Reclaimed Water for Athletic Complex Irrigation: City of Dallas Case Study

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ABSTRACT

The Elm Fork Athletic Complex (EFAC), a 160-acre master-planned soccer facility, is proposed to be constructed in the City of Dallas (City). The EFAC will sit on the site of a former landfill, allowing the City to market this new facility to the soccer community, increase urban park area and trail networks, as well as promoting sustainable design and enhancement of storm water quality. During design, the project included a Reclaimed Water Supply Feasibility Study, to evaluate the feasibility of providing reclaimed water (in lieu of potable water) for irrigation at the EFAC.

Five alternatives were evaluated in the Reclaimed Water Supply Feasibility Study:
1. Wastewater treatment scalping facility located within Dallas Water Utilities collection system
2. Wastewater treatment scalping facility located within Trinity River Authority (TRA) collection system
3. Diversion of TRA Central Regional Wastewater System’s effluent reuse in cooperation with Dallas County Utility and Reclamation District (DCURD)/City of Irving (COI) with the following options: (a) Storage at a DCURD system lake with pumping to the EFAC on-site storage pond and/or directly to the irrigation system, (b) Storage in a new ground storage tank and pumping directly to the EFAC irrigation system, and (c) Direct diversion to the EFAC on-site storage pond

Site selection criteria were established for the determination of scalping facility feasibility. These site selection criteria were established from current Texas Administrative Code on the use of reclaimed water and reclaimed water production facilities. Two potential scalping facility sites were identified within one mile of the EFAC and were evaluated for feasibility.

In contrast to the City providing their own reclaimed water through a scalping facility, three options were evaluated for the purchase of reclaimed water from local sources (DCURD/COI) to supply the EFAC.

This paper describes the regulatory and economic factors that were considered in the Reclaimed Water Supply Feasibility Study for providing reclaimed water to the EFAC. Items covered will include anticipated reclaimed water demands for the EFAC and for the potential of serving
surrounding large water use customers, scalping facility capacity and technologies, connection to an existing reclaimed water system, in addition to comparable life cycle costs for each alternative as compared to potable water.

KEYWORDS

Reclaimed water, City of Dallas, irrigation, scalping plant, reclaimed water production facility

INTRODUCTION

The proposed Elm Fork Athletic Complex is a master-planned soccer facility located on a portion of the closed City of Dallas Walnut Hill Landfill. This 400-acre landfill, closed in 1984, was identified by the Elm Fork Floodplain Management Study (completed in 2004) as a feasible area for development of a sports complex. The development of a major soccer complex on the site of a former landfill allows the City of Dallas (City) to market these new facilities to the soccer community, increase urban park area, add to the trail networks, promote sustainable design, and enhance storm water quality.

A Master Plan Report for the EFAC was completed in January 2007. According to the Report the EFAC will encompass approximately 160-acres bounded by Walnut Hill Lane on the north, Goodnight Lane on the east, Dallas Area Rapid Transit (DART)/Burlington Northern Santa Fe (BNSF) railroad on the south, and Spangler Road on the west. The Master Plan Report identified goals and concepts for the development of the EFAC in two phases. Phase 1 is currently in design (with construction starting in summer 2010) and will include eight large soccer fields and five small soccer fields. Phase 2 will complete the build-out and will include an additional eight large soccer fields and one small soccer field. A nature trail area will also be included in Phase 2. The EFAC location and Master Plan Site layout is presented in Figure 1.

A feasibility report was prepared for the City to include a description and evaluation of the following alternatives for providing reclaimed water to the EFAC for irrigation and non-potable restroom use.

- Construct a reclaimed water production facility (scalping plant)
- Purchase reclaimed water from Dallas County Utility and Reclamation District (DCURD)
- Purchase reclaimed water from the City of Irving

RECLAIMED WATER DEMANDS

The EFAC Master Plan Report identified irrigation requirements for all vegetation types and for the two phases of development. These irrigation requirements were revised in October 2008 to align with the design. The irrigation requirements of the EFAC are outlined below in addition to other potential reclaimed water customer demands.

Elm Fork Athletic Complex Irrigation Demands

In order to meet the irrigation demands of the new EFAC, the Landscape Master Plan for the EFAC proposed a two-stage approach to establish the turf in the new athletic complex. The first stage is an Establishment Period. This period is required to germinate and promote growth for the new seeded, sprigged or sodded fields. In the Establishment Period, it is anticipated that the turf will require 3 inches of water (including rainfall) per week for the turf to be thoroughly
rooted and established. This first stage will last between two and four weeks. The second stage is the Maintenance Period which commences after the Establishment Period, reducing the water need to 1-1/2 inches per week (including rainfall). A summary of the vegetation inventory for each phase of the EFAC is included in Table 1.

### Table 1  EFAC Vegetation Inventory

<table>
<thead>
<tr>
<th>Vegetation Component</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large Fields (count)</td>
<td>8</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>Small Fields (count)</td>
<td>5</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Turf (ft²)</td>
<td>1,257,800</td>
<td>1,071,200</td>
<td>2,329,000</td>
</tr>
<tr>
<td>Trees (count)</td>
<td>100</td>
<td>80</td>
<td>180</td>
</tr>
</tbody>
</table>

Assumptions made for the Establishment Period irrigation include:
- Turf application rate of 3 inches per week
- Tree application rate of 70 gallons per week
- Irrigation period of 16 hours per day
- Irrigating 7 days a week for up to six weeks

Assumptions made for the Maintenance Period irrigation include:
- Turf application rate of 1-1/2 inches per week
- Tree application rate of 35 gallons per week
- Irrigation period of 8 hours per day (approximately 10 PM to 6 AM)
- Irrigation schedule can range from 2 days a week to 6 days per week

The irrigation rates identified in Table 2 were based on the above assumptions.

### Table 2  EFAC Weekly Irrigation Requirements

<table>
<thead>
<tr>
<th>Phase</th>
<th>Establishment Period Irrigation (gallons/week)</th>
<th>Maintenance Period Irrigation (gallons/week)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1</td>
<td>2,359,000</td>
<td>1,180,000</td>
</tr>
<tr>
<td>Phase 2</td>
<td>2,009,000</td>
<td>1,004,000</td>
</tr>
<tr>
<td>Total</td>
<td>---</td>
<td>2,184,000</td>
</tr>
</tbody>
</table>
The Establishment Period will require a little less than 1/2 inch of water per day. The Maintenance Period irrigation demand can be applied in one of the three irrigation schedules identified in Table 3.

