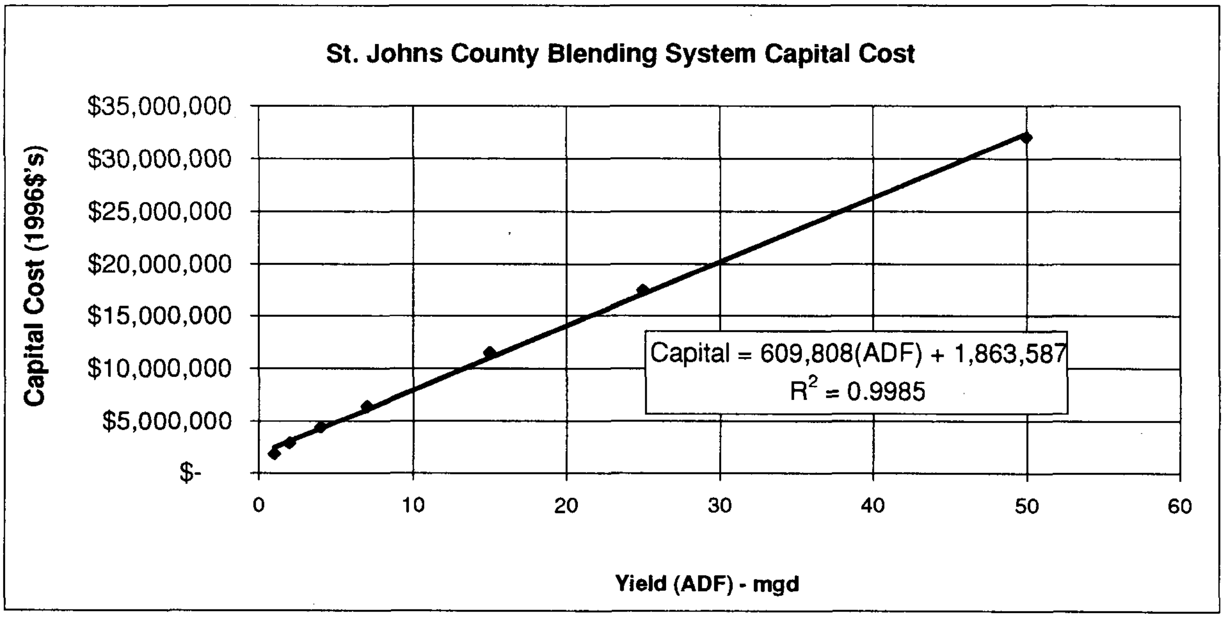
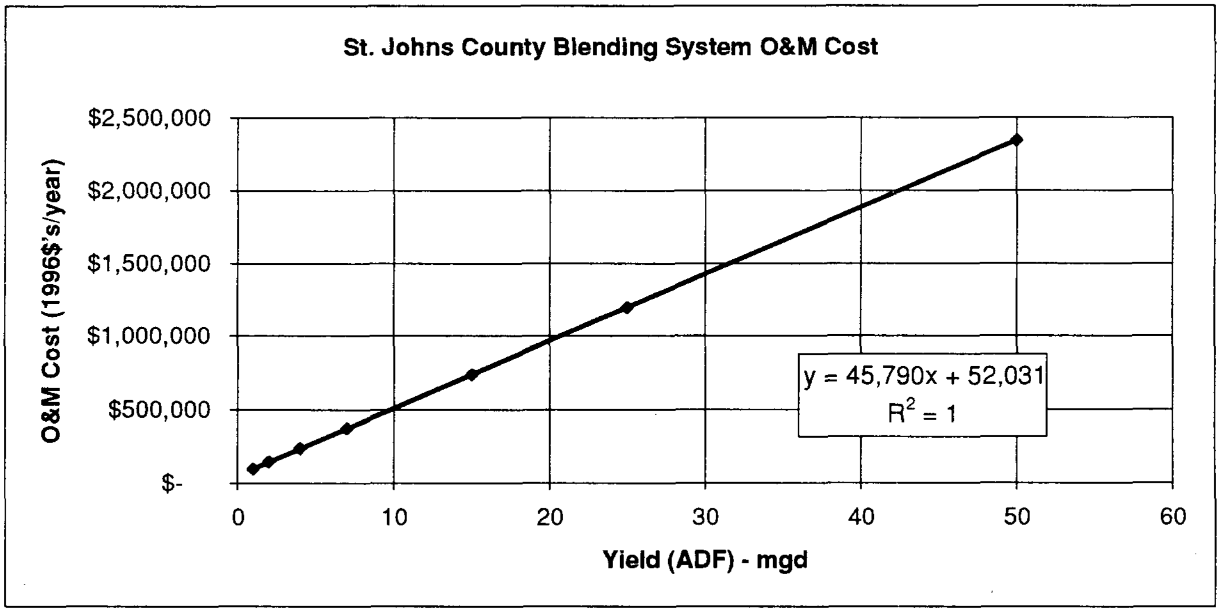


Table E1 - St. Johns County Brackish Ground Water Cost Summary -- Blending System (Wellfield plus Plant)

