3 Wastewater Reuse

3.1 Overview

Wastewater reuse is defined as the types of projects that utilize treated wastewater effluent as a replacement for fresh water supply, reducing the overall demand for fresh water supply. Wastewater reuse typically involves a capital project connecting the wastewater treatment plant discharge facilities to an individual area that has a relatively high, localized use that can be met with non-potable water. Examples most frequently include the irrigation of golf courses and other public lands and specific industries or industrial use areas. Few entities, if any, would be capable of utilizing their entire effluent capacity for reuse at present; long term, it is likely that increased pressure on water supplies will result in increased emphasis on reuse, with reused water approaching the quantity of effluent available. Virtually any water supply entity with a wastewater treatment plant could pursue a reuse alternative. Current examples of existing reuse systems in the Brazos G Area include those of the cities of Abilene, Cleburne, Georgetown, Killeen and Round Rock. Many other smaller communities make their effluent available for irrigation and/or energy development purposes.

Wastewater reuse can be classified into two forms, defined by how the reuse water is handled:

1. Direct Reuse – Pipe treated wastewater directly from wastewater plant to place of use (often referred to as “flange-to-flange”).
2. Indirect Reuse – Discharge treated wastewater to river, stream, or lake for subsequent diversion downstream (often referred to as “bed and banks”).

3.1.1 Direct Reuse

All direct reuse water supply options assume that treated wastewater remains under the control (in pipelines or storage tanks) at all times from treatment to point of use by the entity treating the wastewater and/or supplying reuse water.

Wastewater reuse quality and system design requirements are regulated by TCEQ by 30 TAC §210. TCEQ allows two types of reuse as defined by the use of the water and the required water quality:

- Type 1 – Public or food crops generally can come in contact with reuse water; and
- Type 2 – Public or food crops cannot come in contact with reuse water.

Current TCEQ criteria for reuse water are shown in Table 3.1-1. Trends across the country indicate that criteria for unrestricted reuse water will likely tend to become more stringent over time. The water quality required for Type 1 reuse water is more stringent with lower requirements for oxygen demand (BOD_5 or $CBOD_5$), turbidity, and fecal coliform levels.

Table 3.1-1. TCEQ Quality Standards for Reuse Water

Parameter	Allowable Level
Type 1 Reuse	
BOD_5 or $CBOD_5$	5 mg/L
Turbidity	3 NTU
Fecal Coliform	20 CFU / 100 ml[1]
Fecal Coliform (not to exceed)	75 CFU / 100 ml[2]
Type 2 Reuse For a system other than a pond system	
BOD_5	20 mg/L
or $CBOD_5$	15 mg/L
Fecal Coliform	200 CFU / 100 ml[1]
Fecal Coliform (not to exceed)	800 CFU / 100 ml[2]
Type 2 Reuse For a pond system	
BOD_5	30 mg/L
Fecal Coliform	200 CFU / 100 ml[1]
Fecal Coliform (not to exceed)	800 CFU / 100 ml[2]

[1] geometric mean
[2] single grab sample

Two approaches were utilized to evaluate a broad range of potential reuse water supplies:

1. General evaluation of wastewater reuse for multiple water user groups with needs and potential wastewater sources.
2. Specific supply options for water user groups with defined wastewater sources and identified needs.

The following potential wastewater reuse projects were evaluated as specific management strategies:

1. City of College Station;
2. City of Bryan;
3. City of Cleburne;
4. Waco WMARSS
    i. Waco East;
    ii. Bellmead/Lacy-Lakeview;
    iii. Bull Hide Creek;

   iv. Flat Creek; and
   v. Waco North.

5. Bell County WCID No.1;
6. City of Cedar Park; and
7. City of Georgetown.

3.1.2 Indirect Reuse

Indirect reuse is the discharge of treated wastewater to rivers, streams, or lakes for subsequent diversion downstream (also called "bed and banks"). Several water user groups within the Brazos G Area have applied for or have plans to apply for indirect reuse of municipal wastewater flows. For these entities, indirect reuse may be more economical than direct reuse options and/or enable a greater quantity of treated wastewater flows to be utilized as a replacement for potable water supplies.

3.1.3 Direct and Indirect Potable Reuse

Reclaimed water can either be used for potable or non-potable purposes. Reuse applications typically refer to non-potable reuse where the reclaimed water does not get used for potable purposes from the drinking water system. With advanced water treatment methods available there are two options for potable use of reclaimed water. The two options are Indirect Potable Reuse and Direct Potable Reuse. Indirect potable Reuse is defined as "the use of reclaimed water for potable purposes by discharging to a water supply source, such as surface water or ground water." The mixed reclaimed and natural waters then get additional treatment at a water treatment plant before entering the drinking water distribution system. Direct Potable reuse is defined as "the introduction of advanced treated reclaimed water either directly into the potable water system or into the raw water supply entering the water treatment plant." Under these definitions, aquifer storage and recovery may be considered to be a type of indirect potable reuse.