### Table 3  EFAC Maintenance Period Irrigation Schedule Options (Both Phases)

<table>
<thead>
<tr>
<th>Irrigation Schedule</th>
<th>Maintenance Irrigation Period (gallons per day)</th>
<th>Maintenance Irrigation Period (gallons per hour)</th>
<th>Maintenance Irrigation Period (gallons per minute)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Days per Week</td>
<td>1,092,000</td>
<td>136,500</td>
<td>2,275</td>
</tr>
<tr>
<td>3 Days per Week</td>
<td>728,000</td>
<td>91,000</td>
<td>1,516</td>
</tr>
<tr>
<td>6 Days per Week</td>
<td>364,000</td>
<td>45,500</td>
<td>758</td>
</tr>
</tbody>
</table>

1 Eight hour watering window.

### Additional Potential Reclaimed Water Users

In addition to providing reclaimed water to the EFAC, a proximity analysis was conducted to identify any other potential customers that could also be served by reclaimed water (provided by a scalping plant or other provider). This would require that the additional capacity be added to that needed for the EFAC irrigation. Other potential customers include large potable water users, parks, golf courses, educational institutions, cemeteries, and stadiums or arenas.

Potable water consumption data for City of Dallas customers was obtained in December 2008 from the City. Within a five mile radius from the EFAC, thirteen potable water users (consuming 20,000 gpd or greater) were identified, as listed in Table 4. Only three of the thirteen identified customers met the reclaimed water requirement of 50,000 gpd identified in the City’s Recycled Water Implementation Plan.

### Table 4  Potable Water Users in Five Mile Radius to EFAC (≥ 20,000 gpd)

<table>
<thead>
<tr>
<th>Customer Name</th>
<th>Address</th>
<th>User Type</th>
<th>Average Water Consumption (gallons/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Petra Chemical Company</td>
<td>2929 Storey Lane</td>
<td>Factory/Manufacturer</td>
<td>77,000</td>
</tr>
<tr>
<td>United Parcel Service</td>
<td>10155 Monroe Drive</td>
<td>Vehicle Servicing/Washing</td>
<td>67,000</td>
</tr>
<tr>
<td>Texas Industries, Inc.</td>
<td>10618 Spangler Road</td>
<td>Factory/Manufacturer</td>
<td>62,000</td>
</tr>
<tr>
<td>Lattimore Materials Co.</td>
<td>10361 Bickham Road</td>
<td>Factory/Manufacturer</td>
<td>40,000</td>
</tr>
<tr>
<td>Custom Crete Inc.</td>
<td>2624 Joe Field Road</td>
<td>Factory/Manufacturer</td>
<td>35,000</td>
</tr>
<tr>
<td>Lopez Foods</td>
<td>9727 Brockbank Drive</td>
<td>Factory/Manufacturer</td>
<td>34,000</td>
</tr>
<tr>
<td>Taylor Publishing Co.</td>
<td>1550 West Mockingbird Lane</td>
<td>Factory/Manufacturer</td>
<td>30,000</td>
</tr>
<tr>
<td>The Bentley Retirement</td>
<td>3362 Forest Lane</td>
<td>Other Business</td>
<td>27,000</td>
</tr>
<tr>
<td>Cinemark Inc.</td>
<td>11819 Web Chapel Road</td>
<td>Other Business</td>
<td>27,000</td>
</tr>
<tr>
<td>AJR Metal Works, Inc.</td>
<td>2829 Reward Lane</td>
<td>Commercial</td>
<td>27,000</td>
</tr>
<tr>
<td>John Roberts BMW, Inc.</td>
<td>11661 Denton Drive</td>
<td>Automobile Dealers</td>
<td>23,000</td>
</tr>
<tr>
<td>LES of Texas</td>
<td>11115 Goodnight Lane</td>
<td>Factory/Manufacturer</td>
<td>22,000</td>
</tr>
<tr>
<td>Jong Park</td>
<td>10788 Harry Hines Boulevard</td>
<td>Warehouse</td>
<td>21,000</td>
</tr>
</tbody>
</table>

Of the three City of Dallas large potable water users (≥ 50,000 gpd), the United Parcel Service was not considered as a potential reclaimed water customer as there was a potential for extensive human contact during the servicing/washing of the vehicles. The Petra Chemical Company and
Texas Industries, Inc. likely use potable water for manufacturing purposes. Additional evaluation on the feasibility of these potential reclaimed water customers was not performed at the time of the study and would be necessary to assess the manufacturing water quality requirements and project interest.

Additionally, none of the parks, educational institutions, cemeteries, and stadiums within a five mile radius of the EFAC were identified as large potable water customers for the City and would have large capital investments for smaller reclaimed water use benefits. These facilities were not evaluated further in this study. Two golf courses, L.B. Houston and the North Texas Golf Center (NTGC), are in close proximity to the EFAC and were evaluated for the feasibility of their connection to a reclaimed water system from a reclaimed water provider.

The L.B. Houston Golf Course is a City of Dallas-owned facility located at Royal Lane and Luna Road. It uses water from an on-channel reservoir of the Elm Fork of the Trinity River, to fill adjacent on-site storage ponds for irrigation of fairways and greens (200 acres). Water used to irrigate the course costs about approximately $0.50/1,000 gallons. With this low raw water rate (as compared to potable water) and infrastructure in place to irrigate with water from the Elm Fork of the Trinity River, the total cost for the utilization of reclaimed would not be cost effective for the City of Dallas to switch L.B. Houston to reclaimed water.

The NTGC is located adjacent to the EFAC along the northwest boundary, at Walnut Hill Lane and Luna Road. This facility irrigates the course turf during the months of April through October (as-needed), with potable water. The facility has two water meters: one meter for the club house and restroom use and the second meter for irrigation. NTGC management has indicated that they spend an average of $1,300 per month on potable water used for irrigation. Based on a $3.00/1,000 gallon rate (as of October 1, 2008 rates), it is assumed that the facility irrigates at a rate of approximately 14,500 gallons per day or 101,500 gallons per week. This daily water usage is below that identified as a potential reclaimed water customer in the City’s Recycled Water Implementation Plan. Management at the NTGC would be interested in using reclaimed water for irrigation if it is more cost-effective than using potable water.

REGULATORY REQUIREMENTS

The Texas Commission on Environmental Quality (TCEQ) is the governing body in the State of Texas for reclaimed water projects. Several chapter rules apply and are reviewed below.