Yield	Cl	TDS	Construction Cost	Capital Cost	Annual Cost	Production Cost $/1000 gal.	O&M Cost $/year	Unit Cost $/1000 gal
1	146	557	$ 1,216,309	$ 1,812,876	$ 248,619	$ 0.681	$ 97,926	$ 0.115
2	154	571	$ 1,937,636	$ 2,884,510	$ 384,231	$ 0.526	$ 144,087	$ 0.115
4	170	600	$ 2,958,650	$ 4,393,443	$ 601,879	$ 0.412	$ 235,716	$ 0.115
7	194	642	$ 4,298,767	$ 6,390,782	$ 903,454	$ 0.354	$ 372,446	$ 0.115
15	257	754	$ 7,720,086	$ 11,511,455	$ 1,685,389	$ 0.308	$ 737,919	$ 0.115
25	336	895	$ 11,821,633	$ 17,472,448	$ 2,625,964	$ 0.288	$ 1,196,241	$ 0.115
50	533	1246	$ 21,637,049	$ 31,999,676	$ 4,935,541	$ 0.270	$ 2,342,046	$ 0.115



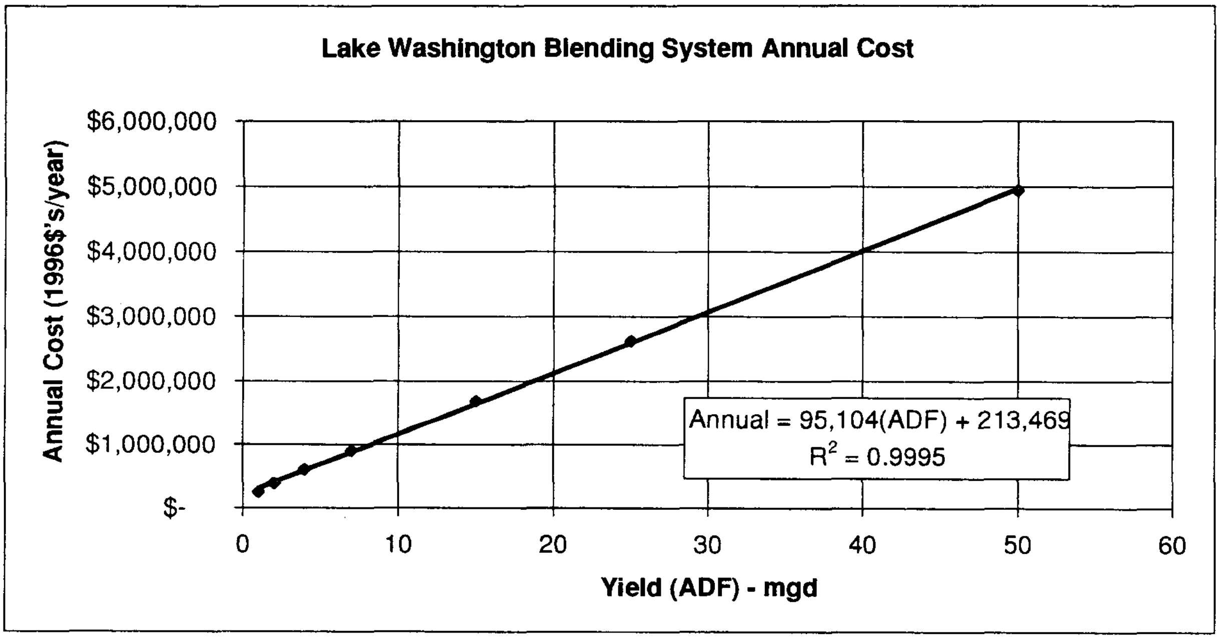
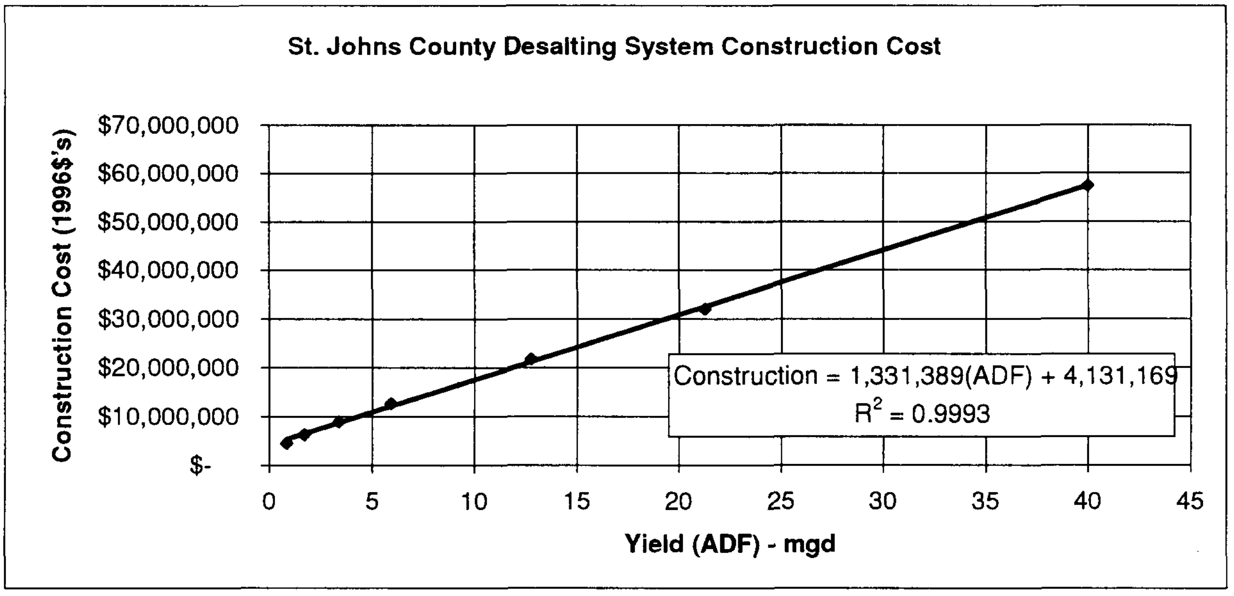