Potable reclaimed water supplied to consumers is held to stricter standards than non-potable reclaimed water use and is required to meet federal and state drinking water standards.

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3.2 General Evaluation of Direct Reuse Potential for Multiple Water User Groups

3.2.1 Description of Option

Many water user groups with projected needs have the potential to develop wastewater reuse projects, and a general evaluation of wastewater reuse potential was conducted for these entities based on wastewater flows used to determine currently available surface water supplies.

3.2.2 Available Supply

The water supply from reuse that would be potentially available for any entity would be that portion of their wastewater effluent stream that is over and above any currently planned reuse and any commitments made to downstream water rights and environmental flows. Of this potential, the amount that can actually be recognized depends on the availability of suitable uses within an economical distance from the treatment plant. If individual high water use industrial plants or open land that benefits from irrigation, such as golf courses, are located relatively close to the plant, then reuse can provide a substantial benefit to water supplies.

In order to identify those communities that may potentially benefit from a reuse program, information regarding each of the communities with both a projected need for additional water supply and a wastewater treatment plant (WWTP) proximate to need was gathered. Table 3.2-1 lists these water user groups, their projected need, approximate average effluent, and an assumed portion of the effluent that may be recoverable. If a WWTP with discharge over 1 MGD is proximate to the need it is listed in the table. Initially, the portion of effluent that may be recoverable was estimated as 25 percent of the current average effluent plus 50 percent of future effluent. A relatively low recoverable percentage was used because of the variability in effluent flows, variability in demand, and the large storage volumes that would likely be needed to match availability with demand. Entities were then contacted to verify this estimate and the assumed effluent recoverable adjusted based on feedback from entities. The difference between the potential supply and any confirmed 2070 discharges would be considered the amount available.

Several water user groups show a potential reuse amount greater than the projected need and could possibly meet their need in this manner. Utilization of this water source is contingent on whether a potential use for the wastewater effluent exists within an economical distance from the treatment plant.

Table 3.2-1. General Wastewater Reuse Potential in the Brazos G Area

WUG	County	Proximate WW Treatment Facility Over 1 MGD	2070 Projected Need (acft/yr)	2070 Projected Need Percent of Demand	Current Reuse	2070 Maximum Available WWTP Effluent (acft/yr)	2070 Estimated Reuse (acft/yr)
Killeen	Bell	Bell County WCID#1	30,366	93%	N	45,120	18,602
Elm Creek WSC	Bell	City of Temple	196	24%	N	11,817	4,872
Bell County-Other	Bell	Bell County WCID#1	307	17%	N	45,120	18,602
Harker Heights	Bell	Bell County WCID#1	3,000	27%	N	45,120	18,602
Cedar Park	Bell	Cedar Park	5,427	52%	Y	9,221	3,986
Manufacturing	Bell	City of Temple	186	27%	N	11,817	4,872
Irrigation	Bell	Bell County WCID#1	719	25%	N	45,120	18,602
Mining	Bell	Bell County WCID#1	5,803	83%	N	45,120	18,602
Temple	Bell	BRA TBRSS	17,103	47%	N	19,209	7,920
Bryan	Brazos	City of Bryan	19,650	55%	Y	22,369	22,366
College Station	Brazos	City of College Station	13,360	44%	Y	24,703	24,696
College Station	Brazos	Texas A&M University	13,360	44%	Y	6,640	6,640
Gatesville	Coryell	City of Gatesville	4,688	66%	N	7,649	3,116
Cleburne	Johnson	City of Cleburne	7,324	54%	N	17,300	7,146
Steam-Electric	Johnson	City of Cleburne	571	30%	N	17,300	7,146
Mining	Jones	City of Abilene	90	53%	Y	11,113	11,110
Mining	Lee	BRA/LCRA BCRWSS West	0	0%	N	5,574	2,409
Mart	McLennan	WMARSS	244	55%	N	56,904	56,904
North Bosque WSC	McLennan	WMARSS	522	46%	N	56,904	56,904
Robinson	McLennan	WMARSS	2,255	50%	N	56,904	56,904
Manufacturing	McLennan	WMARSS	1,309	18%	N	56,904	56,904
Mining	McLennan	WMARSS	3,478	82%	N	56,904	56,904
Sweetwater	Nolan	City of Sweetwater	1,839	84%	Y	1,934	750
Steam-Electric	Robertson	City of Hearne	28,894	63%	N	1,411	562
Abilene	Taylor	City of Abilene	21,240	88%	Y	11,113	11,110
Merkel	Taylor	City of Abilene	41	10%	Y	11,113	11,110
Mining	Taylor	City of Abilene	181	57%	Y	11,113	11,110
Georgetown	Williamson	City of Georgetown	66,676	85%	Y	12,033	5,202
Granger	Williamson	City of Georgetown	56	20%	Y	12,033	5,202
Hutto	Williamson	BRA/LCRA BCRWSS West	10,703	90%	N	5,574	2,409