TCEQ Chapter 210 – Use of Reclaimed Water

Chapter 210 applies to reclaimed water producers, providers, and users. It defines two types of reclaimed water, Type I and Type II, respectively. The two reclaimed water types differ in their quality standards, and are therefore limited to certain applications.

Type I reclaimed water is water used for irrigation or other uses in areas where the public may be present during the time when irrigation takes place or other uses where the public may come in contact with reclaimed water. Type II reclaimed water applications include irrigation or other uses in areas where the public is not present during irrigation activities or other uses where the public would not come in contact with the reclaimed water. Table 5 identifies applications that can utilize Type I or Type II reclaimed water.
Table 5: Applications for Type I and Type II Reclaimed Water

<table>
<thead>
<tr>
<th>Type I</th>
<th>Type II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban parks, athletic fields</td>
<td>Irrigation of sod farms, highway right of ways</td>
</tr>
<tr>
<td>Irrigation of food crops (direct contact with edible portion)</td>
<td>Irrigation of food crops (no direct contact with edible portion)</td>
</tr>
<tr>
<td>Fire Protection</td>
<td>Cooling tower make-up water</td>
</tr>
<tr>
<td>Residential irrigation</td>
<td>Maintenance of water bodies were direct human contact is unlikely</td>
</tr>
<tr>
<td>Golf Courses with unrestricted access</td>
<td>Soil compaction/dust control</td>
</tr>
<tr>
<td>Maintenance of water bodies for recreational activities</td>
<td></td>
</tr>
<tr>
<td>Toilet or urinal flush water</td>
<td></td>
</tr>
</tbody>
</table>

The reclaimed water for the EFAC will be classified as Type I as the potential will exist for the public to be present or come in contact with the reclaimed water during irrigation. Type I quality standards are provided in Table 6.

Table 6: Type I Reclaimed Water Quality Limits

<table>
<thead>
<tr>
<th>Parameter</th>
<th>30-Day Average Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD₃ or CBOD₅</td>
<td>5 mg/L</td>
</tr>
<tr>
<td>Turbidity</td>
<td>3 NTU</td>
</tr>
<tr>
<td>Fecal Coliform</td>
<td>20 CFU/100 mL*</td>
</tr>
<tr>
<td>Fecal Coliform (not to exceed)</td>
<td>75 CFU/100 mL**</td>
</tr>
</tbody>
</table>

BOD – Biological Oxygen Demand
CBOD – Carbonaceous Biological Oxygen Demand
NTU – Nephelometric Turbidity Units
CFU – Colony Forming Units
* Geometric Mean
** Single Grab Sample

Any potential user of reclaimed water must complete and submit an authorization request to TCEQ for approval prior to producing or using reclaimed water. Information on the producer, provider, and user is required. Amendments on current reclaimed water authorizations may be necessary for changes in service area, adding a new user, or Type I or Type II usage conversion. All service agreements between parties must be executed prior to applying for a reclaimed water authorization.

Reclaimed water stored in ponds must be prevented from discharge unless associated with rainfall events in accordance with Chapter 210. Discharge of reclaimed water into a water of the state will require a permit in accordance with Chapter 305, Consolidated Permits. Storage ponds can also be constructed within the 100-year flood plain of the Elm Fork of the Trinity River, just not in the floodway. Chapter 210 identifies specific design requirements for storage ponds or fabricated tanks depending upon the reclaimed water type.

TCEQ Chapter 321 – Control of Certain Activities by Rule, Subchapter P – Reclaimed Water Production Facility

A scalping plant or reclaimed water production facility (RWPF) is characterized as a wastewater treatment plant that withdraws a portion of the flow from a nearby gravity sanitary sewer line for
treatment and then returns all RWPFF waste streams and screenings back into the gravity sewer line. The waste and screenings are conveyed to the downstream wastewater treatment plant for final treatment and disposal. The wastewater withdrawal is on an as-needed basis and is located apart from the domestic wastewater treatment plant. The wastewater is screened, biologically treated, and disinfected to generate Type I/II reclaimed water.

Chapter 321, Subchapter P rules became effective on November 27, 2008, nineteen months after the City of Midland filed a petition to initiate rulemaking for permitting RWPFFs in Texas. The Owner of a scalping plant must possess a domestic wastewater permit and is required to have a reclaimed water authorization. Effluent limits must be in accordance with Chapter 210 dependent upon the type of reclaimed water use. Various buffer options are provided to allow the Owner flexibility in scalping plant siting, and capital investment. The treatment system must also be in accordance with the rules and guidelines established in Chapter 217, Design Criteria for Domestic Wastewater Systems.

Chapter 321 also states that the Owner of the scalping plant must also be the same as the holder of the domestic wastewater treatment permit that the scalped gravity line flows to for treatment. This item becomes a significant factor in the scalping plant site selection criteria and is further discussed in this paper.

RECLAIMED WATER PRODUCTION FACILITY

A scalping plant with a treatment capacity of 400,000 gallons per day is required to provide the irrigation water necessary for the EFAC as no feasible additional potential reclaimed water users were identified within close proximity. It is assumed that the scalping plant would be constructed in conjunction with the EFAC Phase 2 expansion around the year 2015 and will be sized to serve the Maintenance Period demands. The proximity analysis can be revisited prior to the Phase 2 design to evaluate any new or future reclaimed water customers near the potential scalping plant locations. Storage of the reclaimed water prior to irrigation can be provided by either an on-site fabricated storage tank or by the irrigation pond at the EFAC. A storage capacity of 1.0 million gallons is required for irrigating the EFAC two days per week.

Evaluated Treatment Technologies

Two treatment technology options were considered for the scalping plant evaluation: oxidation ditch (OD) and membrane bioreactor (MBR). The OD option includes units capable of providing activated sludge treatment in conventional clarifiers and aeration basins. Cloth disk filters will be required on the tail end of the OD treatment train to provide additional solids removal to meet Type I reclaimed water quality requirements. The MBR option provides for membrane equipment that can accomplish both clarification biological treatment and filtration in one unit. A summary of advantages and disadvantages for MBR and OD technologies are identified in Table 7.