Table E2 - St. Johns County Brackish Ground Water Cost Summary -- Desalting System (Wellfield plus RO Plant plus Concentrate Disposal Well)

Yield	Cl	TDS	Construction Cost	Capital Cost	Annual Cost	Production Cost $/1000 gal.	O&M Cost $/year	Unit Cost $/1000 gal
0.85	15	56	$ 4,566,883	$ 6,671,209	$ 1,114,545	$ 3.592	$ 475,685	$ 0.325
1.7	15	57	$ 6,166,664	$ 9,016,601	$ 1,764,412	$ 2.844	$ 860,720	$ 0.325
3.4	17	60	$ 8,883,424	$ 12,984,364	$ 2,918,401	$ 2.352	$ 1,561,509	$ 0.325
5.95	19	64	$ 12,625,093	$ 18,463,956	$ 4,504,566	$ 2.074	$ 2,528,917	$ 0.325
12.75	26	75	$ 21,701,021	$ 31,783,812	$ 8,344,151	$ 1.793	$ 4,882,541	$ 0.325
21.25	34	89	$ 31,998,343	$ 46,728,679	$ 12,718,210	$ 1.640	$ 7,593,118	$ 0.325
40	53	125	$ 57,343,096	$ 83,773,445	$ 22,429,997	$ 1.536	$ 13,225,463	$ 0.330