Table 3.2-1. General Wastewater Reuse Potential in the Brazos G Area

WUG	County	Proximate WW Treatment Facility Over 1 MGD	2070 Projected Need (acft/yr)	2070 Projected Need Percent of Demand	Current Reuse	2070 Maximum Available WWTP Effluent (acft/yr)	2070 Estimated Reuse (acft/yr)
Leander	Williamson	City of Leander	22,322	78%	N	3,950	1,707
Mining	Williamson	City of Georgetown	10,743	96%	N	12,033	5,202
Round Rock	Williamson	BRA/LCRA BCRWSS East	16,642	44%	N	63,194	27,317
Williamson C-O	Williamson	City of Leander	37,798	86%	N	3,950	1,707
Irrigation	Williamson	BRA/LCRA BCRWSS East	172	52%	N	63,194	27,317
Florence	Williamson	BRA TBRSS	72	43%	N	19,209	7,920

3.2.3 Environmental Issues

A summary of environmental issues is presented in Table 3.2-2.

3.2.4 Engineering and Costing

The required improvements to implement a wastewater reuse supply would be expected to vary considerably between entities based on the upgrades required both in treatment and distribution. Therefore, general cost estimates were developed for varying wastewater reuse scenarios as described in Table 3.2-3. To provide more flexibility in the types of wastewater reuse applications possible, the scenarios assume the use of a type 1 quality wastewater effluent.

Table 3.2-2. Environmental Issues: General Wastewater Reuse

Issue	Description
Environmental Water Needs / Instream Flows	Possible low impact on in-stream flows due to decreased effluent return flows; possible increased water quality to remaining stream flows.
Bays and Estuaries	Possible low negative impact.
Fish and Wildlife Habitat	Possible variable impacts depending on changes in volume of effluent return flows; possible high negative impact to fish and wildlife habitat with substantially reduced stream flows.
Cultural Resources	Possible low impact.
Threatened and Endangered Species	Possible variable impacts depending on habitat requirements for listed species.
Comments	Assumes needed infrastructure will be in urbanized areas.

Table 3.2-3. Wastewater Reuse Scenarios

Scenario #	Treatment	Distribution
1	Existing WWTP is achieving treatment that meets the Type 1 effluent requirements. Treatment upgrade includes only the addition of chlorine for distribution.	Treated wastewater is supplied to demand location(s) from central WWTP by addition of piping and pump station.
2	Existing WWTP is nearly achieving treatment that meets the Type 1 effluent requirements. Treatment upgrade includes tertiary treatment and chlorine.	Treated wastewater is supplied to demand location(s) from central WWTP by addition of piping and pump station.

Scenarios 1 and 2 include central storage at the wastewater plant with reuse water delivered to demand location on an as needed basis. An alternate delivery option not included here is a more decentralized reuse system with storage located at the point of use. Providing storage at the point of use may decrease required pipeline and pump station size because the water can be transported at a more uniform rate to fill storage tanks at the point of use. However, installation of storage tanks at the point of use may be problematic in highly urbanized areas or undesirable near high public use areas.

Cost estimates were developed for each of these scenarios with required facilities for each scenario shown in Table 3.2-4. The demand for reuse water used for irrigation of golf courses, parks, schools, crops, or other landscapes will vary seasonally. For planning purposes the application rates in Table 3.2-5 are assumed to determine the available project yield for varying sizes of wastewater reuse facilities. Reuse facilities are sized for the peak usage periods, and consequently, the average annual rate of usage may be considerably lower than the peak usage. For a reuse system with typical application rates, as shown in Table 3.2-5, the annual available project yield is 57 percent of the reuse system capacity. Available project yield may be greater than 57 percent of maximum capacity for systems supplying a large portion of the reuse water to industrial, non-municipal or other users that have a more uniform seasonal demand pattern.

Table 3.2-4. Required Distribution Facilities for Generalized Wastewater Reuse Scenarios

Facility	Maximum Capacity (MGD)				Description
	0.5	1	5	10	
Pump Station, HP	127	248	1,209	2,332	Capacity to deliver maximum daily demand in 6 hours
Storage Tank, MG	0.5	1	5	10	Store one days treated reuse water at WWTP
Pipeline, Size in Inches (Length in Miles)	12 (2)	16 (2)	30 (3) 18 (2) 12 (1)	48 (4) 18 (3) 12 (2)	Capacity to deliver maximum daily demand in 6 hours
Available Project Yield, acft/yr (MGD)	319 (0.28)	638 (0.57)	3,193 (2.85)	6,385 (5.7)	Yield is 57 percent of maximum treatment capacity based on seasonal use

Table 3.2-5. Wastewater Reuse Irrigation Application Rate

Use Level	Application Rate	Duration
Peak	1.25 in/week	4 months
Normal	0.75 in/week	3 months
Below Normal	0.25 in/week	5 months
Average	0.71 in/week	weighted
Average/Peak	0.71 / 1.25 = 0.57	

Irrigation water for landscapes such as golf courses and parks will generally be applied during periods when these areas are not being utilized, typically at night. Therefore, the distribution facilities are sized to deliver the total daily demand in a 6-hour period. Pumping facilities are sized to provide a residual pressure of 60 psi at the delivery point.