The MBR process is recommended for treatment at the scalping plant. In any MBR treatment plant, screening is typically the first unit operation used at wastewater treatment plants (WWTPs). For this application, fine inline screens are recommended to provide screening within the interceptor to allow the screenings to remain in the interceptor and be transported to the downstream WWTP, and to eliminate the need for separate screenings handling equipment.
Table 7 Summary of Advantages and Disadvantages of MBR and Oxidation Ditch

<table>
<thead>
<tr>
<th></th>
<th>Membrane Bioreactor</th>
<th>Oxidation Ditch</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advantages</strong></td>
<td>• Consistent, high quality effluent.</td>
<td>• Does not require blowers and diffusers to inject air into the MLSS.</td>
</tr>
<tr>
<td></td>
<td>• Ability to treat high Mixed Liquor Suspended Solids (MLSS) concentration or heavy industrial wastewaters.</td>
<td>• Simple in operation</td>
</tr>
<tr>
<td></td>
<td>• Smaller footprint.</td>
<td>• Does not require frequent maintenance when compared to single stage nitrification or other aeration techniques.</td>
</tr>
<tr>
<td></td>
<td>• Flexibility in sludge wasting frequency.</td>
<td>• Capable of treating shock or toxic loads</td>
</tr>
<tr>
<td></td>
<td>• Effluent not compromised by sludge bulking or non-settling biomass in reactor tank.</td>
<td>• Easily adaptable for nutrient removal</td>
</tr>
<tr>
<td><strong>Disadvantages</strong></td>
<td>• Higher capital investment when compared to conventional biological treatment processes.</td>
<td>• Not capable of handling higher BOD loading rates when compared to single stage nitrification.</td>
</tr>
<tr>
<td></td>
<td>• Higher Operation and Maintenance (O&amp;M) cost.</td>
<td>• Larger footprint for construction.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Lower energy efficiency of the surface aerators and mixers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Difficult to expand plant capacity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• May be unable to consistently meet Type I effluent quality requirements</td>
</tr>
</tbody>
</table>

Disinfection of the reclaimed water is required after treatment to reduce fecal coliforms and to avoid growth of micro-organisms and algae inside the storage tank. For this application, disinfection by 12.5% bulk sodium hypochlorite (NaOCl) was recommended.

**DWU Reclaimed Water Production Facility**

Site selection criteria were developed to guide decision making in the feasibility of locations for scalping plants (Figure 2). Two sites were identified through the site selection process with the evaluation summarized below.
Site #1 is located along DWU’s Shady Trail interceptor (Figure 3) and meets the following criteria:

- Located in DWU Sewershed
- Within one mile of the EFAC
- Adequate interceptor line size
- Direct interceptor access
- Not located near potable wells or storage
- Enhanced buffer requirement can be met with an enclosure building

Despite the advantages of Site #1 above, the City would need to purchase the property and there is not adequate flow metering data to confirm minimum flow capacity and the percentage that the scalping plant would consume at this location in the Shady Trail interceptor. Temporary flow metering in the collection system near the proposed scalping plant property would be recommended to confirm flow availability. Flow metering data obtained from a downstream flow meter suggest historical minimum flows inadequate to support a scalping plant withdrawal at this time. Site #1 was identified and used in this evaluation since it is currently undeveloped. Possible purchase of a property along Shady Trail Road would need to be further evaluated. A conceptual MBR layout was developed for Site #1 to provide guidance on approximate size constraints (Figure 3). If this property were to be completely built out with MBR treatment trains, a total system capacity of approximately 4.0 MGD may be achieved.
Site #2 is located on the east side of the existing 66” diameter and future 72” diameter Trinity River Authority (TRA) sewer interceptors and south of L.B. Houston Golf Course (Figure 4). Site #2 meets the following site selection criteria:

- Within one mile of the EFAC
- Adequate interceptor size
- Direct interceptor access
- Not located near potable wells or storage
- Enhanced buffer requirement can be met without building
- City of Dallas owned property

This site is located within a TRA sewershed with the collection system draining to the TRA Central Regional Wastewater System (CRWS) plant. As identified in TCEQ Chapter 321, this would require TRA to own and operate the scalping plant at this location. TRA is open to the idea of owning a scalping plant, if it is a reasonable financial investment. However, the City would need to explore the option of entering into agreements with TRA to give the City the ownership of the scalping plant. This scenario would need to be further explored with all parties and TCEQ if the scalping plant alternative was the City’s direction for providing reclaimed water to the EFAC.
There is currently a lack of accurate flow metering data in the 66” diameter line. However, TRA has planned for a parallel 72” diameter line to help transfer flows that would normally be conveyed in the 66” diameter line, indicating a presence of significant flow availability. Additional information on the amount of flow currently transferred in the 66” diameter line would be required to confirm feasibility. Site #2 is also located within the 100-year flood plain and requires either a levee or elevated structures to protect the scalping plant. Consequently, access to the scalping plant will be hindered by occasional flooding of the Elm Fork of the Trinity River. Coordination and permitting with the Corps of Engineers would also be required. A conceptual MBR layout was developed for Site #2 to provide guidance on approximate size constraints and facility aspects (Figure 4).

**PURCHASE RECLAIMED WATER FROM DCURD/CITY OF IRVING**

**DCURD Existing Facilities and Service Area**

The Dallas County Utility and Reclamation District (DCURD) currently supplies reclaimed water to customers in the Las Colinas area of the City of Irving (COI). Reclaimed water uses include golf course turf and other landscape irrigation as well as maintaining water levels in area ponds and lakes. All existing uses are categorized as Type II, with future plans to connect a Type I use for toilet flush water. DCURD currently has customer commitments for up to a peak of 13 MGD; however, the historical average is around 7.0 MGD during the summer months. Through the current agreement between the Trinity River Authority (TRA) and DCURD, TRA will supply up to a maximum of 8,000 acre-feet/year to DCURD (average of 7.14 MGD or approximately 2.6 billion gallons per year). It is estimated that the EFAC will require up to 2.2 million gallons per week in Phase II (or 0.31 MGD) for irrigation needs. This demand translates to an increase in DCURD’s peak customer commitment of approximately 2.4%.

The pump station and pipeline for supplying reclaimed water to DCURD are owned by TRA. The pump station is located at TRA’s Central Regional Wastewater System (CRWS) plant in Grand Prairie, Texas with the pipeline extending north to the COI, paralleling the west bank of
the Elm Fork of the Trinity River, and discharging into Lake Remle. Lake Remle is an off-
channel lake located on the west side of the Elm Fork of the Trinity River. Various pump
stations transfer water from Lake Remle through the DCURD system to other lakes within the
system that support other transfer or dedicated pump stations for customer usage.

Existing TRA CRWS reclaimed water pump station capacity has a firm pumping capacity of
approximately 14.4 MGD with an estimated peak hydraulic capacity of the pipeline near 22
MGD. The pipeline is 30-inch diameter with the capability to convey gravity flow in addition to
pumped flow. Approximately 2 MGD can gravity flow through the existing pipeline to Lake
Remle. DCURD utilizes this gravity flow option whenever possible, to avoid turning on the
pumps at the TRA CRWS.