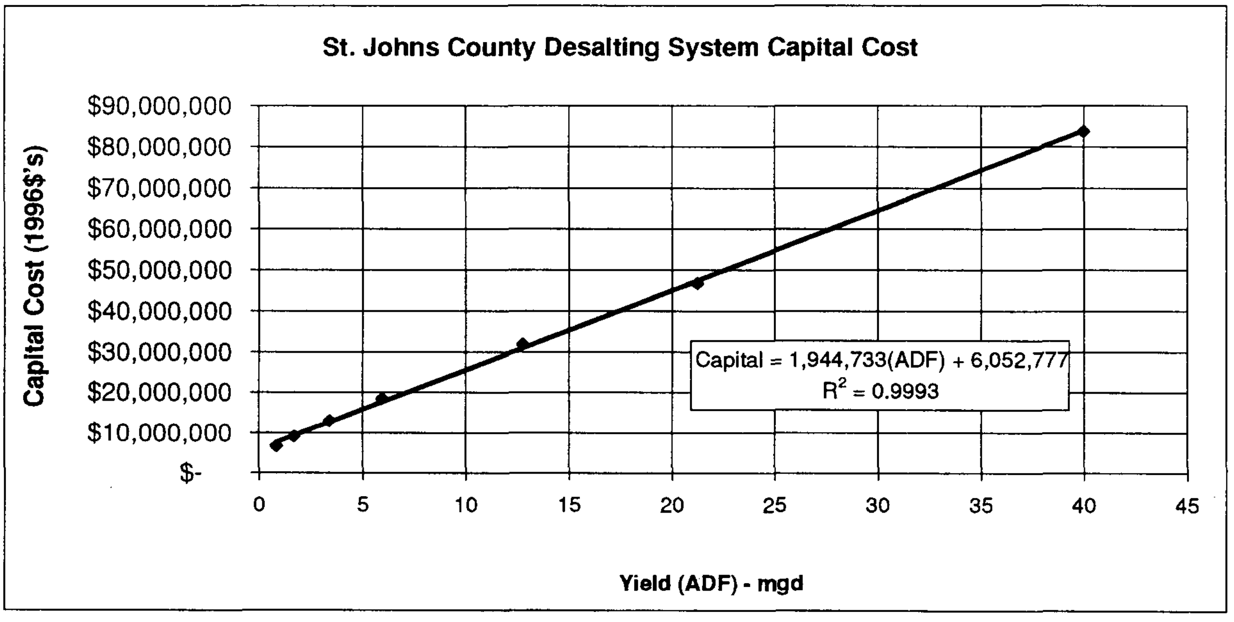
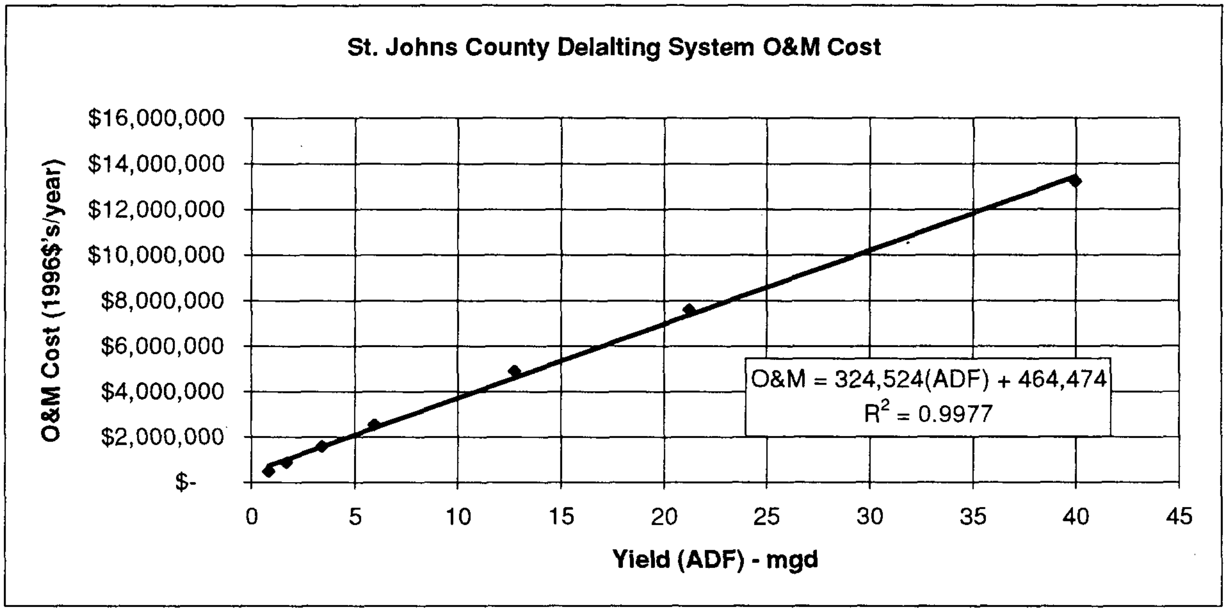
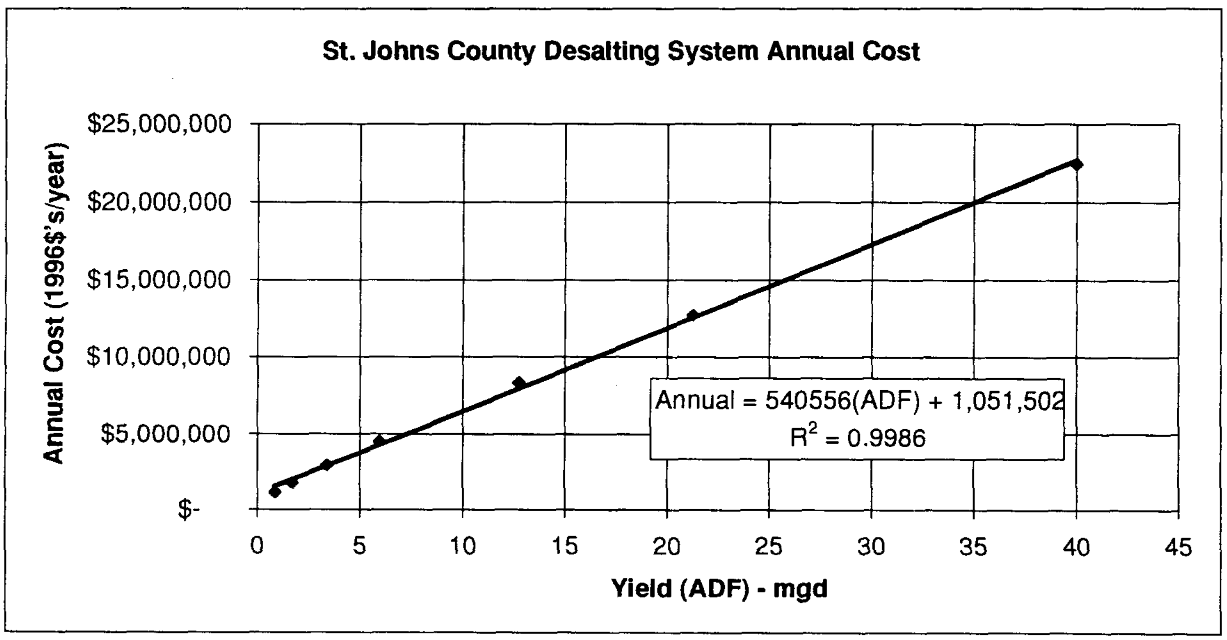


Table E2 - St. Johns County Brackish Ground Water Cost Summary -- Desalting System (Wellfield plus RO Plant plus Concentrate Disposal Well)