Table 3.2-6 shows annual cost of reuse water per 1,000 gallons for a range of project scenarios and capacities. Figure 3.2-1 expresses those costs graphically as an annual cost per acft. These costs are for general planning purposes and will vary significantly depending on the specific circumstances of an individual water user group. Table 3.2-7 and Table 3.2-8 show the total project capital costs and total operations and maintenance costs for reuse water supplies, respectively.

Table 3.2-6. General Wastewater Reuse Annual Cost of Water ($ per 1,000 gal available project yield)

Scenario	Capacity (MGD)			
	0.5	1	5	10
1	$5.75	$3.90	$2.87	$2.67
2	$9.89	$6.92	$4.67	$4.23
Debt Service (3.5 percent for 20 years)				

Figure 3.2-1. General Wastewater Reuse Annual Cost of Water ($ per acft available project yield

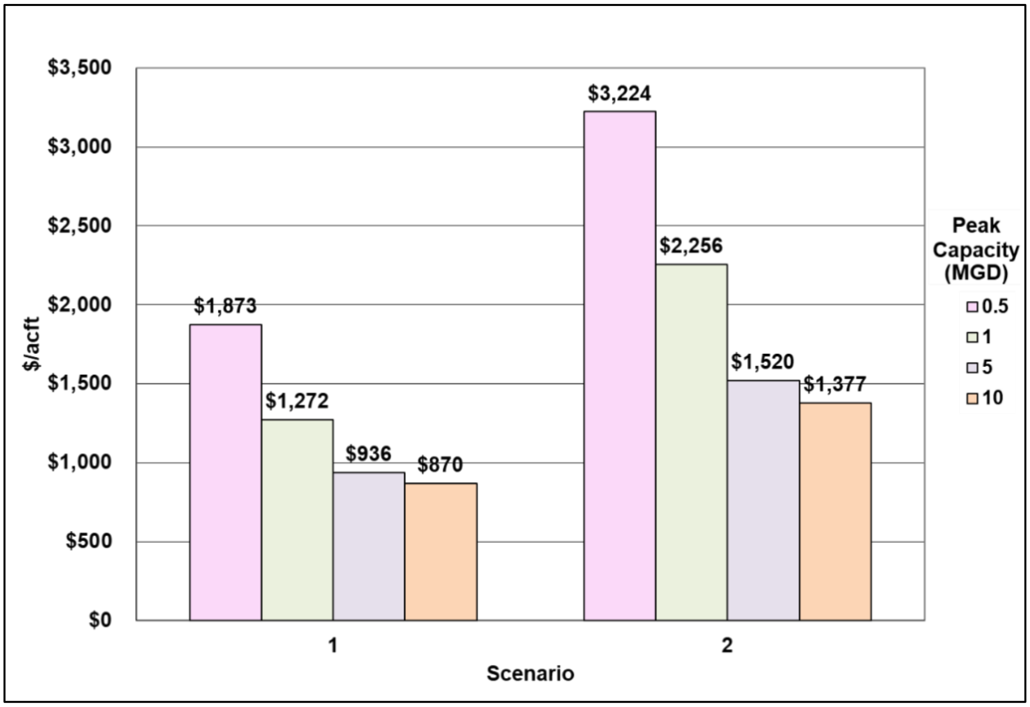

Table 3.2-7. General Wastewater Reuse Total Project Capital Cost ($ per gallon maximum capacity)

Scenario	Maximum Capacity (MGD)			
	0.5	1	5	10
1	$12.03	$7.89	$5.71	$2.86
2	$15.74	$10.55	$7.15	$3.57

Table 3.2-8. General Wastewater Reuse Total Operations and Maintenance Cost ($ per 1,000 gallons)

Scenario	Maximum Capacity (MGD)			
	0.5	1	5	10
1	$0.91	$0.73	$0.58	$0.53
2	$3.56	$2.68	$1.79	$1.62

The general wastewater reuse costs are utilized to develop the cost estimates for individual water user groups shown in Table 3.2-9. Cost Estimate Summaries: Reuse as a Water Management Strategy for Multiple Water User Groups. The reuse project maximum capacity (MGD) for each water user group was developed based on the "2070 Projected Need" and "2070 Potential Reuse," as shown in Table 3.2-1. A reuse scenario, as shown in Table 3.2-1, was applied to each water user group based on available information about existing wastewater treatment facilities proximate to the need.

Information for individual water user groups that have specific reuse water supply options are not included in Table 3.2-9; the individual options should be referenced for information on reuse options for these water user groups.