DCURD currently operates under a Reclaimed Water Authorization granted by the TCEQ on
May 2, 1997. This authorization has no expiration date and is effective as long as the domestic
wastewater treatment plant is authorized to discharge treated wastewater or until DCURD
requests a termination of the contract. In order for DCURD to increase their service area and
allow the City of Dallas to use the reclaimed water for the EFAC, permission must be given by
the City of Irving City Council and the TCEQ Executive Director.

City of Irving Reclaimed Water Approach

The City of Irving finalized their Recycled Water Implementation Plan in December 2008. The
City of Irving currently provides for an interbasin transfer of raw water from Chapman Lake
(Sulfur River Basin) to Lake Lewisville (Trinity River Basin) to supplement their drinking water
supply that is ultimately treated at either DWU’s Elm Fork WTP or DWU’s Bachman WTP.
The City of Irving holds a water rights permit to reuse up to 28.2 MGD, which is the amount of
water that is transferred from Chapman Lake. The percentage of water that is returned to TRA
CRWS for treatment has decreased to near 50% in recent years due to drought conditions. Based
on this historical trend, it is assumed that only 50% (or 14.1 MGD) of the water transferred from
Chapman Lake will be available to the City of Irving for reclaimed water uses in times of
drought.

There is currently no infrastructure in place to transport COI reclaimed water to the EFAC. The
COI Recycled Water Implementation Plan outlines the option of initially sharing the DCURD
pipeline (Phase I) for reclaimed water transport from the TRA CRWS. If future COI reclaimed
water customer commitments exceed the initial agreement with DCURD, COI would look into
additional water from DCURD or the potential for constructing a parallel pipeline (Phase II) next
to the DCURD pipeline. It is estimated that the EFAC will require up to 2.2 million gallons per
week (or 0.31 MGD) on average for irrigation needs. This demand is approximately 2.2% of the
City of Irving’s 14.1 MGD of reclaimed water availability.

As of May 2009, the City of Irving was in the process of negotiating agreements with both TRA
and DCURD. The next step for the City of Irving will be to apply for their Reclaimed Water
Authorization and develop policies, procedures, and rates for their reclaimed water system.
According to the City of Irving’s Recycled Water Implementation Plan, the EFAC is identified
as a Phase II potential customer for connection around the year 2015. This time frame is in line
with the scheduled Phase II EFAC build-out, when the reclaimed water will be incorporated.
There may be a potential for the EFAC to be included as a Phase I customer for the City of
Irving; however, that option would need to be further explored if DCURD cannot provide the
EFAC with the calculated quantities of reclaimed water.

**TRA CRWS Effluent Quality**

Effluent quality data for the TRA CRWS was evaluated for conformance with Type I reclaimed water quality requirements. The availability of Type I reclaimed water from TRA CRWS plays a key role in the development of options for this source of reclaimed water to be used at the EFAC. Table 8 lists a summary of historical effluent quality sampling data recorded at TRA CRWS. Type I standards are identified at the bottom of Table 8. TRA CRWS effluent is of adequate quality to meet Type I reclaimed water quality standards and can be used directly from the WWTP if required.

<table>
<thead>
<tr>
<th>Month</th>
<th>BOD (mg/L)</th>
<th>TSS (mg/L)</th>
<th>Turbidity (NTU)</th>
<th>Fecal Coliform (COL/100 mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 2008</td>
<td>1.1</td>
<td>1.07</td>
<td>0</td>
<td>1.08</td>
</tr>
<tr>
<td>February 2008</td>
<td>1.1</td>
<td>1.41</td>
<td>0</td>
<td>5.54</td>
</tr>
<tr>
<td>March 2008</td>
<td>1.12</td>
<td>1.38</td>
<td>0</td>
<td>7.36</td>
</tr>
<tr>
<td>April 2008</td>
<td>1.26</td>
<td>1.12</td>
<td>0</td>
<td>0.11</td>
</tr>
<tr>
<td>May 2008</td>
<td>1.36</td>
<td>1.06</td>
<td>0.72</td>
<td>1.70</td>
</tr>
<tr>
<td>June 2008</td>
<td>1.02</td>
<td>1.19</td>
<td>0.03</td>
<td>7.00</td>
</tr>
<tr>
<td>July 2008</td>
<td>1.21</td>
<td>1.19</td>
<td>0.03</td>
<td>5.00</td>
</tr>
<tr>
<td>August 2008</td>
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<td>0</td>
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<tr>
<td>September 2008</td>
<td>1.04</td>
<td>1.05</td>
<td>0.02</td>
<td>3.82</td>
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<tr>
<td>October 2008</td>
<td>1.01</td>
<td>1.02</td>
<td>0.02</td>
<td>7.29</td>
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<td>November 2008</td>
<td>1.00</td>
<td>1.04</td>
<td>0.71</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>Maximum in 2008</strong></td>
<td><strong>1.36</strong></td>
<td><strong>1.41</strong></td>
<td><strong>0.72</strong></td>
<td><strong>12.00</strong></td>
</tr>
<tr>
<td><strong>Type I Max. Limit</strong></td>
<td><strong>5.0</strong></td>
<td>-</td>
<td><strong>3.0</strong></td>
<td><strong>75</strong></td>
</tr>
</tbody>
</table>

**Option 1 - Pump from Lake Remle**

The first option for providing reclaimed water from DCURD/COI involves pumping water from Lake Remle to the EFAC. The existing DCURD pipeline from TRA discharges into Lake Remle and is owned and operated by DCURD. The 30-inch pipeline has an open-ended single point discharge. There are currently no other direct connections to this line prior to its discharge into the lake. Two existing DCURD pump stations pull water out of Lake Remle for distribution to other customers in the DCURD system and are located on the south side of the lake. The lake is designed so that the reclaimed water is detained for a minimum of 30 days prior to being transferred and used in the DCURD system. TCEQ has stated that the water is still considered reclaimed and that they recommend providing treatment to Type I standards for the protection of the public.