Yield	Cl	TDS	Construction Cost	Capital Cost	Annual Cost	Production Cost $/1000 gal.	O&M Cost $/year	Unit Cost $/1000 gal
0.85	15	56	$ 4,566,883	$ 6,671,209	$ 1,114,545	$ 3.592	$ 475,685	$ 0.325
1.7	15	57	$ 6,166,664	$ 9,016,601	$ 1,764,412	$ 2.844	$ 860,720	$ 0.325
3.4	17	60	$ 8,883,424	$ 12,984,364	$ 2,918,401	$ 2.352	$ 1,561,509	$ 0.325
5.95	19	64	$ 12,625,093	$ 18,463,956	$ 4,504,566	$ 2.074	$ 2,528,917	$ 0.325
12.75	26	75	$ 21,701,021	$ 31,783,812	$ 8,344,151	$ 1.793	$ 4,882,541	$ 0.325
21.25	34	89	$ 31,998,343	$ 46,728,679	$ 12,718,210	$ 1.640	$ 7,593,118	$ 0.325
40	53	125	$ 57,343,096	$ 83,773,445	$ 22,429,997	$ 1.536	$ 13,225,463	$ 0.330

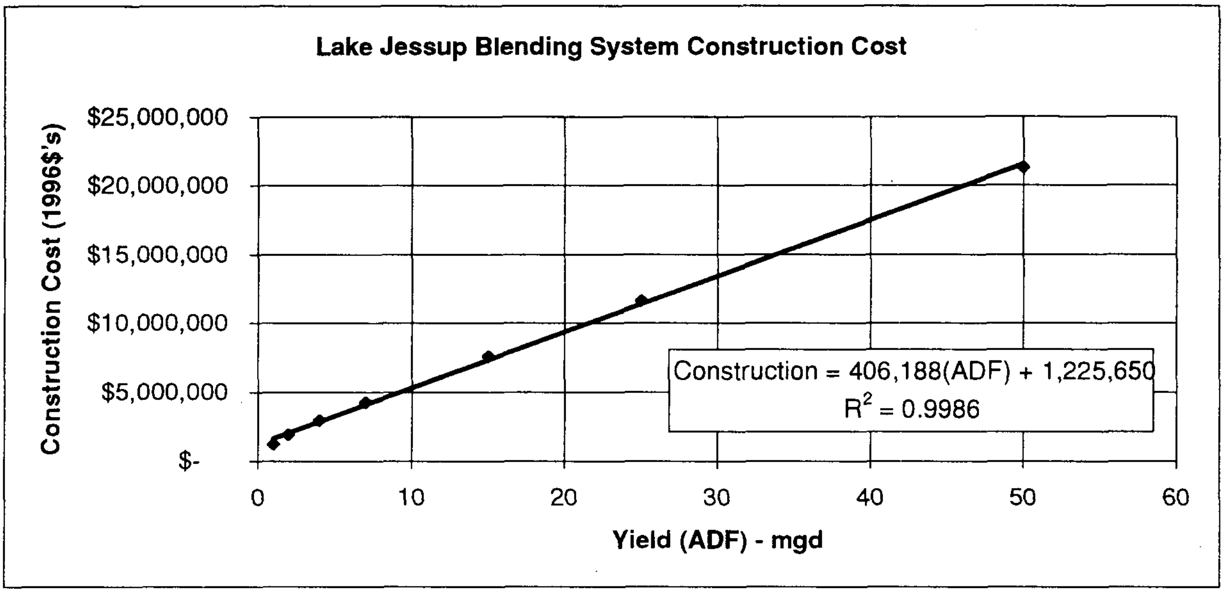




Appendix F
Cost Estimates and Equations for Lake Jessup Site

Table F1 - Lake Jessup Brackish Ground Water Cost Summary -- Blending System (Wellfield plus Plant)

Yield	Cl	TDS	Construction Cost	Capital Cost	Annual Cost	Production Cost $/1000 gal.	O&M Cost $/year	Unit Cost $/1000 gal
1	31.6	353	$ 1,197,603	$ 1,785,753	$ 246,433	$ 0.675	$ 97,926	$ 0.115
2	79	438	$ 1,909,577	$ 2,843,824	$ 380,953	$ 0.522	$ 144,087	$ 0.115
4	127	524	$ 2,921,238	$ 4,339,195	$ 597,507	$ 0.409	$ 235,716	$ 0.115
7	166	592	$ 4,242,648	$ 6,309,411	$ 896,897	$ 0.351	$ 372,446	$ 0.115
15	218	686	$ 7,607,849	$ 11,348,712	$ 1,672,274	$ 0.305	$ 737,919	$ 0.115
25	254	749	$ 11,643,925	$ 17,214,772	$ 2,605,199	$ 0.286	$ 1,196,241	$ 0.115
50	302	834	$ 21,300,340	$ 31,519,543	$ 4,896,763	$ 0.268	$ 2,342,046	$ 0.115