Table 3.2-9. Cost Estimate Summaries: Reuse as a Water Management Strategy for Multiple Water User Groups

WUG	County	Reuse Maximum Capacity (MGD)	Available Project Yield (MGD)	Scenario	Unit Cost ($/1000 gal)	Project Cost ($/gal)	Project Cost ($)
Killeen	Bell	See Individual Option					
Elm Creek WSC	Bell	0.35	0.2	2	$9.89	$15.74	$5,510,000
Bell C-O	Bell	0.5	0.3	2	$9.89	$15.74	$7,871,000
Harker Heights	Bell	See Individual Option					
Cedar Park	Bell	See Individual Option					
Manufacturing	Bell	0.2	0.2	2	$9.89	$15.74	$3,148,000
Irrigation	Bell	1	1	2	$6.92	$10.55	$10,546,000
Mining	Bell	5	5	2	$4.67	$7.15	$35,745,000
Temple	Bell	10	5.7	2	$4.23	$3.57	$35,745,000
Bryan	Brazos	See Individual Option					
College Station	Brazos	See Individual Option					
Gatesville	Coryell	7.5	4.3	2	$4.23	$3.57	$26,808,000
Cleburne	Johnson	See Individual Option					
Steam-Electric	Johnson	5	5	2	$4.67	$7.15	$35,745,000
Mining	Jones	0.1	0.1	2	$9.89	$15.74	$1,574,000
Mining	Lee	0.5	0.5	2	$9.89	$15.74	$7,871,000
Mart	McLennan	See Individual Option					
North Bosque WSC	McLennan	0.8	0.5	1	$3.90	$7.89	$6,311,000
Robinson	McLennan	0.35	0.2	1	$5.75	$12.03	$4,211,000
Mining	McLennan	See Individual Option					
Manufacturing	McLennan	1	1	1	$3.90	$7.89	$7,889,000
Sweetwater	Nolan	2.8	1.6	1	$2.87	$5.71	$15,992,000
Steam-Electric	Robertson	0.2	0.2	2	$9.89	$15.74	$3,148,000
Abilene	Taylor	See WWP plan in Section 4C.38					
Merkel	Taylor	0.1	0.1	2	$9.89	$15.74	$1,574,000

Table 3.2-9. Cost Estimate Summaries: Reuse as a Water Management Strategy for Multiple Water User Groups

WUG	County	Reuse Maximum Capacity (MGD)	Available Project Yield (MGD)	Scenario	Unit Cost ($/1000 gal)	Project Cost ($/gal)	Project Cost ($)
Merkel	Taylor	0.1	0.1	2	$9.89	$15.74	$1,574,000
Mining	Taylor	0.2	0.2	2	$9.89	$15.74	$3,148,000
Georgetown	Williamson	10	5.7	2	$4.23	$3.57	$35,745,000
Granger	Williamson	0.15	0.1	2	$9.89	$15.74	$2,361,000
Hutto	Williamson	10	5.7	2	$4.23	$3.57	$35,745,000
Leander	Williamson	10	5.7	2	$4.23	$3.57	$35,745,000
Mining	Williamson	5	5.0	2	$4.67	$7.15	$35,745,000
Round Rock	Williamson	10	5.7	2	$4.23	$3.57	$35,745,000
Williamson C-O	Williamson	10	5.7	2	$4.23	$3.57	$35,745,000
Irrigation	Williamson	0.1	0.1	2	$9.89	$15.74	$1,574,000
Florence	Williamson	0.2	0.1	2	$9.89	$15.74	$3,148,000

3.2.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 3.2-10, and the option meets each criterion. Each community that pursues wastewater reuse will need to investigate concerns that would include at a minimum:

- Amount of treated effluent available, taking into consideration downstream water commitments and discharge permit restrictions,
- Potential users, primarily individual large-scale users that could utilize non-potable water (e.g., certain industries) and irrigated lands (e.g., golf courses and park areas), and
- Capital costs of constructing needed distribution systems connecting the treatment facilities to the areas of reuse.

Table 3.2-10. Comparison of General Wastewater Reuse Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Potentially important source, up to 25 percent of demand
2. Reliability	2. High reliability
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. Produces instream flows—low to moderate impact
2. Habitat	2. Possible low impact
3. Cultural Resources	3. None or low impact
4. Bays and Estuaries	4. None or low impact
5. Threatened and Endangered Species	5. Possible impact
6. Wetlands	6. None or low impact
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; benefit accrues to demand centers by more efficient use of available water supplies; no effect on navigation
D. Threats to Agriculture and Natural Resources	Generally positive effect to agriculture and natural resources by avoiding need for new supplies
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Could offset the need for voluntary redistribution of other supplies

Reuse of reclaimed wastewater requires a TCEQ authorization. Requirements specific to pipelines needed to link wastewater treatment facilities to reuse water customers may include:

- U.S. Army Corps of Engineers Section 404 permit(s) for pipeline stream crossings; discharges of fill into wetlands and waters of the United States for construction; and other activities;
- TPDES Storm Water Pollution Prevention Plan;
- TPWD Sand, Shell, Gravel and Marl permit for construction in state-owned streambeds; and
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

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3.3 Bell County WCID No.1 Reuse Projects

3.3.1 Description of Option

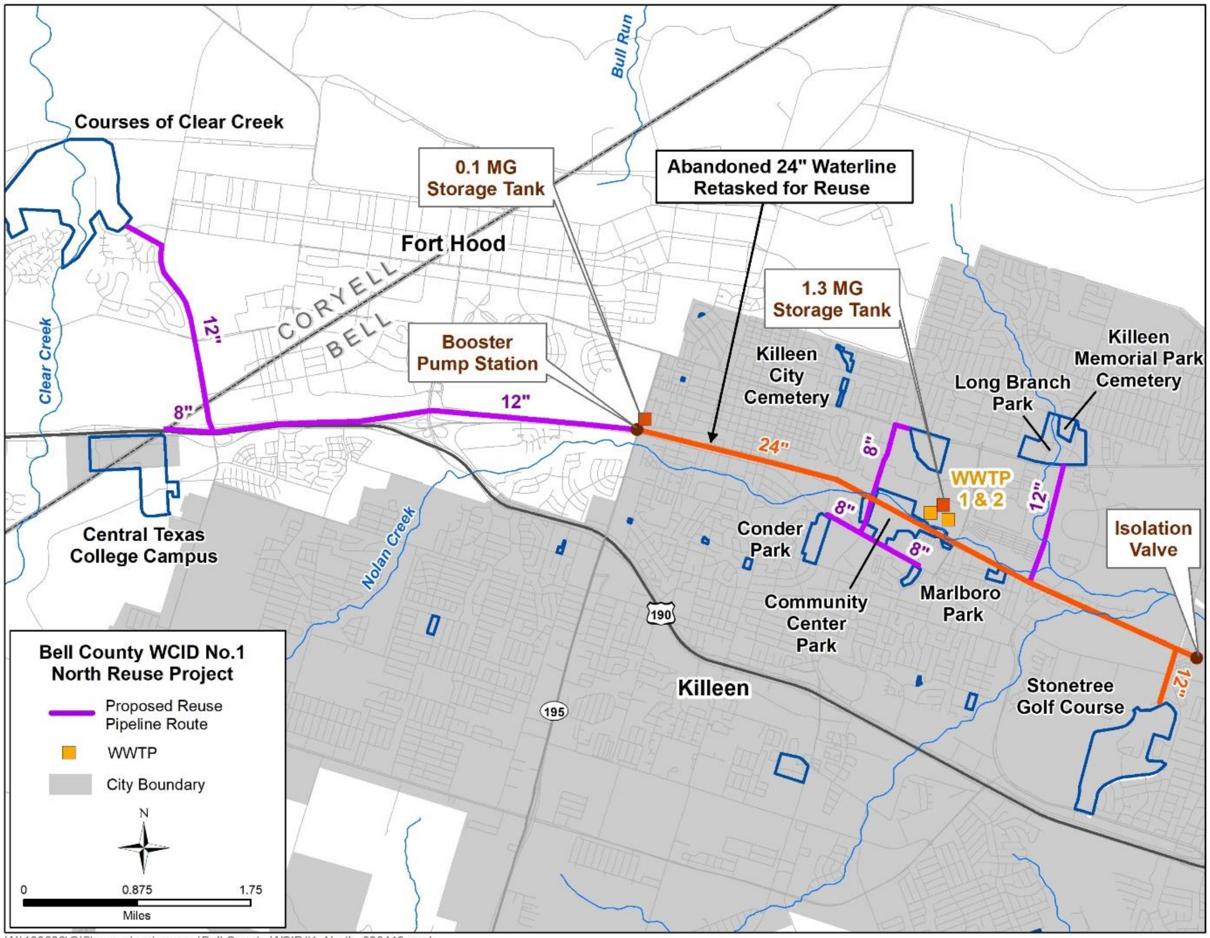
Bell County WCID No. 1 has evaluated several wastewater reuse options as part of its Master Plan update. The reuse portion of the Master Plan identifies both near-term potential customers as well as other future customers that would utilize the total available reuse supply generated through the District's regional wastewater system. The near-term potential projects are those that the District and the cities of Killeen and Harker Heights have identified for implementation within the next 20 years. Other potential demands are associated with future reuse projects at Fort Hood, and additional projects for Killeen, Harker Heights, and other communities in the US Highway 190 corridor.