For this option, water would be pulled from Lake Remle and pumped to the on-site irrigation pond at the EFAC. A remote control panel will be provided at the EFAC to control the operation of the reclaimed water pump station at Lake Remle. The pump station location near Lake Remle and the pipeline alignment are illustrated in Figure 5. This option can be expanded to include service to both the L.B. Houston Golf Course and/or the North Texas Golf Center, if desired by the City.
The on-site EFAC irrigation pond design will include a top of pond elevation of approximately 428.00 feet. The approximate normal pool elevation will be about 426.00 feet. The pond will be off-channel but adjacent to the Wesco Channel which discharges into the Elm Fork of the Trinity River. A preliminary total pond capacity of approximately 12.9 MG is proposed. The proposed on-site irrigation pond will store storm water and reclaimed water. The irrigation system will pull from the pond when needed. Preliminary estimates indicated up to 2.2 million gallons of water per week will be required for irrigation which can be made up of storm water and/or reclaimed water from the irrigation pond. Reclaimed water is also proposed to be used to maintain aesthetic water levels in the irrigation pond during times of low storm water contribution or drought.

The adjacent Wesco Channel has been redesigned in conjunction with the Elm Fork Athletic Complex project to carry the anticipated 100-year local flows and is not expected to impact the irrigation pond. However, modeling of the Elm Fork of the Trinity River corridor indicates that the irrigation pond and Wesco Channel will be inundated by backwater flooding of the Elm Fork of the Trinity River around the 25-year flood event (WSE of 428.18). An earthen spillway is planned to be provided for the irrigation pond at an elevation of approximately 427.00 feet. Flows over the spillway will be directed to the Wesco Channel. Overflows would be directly related to large storm events as controls will prevent reclaimed water from entering the pond while the pond is experiencing high water levels. Through correspondence with TCEQ, the on-site irrigation pond as described above (and not on channel) would feasibly be allowed to hold reclaimed water to be used for Type 1 irrigation needs. In addition, filtration and disinfection
facilities would be implemented to treat the water prior to irrigation. This treatment will ensure that the water used for irrigation meets TCEQ standards for Type I reuse for athletic fields. The evaluated pipeline alignment for this option is illustrated in Figure 5.

In order to use the water from Lake Remle for Type I reclaimed water uses, the following equipment and infrastructure will be required. In addition to a new pump station, filtration and disinfection equipment at the on-site irrigation pond will be required to treat and produce water to Type I quality standards prior to use. Equipment will include:

- **Pump Station** - The new pump station at Lake Remle would be sited near the two existing pump stations at this lake. Various package pump systems were considered to provide a smaller footprint pump station at Lake Remle. Submersible pumps were considered because the submersible pumps can meet the high head requirement and the construction cost for submersible pumps is less when compared to vertical turbine pumps. Based on the preliminary evaluation of the pumps, one (1) pump capable of pumping 3.3 MGD at 70-80 psi would be provided. The pump and associated valving will be installed in a below-grade vault.

- **Filtration and Disinfection Equipment** – Inline pressure filters were considered to provide removal of suspended solids from the stored reclaimed water before using for irrigation. The diameter of each sand pressure filter will be 48-inch and each filter will be 16-inch high with a maximum operating pressure of 180 psi. The sand filters will be mounted on a skid with a footprint of 32’-0” x 12’-0”. In addition to filtration, an in-vessel ultraviolet disinfection system will also be provided to disinfect the reclaimed water.

- **Pipeline** – A single 12-inch PVC pipe will be provided to route the pumped flows from the submersible pump station to the on-site irrigation pond at the EFAC.

The following lists advantages and disadvantages for Option 1 - Pump from Lake Remle.

**Advantages**
- No modifications made to existing DCURD infrastructure
- Existing lake with large storage capacity
- Minimal change in Lake Remle water surface elevation due to required demand
- Ample land for new pump station
- Could potentially supply L.B. Houston Golf Course and North Texas Golf Center
- Utilize on-site irrigation pond at the EFAC

**Disadvantages**
- Filtration and disinfection required after lake withdrawal to maintain Type I quality
- Double pumping to sprinkler system
- Potential landfill areas along the pipe alignment will require additional excavation and disposal of existing buried waste material significantly increasing construction cost

**Option 2 – Gravity to On-Site EFAC Irrigation Pond**

The second option for providing reclaimed water from DCURD/COI involves diverting water directly from the DCURD piping to the on-site EFAC irrigation pond. This eliminates the intermediate pumping step as described in Option 1 above.
A valve and meter vault would be constructed along the existing DCURD pipeline near Spur-348 to isolate and direct the flow to either Lake Remle or to the on-site EFAC irrigation pond. Additional analysis and evaluation is necessary to confirm the gravity flow capacity that could be obtained at the EFAC irrigation pond. If gravity flow is insufficient, the water can also be pumped to the on-site EFAC irrigation pond. The evaluated pipeline alignment for this option is illustrated in Figure 5.

**Required Equipment**

Option 2 requires the following equipment and infrastructure for providing Type I reclaimed water.

- **Valve and Meter Vault** – An underground valve vault would be required to house the isolation valve, meter, and valve actuators that will route the reclaimed water from the existing DCURD line to the on-site irrigation pond. Two isolation valves will be installed – one on the existing 30-inch DCURD piping and the other on the proposed 12-inch PVC pipe that will route water to the on-site irrigation pond.

- **Filtration and Disinfection Equipment** – Inline pressure filters and ultraviolet disinfection as identified in Option 1 above.

- **Piping** – A 12-inch PVC conveyance pipe would be constructed to route reclaimed water from the DCURD pipeline to the on-site irrigation pond at the Elm Fork Athletic Complex.

The following lists advantages and disadvantages for Option 2 – Direct Tie-In to DCURD Piping.

**Advantages**
- Reclaimed water can be used to supplement irrigation and maintain levels in irrigation pond
- On-site storage; no fabricated tank construction required
- Low electrical requirement; minimal pumping required

**Disadvantages**
- Valve controls required
- Modifications made to existing DCURD infrastructure
- Filtration and disinfection required prior to use
- Potential landfill areas along the pipe alignment will require additional excavation and disposal of existing buried waste material significantly increasing construction cost

**Option 3 – Off-Site Ground Storage Tank**

The third option for providing reclaimed water from DCURD/COI involves diverting water from the DCURD pipeline to a new ground storage tank and pump station within the City of Irving city limits. This option eliminates earthen storage and the requirement for additional filtration and disinfection prior to use. A valve vault would be constructed along the DCURD pipeline in this option to be able to isolate and direct the flow to either Lake Remle or to a new ground storage tank and pump station. It is anticipated that the flows would be conveyed by gravity to the new ground storage tank, with no need for additional pumping. Additional analysis and evaluation may be necessary to confirm the gravity flow capacity that could be conveyed to the
ground storage tank. The evaluated pipeline alignment for this option is illustrated in Figure 5.