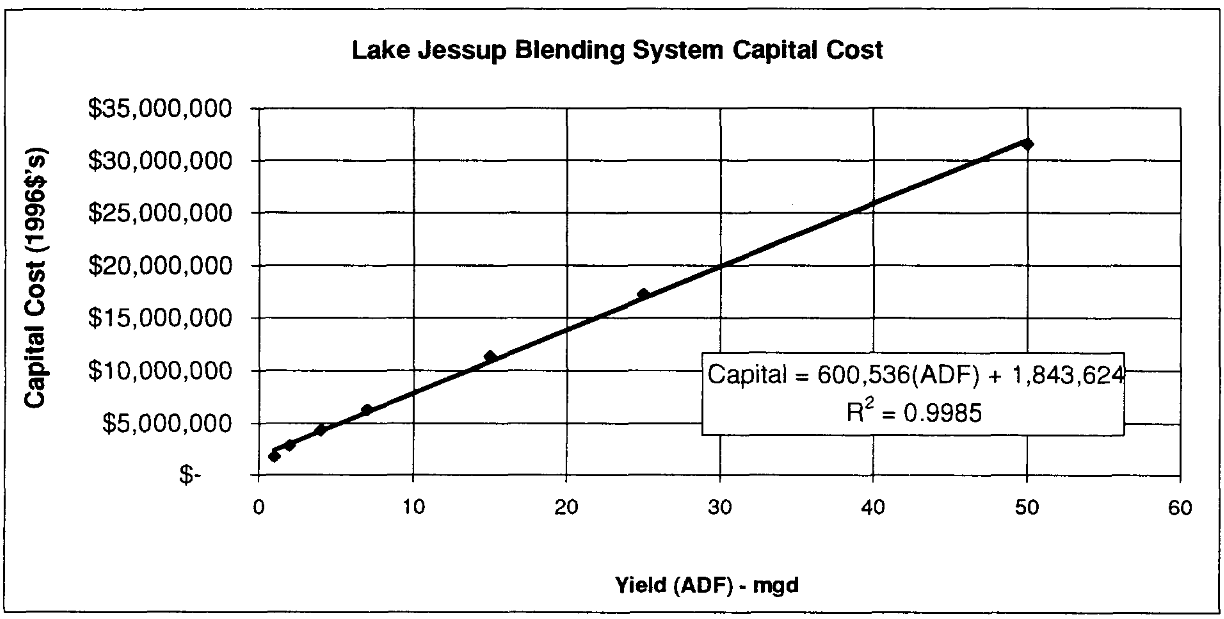
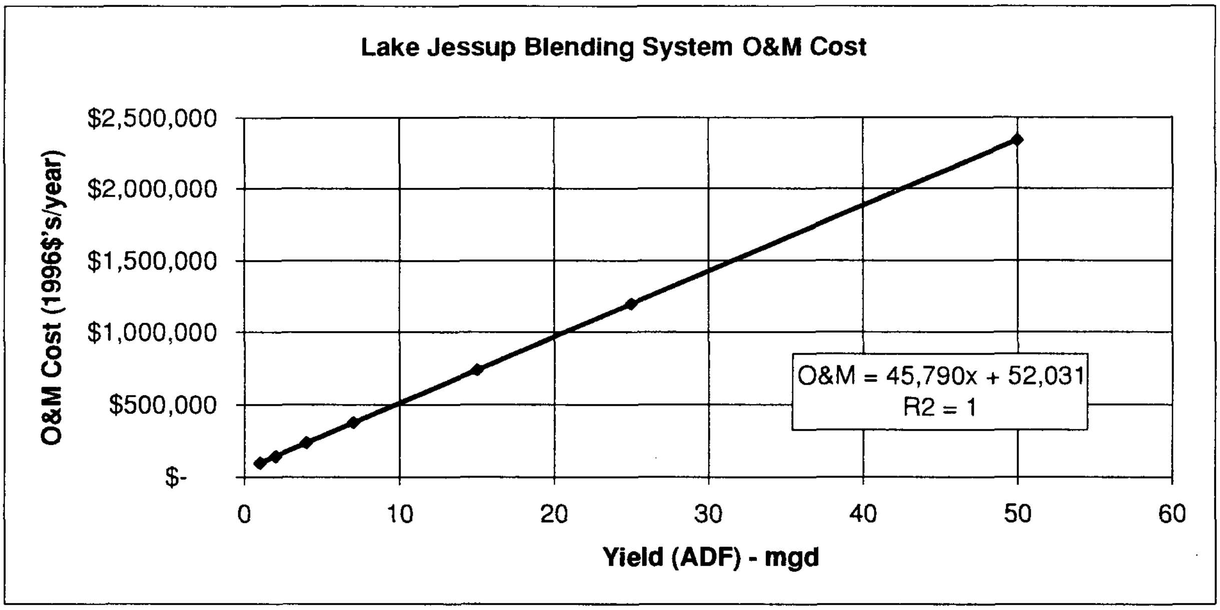


Table F1 - Lake Jessup Brackish Ground Water Cost Summary -- Blending System (Wellfield plus Plant)