The near-term potential customers will be served through two projects identified as the North Reuse Project and the South Reuse Project. The North Reuse Project consists of supplying treated wastewater from WWTPs 1 and 2 to potential customers for irrigation use at several municipal parks, two cemeteries in Killeen, golf courses including the Courses of Clear Creek near Fort Hood, the Stonetree Golf Course, and the Central Texas College campus. Irrigation demands for the North project are shown in Table 3.3-1. An abandoned 24-inch diameter water line will be placed back into service as the main transmission of the North Reuse Project. The locations of the WWTPs, potential customers and proposed North Reuse Project facilities are shown in Figure 3.3-1. Although average annual demands total approximately 1,925 acft/yr (1.72 MGD annual average), the reuse system must be sized to meet the peak irrigation demand during the summer months, which is about 3.03 MGD.

Table 3.3-1. Water Reuse Demands for Bell County WCID No. 1 North Reuse Project

Reuse Customer	Average Demand (MGD)	Peak Demand (MGD)
Courses at Clear Creek	0.47	0.82
Stonetree Golf Course	0.44	0.78
Community Center Ball Park	0.25	0.44
Long Branch Park	0.21	0.38
Central Texas College	0.11	0.19
Killeen City Cemetery	0.11	0.19
Conder Park	0.07	0.13
Memorial Park Cemetery	0.03	0.06
Marlboro Park	0.02	0.03
Total	**1.72**	**3.03**

Figure 3.3-1. Bell County WCID No. 1 North Reuse Project



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The South project includes potential irrigation customers to be supplied from the South WWTP. A portion of the existing effluent discharge line will be used to deliver a portion of the reuse supply. The locations of the WWTP, potential customers and proposed South Reuse Project facilities are shown in Figure 3.3-2. Average annual demand for the South project is approximately 748 acft/yr, and peak irrigation demand is about 1.18 MGD. Irrigation demands for the South project are shown in Table 3.3-2.

The long-term need for reuse supply is anticipated by the District to increase greatly in the future. Future reuse demands are associated with Fort Hood, and municipalities along the US Highway 190 corridor such as Harker Heights, Nolanville, Copperas Cove, and others. The North Reuse System would be expanded with new reuse transmission mains to serve these areas. Table 3.3-3 shows the future potential reuse demands.

3.3.2 Available Supply

The water supply that would be potentially available for the District would be that portion of their wastewater effluent stream that has suitable uses within an economical distance from the treatment plant. The District's three WWTP have a total rated capacity of 30 MGD. The average daily effluent flow from WWTP 1 and 2 is 13.2 MGD (14,784 acft/yr) of Type

1 effluent. The South WWTP facility is rated for 6 MGD capacity averaging about 4 MGD (4,480 acft/yr) of Type 1 effluent for use in unrestricted areas.