**Required Equipment**

Option 3 requires the following equipment and infrastructure for providing Type I reclaimed water.

- **Valve and Meter Vault** – Similar to Option 2 Valve and Meter Vault.
- **Ground Storage Tank** – A single 1.0 MG ground storage tank would be provided to allow for storage of reclaimed water from the DCURD piping. From the ground storage tank, the reclaimed water would be pumped directly to the sprinkler system of the Elm Fork Athletic Complex. It is preferred for the ground storage tank to be constructed on the western side of the Elm Fork of the Trinity River channel levee to avoid the 100-year floodplain.
- **Pump Station** – A packaged vertical turbine pump station would be provided to pump stored reclaimed water from the ground storage tank to the sprinkler system. Variable frequency drives would be provided for the vertical turbine pumps. The pumping system would be designed to pump a firm capacity of 2.2 MGD.
- **Pipeline** – A 12-inch PVC conveyance pipe would be constructed to route reclaimed water from the storage tank to the sprinkler system.

The following lists advantages and disadvantages for Option 3 – Indirect Tie-In to DCURD Pipeline.

**Advantages**

- No additional filtration or disinfection required prior to use; if chlorine boost is required, TRA CRWS has a dedicated DCURD chlorinator that can be used
- Incorporating gravity flow for filling the tank

**Disadvantages**

- Large storage tank capacity required to be constructed
- Property purchase required (preferably outside of Trinity River 100-year floodplain)
- Potential landfill areas along the pipe alignment will require additional excavation and disposal of existing buried waste material significantly increasing construction cost

**ALTERNATIVE PROBABLE COSTS**

Table 9 provides a comparison of Opinions of Probable Construction Cost (OPCC) for the recommend treatment technology alternatives from the Scalping Plant Evaluation and the three reclaimed water supply options that were evaluated.

The three DCURD/COI alternatives are found to have lower cost per gallon than any of the reclaimed water production facility alternatives. The higher cost for the reclaimed water production facility can be attributed to the capital investment needed for the construction of those facilities, including the MBR system, odor control system and enclosure building, and levee construction for flood protection.
Table 9  Summary Cost Comparison for the Water Supply Alternatives

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MBR Alternative 1</td>
<td>$6,628,000</td>
<td>$16.57</td>
<td>$9,966,000</td>
<td>$24.92</td>
</tr>
<tr>
<td>MBR Alternative 2</td>
<td>$7,964,000</td>
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<tr>
<td>DCURD/COI Option 1</td>
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<td>$7.63</td>
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<tr>
<td>DCURD/COI Option 3</td>
<td>$3,950,000</td>
<td>$9.87</td>
<td>$5,939,000</td>
<td>$14.84</td>
</tr>
</tbody>
</table>

DCURD/COI Reclaimed Water Rates

In May 2009, DCURD and the City of Irving were involved in negotiations for preparing reclaimed water agreements for the City of Irving to move forward with their Reuse Program. It is unclear when reclaimed water rate information would be available from the City of Irving. However, DCURD was able to provide a reclaimed water rate for the year 2009 specifically for the EFAC. It is assumed that the EFAC would be approved as an “in-district” user (approval needed from City of Irving City Council). Table 10 identifies a breakdown of the costs associated with the DCURD reclaimed water rate.

Table 10  DCURD Reclaimed Water Rate Breakdown

<table>
<thead>
<tr>
<th>Contract Item</th>
<th>Item Cost ($/1,000 gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Cost – Pumping from TRA</td>
<td>0.025</td>
</tr>
<tr>
<td>Chlorine Usage Cost from TRA</td>
<td>0.015</td>
</tr>
<tr>
<td>DCURD Commodity Cost (In District)</td>
<td></td>
</tr>
<tr>
<td>Base Water Rate from TRA (~ $0.204/1,000 gallons)</td>
<td>1.38</td>
</tr>
<tr>
<td>Administrative and Operational Costs</td>
<td></td>
</tr>
<tr>
<td>Annual Capital Cost</td>
<td>0.26</td>
</tr>
<tr>
<td><strong>TOTAL WATER COST</strong></td>
<td><strong>1.68</strong></td>
</tr>
</tbody>
</table>

If “in-district” approval is not obtained, the DCURD Commodity Cost would double. The DCURD Commodity Cost is also adjusted annually and can be assumed to increase at a rate similar to average inflation. The Annual Capital Cost is distributed over the total anticipated capacity of water used per year (85.8 MG/yr). The capital cost is paid annually for 20 years, after which the customer is assumed to have ownership and is no longer required to pay capital.

Operation and Maintenance (O&M) Costs

Table 11 provides a comparison between operation and maintenance cost (O&M) for the recommended treatment technology alternatives from the Scalping Plant Evaluation, the three reclaimed water supply options, and potable water in relation to 20-year, 30-year and 50-year life cycle costs. The O&M cost are provided for the year 2009 which are then extrapolated to year 2016 (the anticipated first year of operation). The following assumptions were used to estimate the O&M costs for the alternatives:

- All the reclaimed water production alternatives to be operational for 24 hours/365 days per year at average flow rates (2.2 MG/week in spring and summer and 1.1 MG/week in fall and winter).
• All the DCURD/COI alternatives to be operational twice a week for a period of 8 hours every operation event (2.2 MG/week in spring and summer and 1.1 MG/week in fall and winter).
• Annual maintenance cost to be 3% of the total mechanical, valves, and HVAC.
• Mechanical equipment, valves and HVAC equipment will be replaced every 20 years (21st and 41st years in the life cycle cost analysis). No new structures will be required.
• The labor cost is estimated to be $25.00/hour.
• The price of reclaimed water from DCURD is $1.68/1,000 gallons (with capital distribution over 85.8 MG/year).
• The price of potable water from City of Dallas distribution system is $1.97/1000 gallons for users of more than 1.0 million gallons per month.
• The electricity cost is assumed to be 11.0 cents/KWH.
• 12.5% Sodium Hypochlorite included at $3.00/gallon for Scalping Plant Alternatives.
• 40% w/v Citric Acid included at $5.00/gallon for Scalping Plant Alternatives.

Tables 12 and 13 provide the summary comparison of life cycle cost (LCC) versus water usage for reclaimed water and potable water alternatives. Potable water remains the most cost-effective over the course of a 50 year life cycle; however, the difference in rates between potable and the reclaimed water options from DCURD/COI decreases after 20 years. This decrease between the two rates is attributed to the drop-off of the capital pay-in for the DCURD system after 20 years. Scalping plant options produce the highest life cycle cost per 1,000 gallons, primarily due to high initial investment capital costs.