Yield	Cl	TDS	Construction Cost	Capital Cost	Annual Cost	Production Cost $/1000 gal.	O&M Cost $/year	Unit Cost $/1000 gal
1	32	353	$ 1,197,603	$ 1,785,753	$ 246,433	$ 0.675	$ 97,926	$ 0.115
2	79	438	$ 1,909,577	$ 2,843,824	$ 380,953	$ 0.522	$ 144,087	$ 0.115
4	127	524	$ 2,921,238	$ 4,339,195	$ 597,507	$ 0.409	$ 235,716	$ 0.115
7	166	592	$ 4,242,648	$ 6,309,411	$ 896,897	$ 0.351	$ 372,446	$ 0.115
15	218	686	$ 7,607,849	$ 11,348,712	$ 1,672,274	$ 0.305	$ 737,919	$ 0.115
25	254	749	$ 11,643,925	$ 17,214,772	$ 2,605,199	$ 0.286	$ 1,196,241	$ 0.115
50	302	834	$ 21,300,340	$ 31,519,543	$ 4,896,763	$ 0.268	$ 2,342,046	$ 0.115



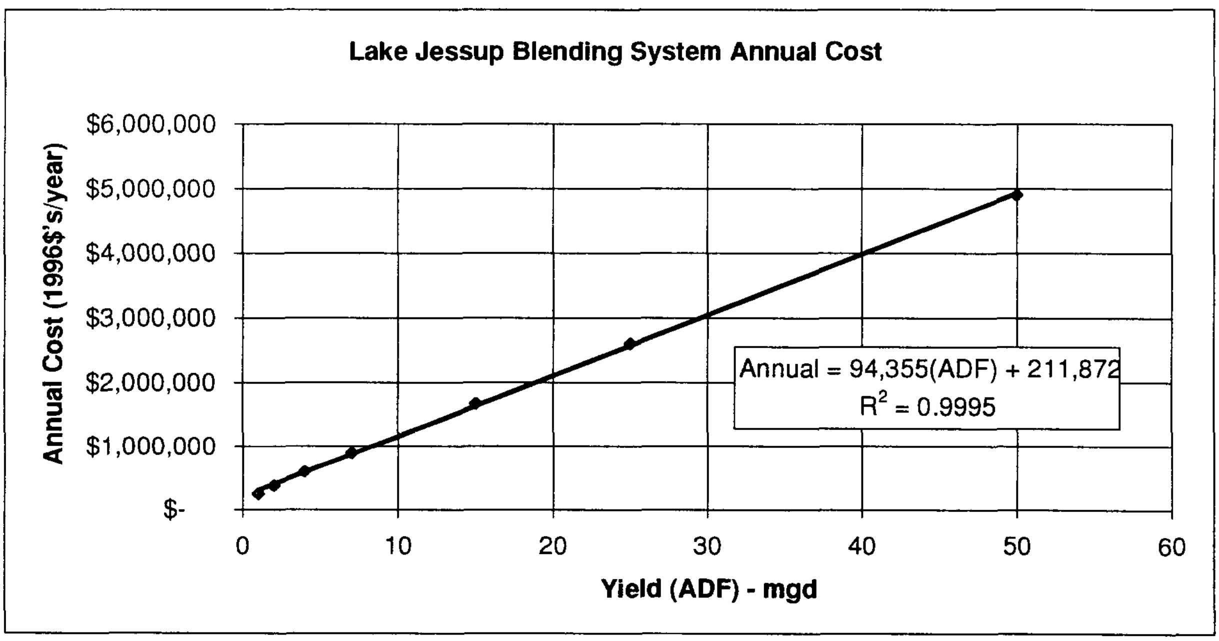
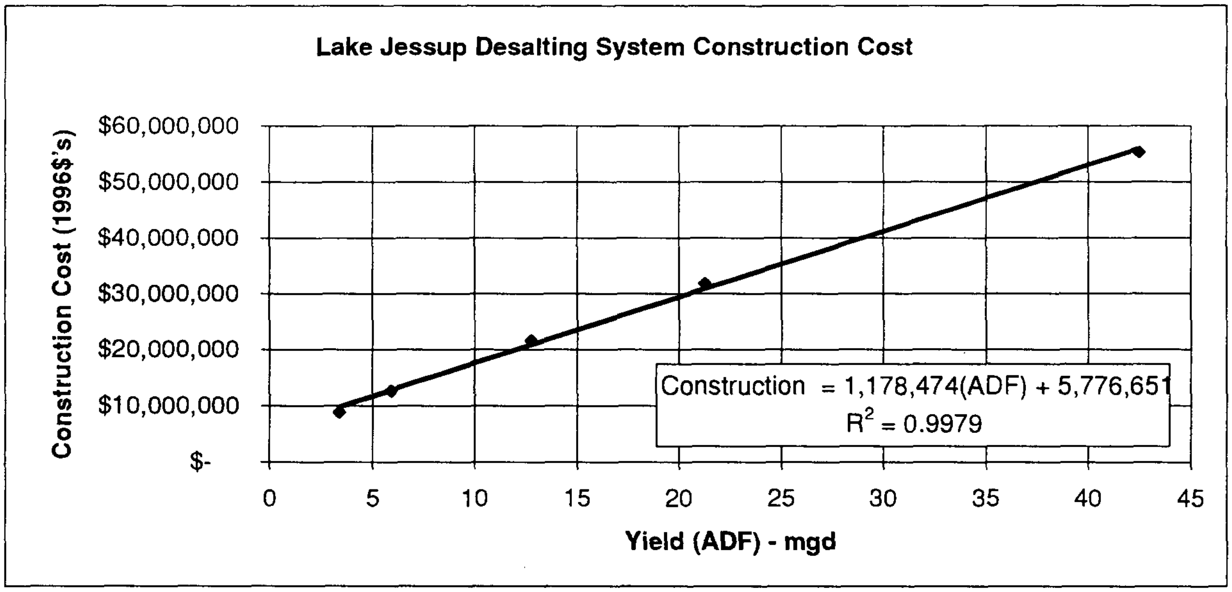