### Table 11 Comparison of Life Cycle Costs for Reclaimed and Potable Water Alternatives

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>MBR Alternative 1</td>
<td>$269,000</td>
<td>$14,229,000</td>
<td>$19,134,000</td>
<td>$26,071,000</td>
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<tr>
<td>MBR Alternative 2</td>
<td>$294,000</td>
<td>$16,560,000</td>
<td>$21,795,000</td>
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<tr>
<td>Potable Water</td>
<td>$254,000</td>
<td>$5,171,000</td>
<td>$7,712,000</td>
<td>$12,794,000</td>
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<tr>
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<td>$12,280,000</td>
<td>$17,709,000</td>
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<td>$7,723,000</td>
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<td>$316,000</td>
<td>$11,274,000</td>
<td>$14,484,000</td>
<td>$20,105,000</td>
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</tbody>
</table>

Notes:
1. Total annual demand of 85.8 Million Gallons per Year (2.2 MG/week in spring and summer and 1.1 MG/week in fall and winter).
2. Reclaimed water rate from DCURD based on 85.8 MG/yr is $1.68/1,000 gallons.
3. Potable water rate based on City of Dallas rate schedule ($1.97/1,000 gallons).
4. Annual Equivalent Life Cycle Costs assumes a 6% Bond Interest Rate.
5. DCURD Capital Cost to expire after 20 years of City investment.

### Table 12 Comparison of Life Cycle Cost

<table>
<thead>
<tr>
<th>Alternatives</th>
<th>Annual Equivalent Life Cycle Costs – 20 Years, (Per Year)</th>
<th>Annual Equivalent Life Cycle Costs – 30 Years, (Per Year)</th>
<th>Annual Equivalent Life Cycle Costs – 50 Years, (Per Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBR Alternative 1</td>
<td>$1,241,000</td>
<td>$1,390,000</td>
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<tr>
<td>MBR Alternative 2</td>
<td>$1,444,000</td>
<td>$1,583,000</td>
<td>$1,855,000</td>
</tr>
<tr>
<td>Potable Water</td>
<td>$451,000</td>
<td>$560,000</td>
<td>$812,000</td>
</tr>
<tr>
<td>DCURD/COI Option 1</td>
<td>$792,000</td>
<td>$892,000</td>
<td>$1,124,000</td>
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<tr>
<td>DCURD/COI Option 2</td>
<td>$673,000</td>
<td>$767,000</td>
<td>$977,000</td>
</tr>
<tr>
<td>DCURD/COI Option 3</td>
<td>$983,000</td>
<td>$1,052,000</td>
<td>$1,276,000</td>
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</table>

Notes:
1. Total annual demand of 85.8 Million Gallons per Year (2.2 MG/week in spring and summer and 1.1 MG/week in fall and winter).
2. Reclaimed water rate from DCURD based on 85.8 MG/yr is $1.68/1,000 gallons.
3. Potable water rate based on City of Dallas rate schedule ($1.97/1,000 gallons).
4. Annual Equivalent Life Cycle Costs assumes a 6% Bond Interest Rate.
5. DCURD Capital Cost to expire after 20 years of City investment.
Table 13  Comparison of Life Cycle Cost per 1,000 Gallons

<table>
<thead>
<tr>
<th>Alternatives</th>
<th>LC Cost/1000 Gallons (Based on LCC For 20 Years)</th>
<th>LC Cost/1000 Gallons (Based on LCC For 30 Years)</th>
<th>LC Cost/1000 Gallons (Based on LCC For 50 Years)</th>
</tr>
</thead>
<tbody>
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<td>MBR Alternative 1</td>
<td>$14.46</td>
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<td>$16.83</td>
<td>$18.45</td>
<td>$21.63</td>
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<tr>
<td>Potable Water</td>
<td>$5.25</td>
<td>$6.53</td>
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</tr>
<tr>
<td>DCURD/COI Option 1</td>
<td>$9.23</td>
<td>$10.40</td>
<td>$13.10</td>
</tr>
<tr>
<td>DCURD/COI Option 2</td>
<td>$7.85</td>
<td>$8.90</td>
<td>$11.40</td>
</tr>
<tr>
<td>DCURD/COI Option 3</td>
<td>$11.46</td>
<td>$12.30</td>
<td>$14.90</td>
</tr>
</tbody>
</table>

Notes:
1. Total annual demand of 85.8 Million Gallons per Year (2.2 MG/week in spring and summer and 1.1 MG/week in fall and winter).
2. Reclaimed water rate from DCURD based on 8.5 MG/yr is $1.68/1,000 gallons.
3. Potable water rate based on City of Dallas rate schedule ($1.97/1,000 gallons).
4. Annual Equivalent Life Cycle Costs assumes a 6% Bond Interest Rate.
5. DCURD Capital Cost to expire after 20 years of City investment.

SUMMARY AND RECOMMENDATIONS

DCURD/COI Option 2 was recommended for providing reclaimed water to the EFAC. Option 2 involves a tie-in with the existing DCURD pipeline and construction of a new valve vault, pipeline to the on-site irrigation pond at the EFAC, and filtration and disinfection facilities prior to use. The OPCC for the DCURD/COI Option 2 is $2,030,000 in 2009 U.S. Dollars. Option 2 provides the EFAC with the following advantages:

- Reduced dependence on potable water for irrigation
- Can be used to maintain aesthetic water level in on-site irrigation pond
- Aligns with City of Dallas “Green Initiative and Conservation”
- Provides a drought-proof supply of water
- Provides filtration and disinfection for reclaimed water before being used for irrigation
  - Potential for reduction in maintenance and prolonged life of the irrigation system
  - Maintains water in accordance with state rules for unrestricted public access facility
  - May be more appealing to the public with this level of treatment
- Reclaimed water (with ultraviolet disinfection) provides advantages over potable water for vegetation, as reclaimed water provides nutrients (potentially reducing fertilizer usage) and very little to no chlorine present
- Annual operation and maintenance is less costly with reclaimed water than with potable water
- Possible “gravity” flow to the on-site irrigation pond minimizes pumping needs
- On-site storage; no fabricated tank construction required
- Lowest OPCC for all reclaimed water alternatives

Even though the DCURD/COI Option 2 had the lowest OPCC when compared with the other evaluated reclaimed water alternatives, no reasonable payback will be achieved with this option. A reclaimed water rate of approximately $0.50 would be required to achieve a 20 year payback on the DCURD/COI Option 2 capital investment.