Table F2 - Lake Jessup Brackish Ground Water Cost Summary -- Desalting System (Wellfield plus RO Plant plus Concentrate Disposal Well)

Yield	Cl	TDS	Construction Cost	Capital Cost	Annual Cost	Production Cost $/1000 gal.	O&M Cost $/year	Unit Cost $/1000 gal
3.4	13	52	$ 8,846,012	$ 12,930,117	$ 2,914,030	$ 2.348	$ 1,561,509	$ 0.325
5.95	17	59	$ 12,568,975	$ 18,382,584	$ 4,498,009	$ 2.071	$ 2,528,917	$ 0.325
12.75	22	69	$ 21,588,785	$ 31,621,069	$ 8,331,036	$ 1.790	$ 4,882,541	$ 0.325
21.25	25	75	$ 31,820,636	$ 46,471,002	$ 12,697,444	$ 1.637	$ 7,593,118	$ 0.325
42.5	30	83	$ 55,230,875	$ 80,718,819	$ 22,710,616	$ 1.464	$ 13,833,846	$ 0.325



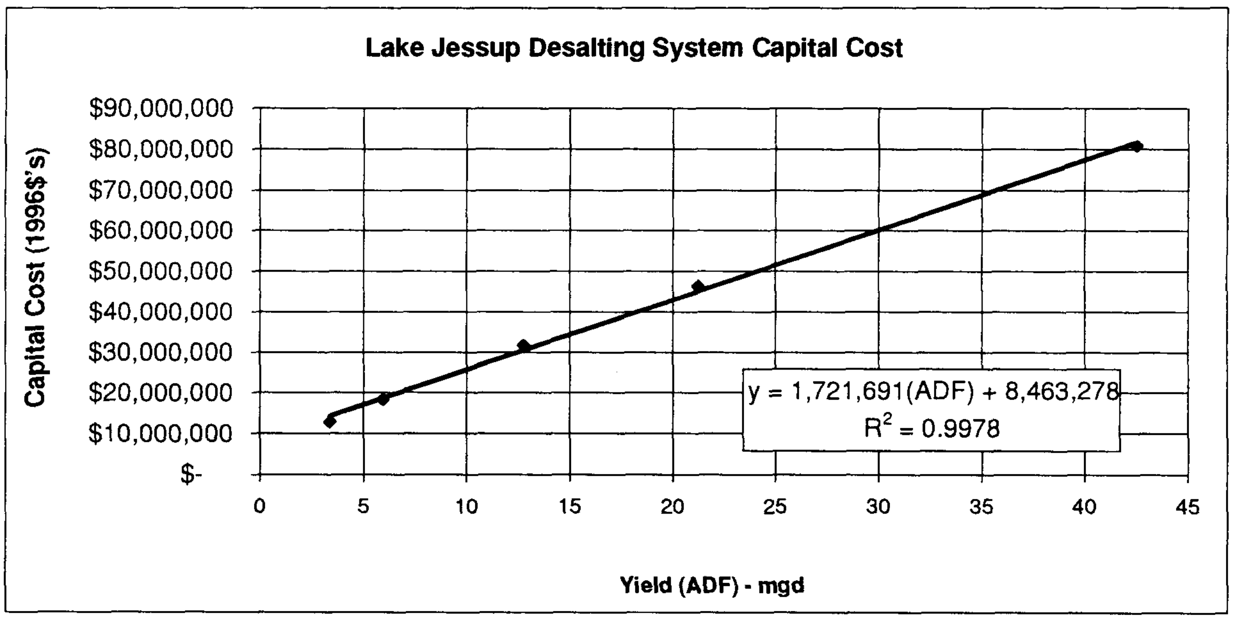


Table F2 - Lake Jessup Brackish Ground Water Cost Summary -- Desalting System (Wellfield plus RO Plant plus Concentrate Disposal Well)

Yield	Cl	TDS	Construction Cost	Capital Cost	Annual Cost	Production Cost $/1000 gal.	O&M Cost $/year	Unit Cost $/1000 gal
3.4	13	52	$ 8,846,012	$ 12,930,117	$ 2,914,030	$ 2.348	$ 1,561,509	$ 0.325
5.95	17	59	$ 12,568,975	$ 18,382,584	$ 4,498,009	$ 2.071	$ 2,528,917	$ 0.325
12.75	22	69	$ 21,588,785	$ 31,621,069	$ 8,331,036	$ 1.790	$ 4,882,541	$ 0.325
21.25	25	75	$ 31,820,636	$ 46,471,002	$ 12,697,444	$ 1.637	$ 7,593,118	$ 0.325
42.5	30	83	$ 55,230,875	$ 80,718,819	$ 22,710,616	$ 1.464	$ 13,833,846	$ 0.325