Figure 3.3-2. Bell County WCID No. 1 South Reuse Project

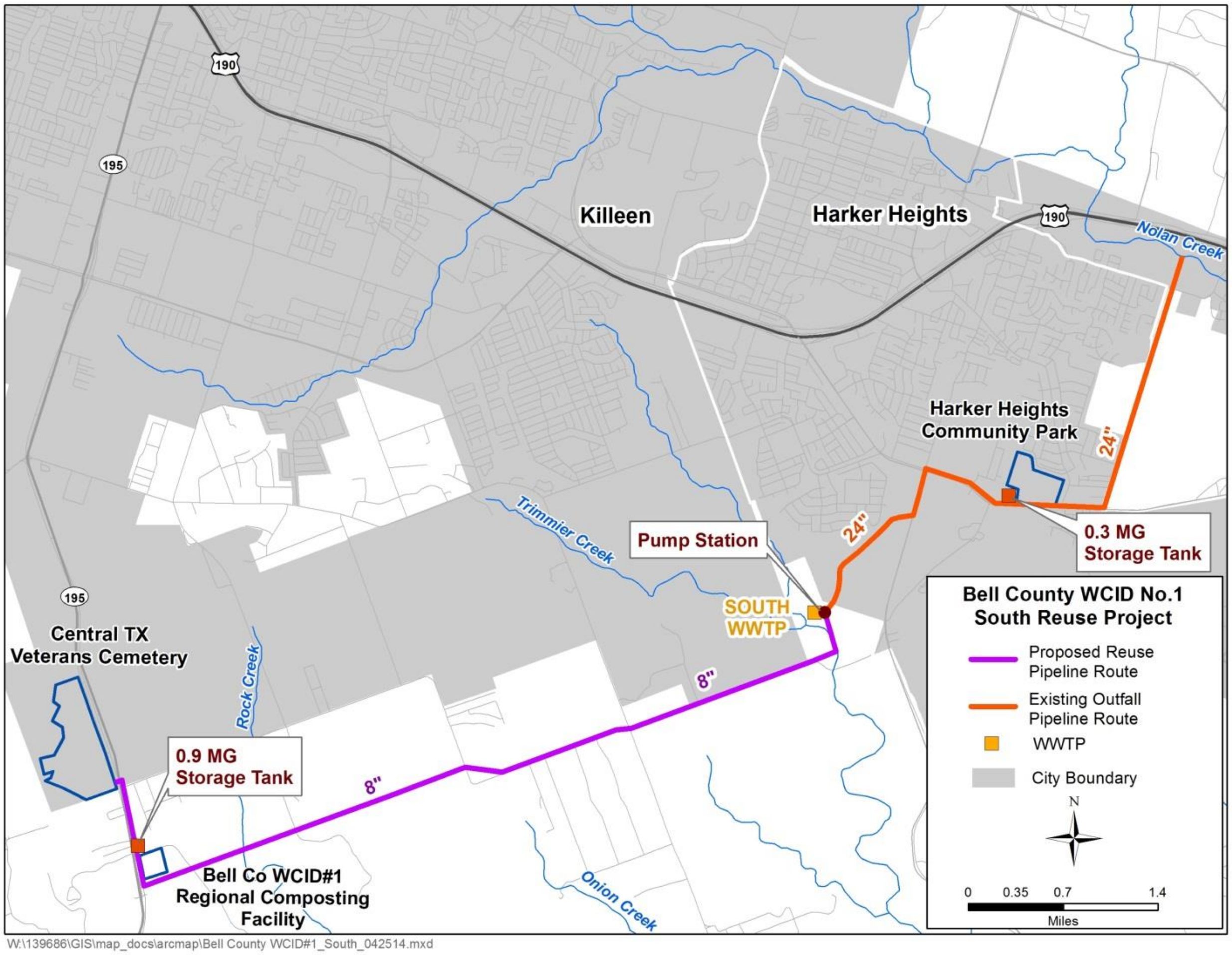


Table 3.3-2. Water Reuse Demands for Bell County WCID No. 1 South Reuse Project

Reuse Customer	Average Demand (MGD)	Peak Demand (MGD)
Central Texas State Veteran's Cemetery	0.48	0.85
Harker Heights Community Park	0.17	0.29
Composting Facility	0.02	0.03
Total	0.67	1.18

The Year 2070 Estimated WWTP Effluent for WWTP 1 and 2 is 26,880 acft/yr (24MGD) and 6,720 acft/yr (6 MGD) for the South WWTP. Since there is no current reuse, potentially all of this volume would be available for direct reuse. The currently proposed near term and future reuse projects could potentially use most of the year 2070 estimated WWTP effluent for the District.

Table 3.3-3 Other Potential Future Water Reuse Demands for Bell County WCID No. 1 Reuse System

Reuse Customer	Average Demand (MGD)	Peak Demand (MGD)
Fort Hood		
Vehicle Wash	5.00	5.00
Dust Control	1.20	1.20
Irrigation	6.25	11.06
Site Cooling	0.50	0.50
Future Development (Stillhouse Hollow Lake residential and recreational areas)	0.75	1.33
Nolanville Irrigation	0.50	0.89
Lions Club Park	0.45	0.80
Bacon Ranch Park	0.38	0.67
Camacho Park	0.22	0.39
Timber Ridge Park	0.15	0.27
Maxdale Park	0.15	0.27
AA Lane Park	0.06	0.11
Stewart Park	0.05	0.09
Fowler Park	0.04	0.07
Phyllis Park	0.03	0.05
Fox Creek Park	0.03	0.05
Lions Neighborhood Park	0.02	0.04
Home and Hope Park	0.02	0.04
Pershing	0.02	0.04
Santa Rosa Park	0.02	0.04
Ira Cross Park	0.02	0.04
Other Killeen Areas	1.50	2.66
Other Harker Heights Areas	1.20	2.12
Total	18.6	27.7

3.3.3 Environmental Issues

Environmental impacts could include:

- Possible low impact on instream flows below discharge points due to reduced effluent return flow rates;
- Possible increased water quality to remaining stream flows;
- Possible negative impact to fish and wildlife habitat with reduced stream flows; and
- Possible negative impact to threatened and endangered species depending on habitat and stream flow requirements.

A summary of environmental issues is presented in Table 3.3-4.

Table 3.3-4. Environmental Issues: Bell County WCID No. 1 North and South Reuse Projects

Issue	Description
Implementation Measures	Development of additional distribution pipelines, and pump stations
Environmental Water Needs / Instream Flows	Possible low impact on in-stream flows due to decreased effluent return flows; possible increased water quality to remaining stream flows
Bays and Estuaries	Possible low negative impact
Fish and Wildlife Habitat	Possible variable impacts depending on changes in volume of effluent return flows; possible high negative impact to fish and wildlife habitat with substantially reduced stream flows
Cultural Resources	Possible low impact
Threatened and Endangered Species	Possible variable impacts depending on habitat requirements for listed species
Comments	Assumes needed infrastructure for the North project will be in urbanized areas and mostly rural areas for the South project

3.3.4 Engineering and Costing

The North Reuse Project will make use of an abandoned 24-inch diameter transmission line to convey treated reuse water to potential customers. New facilities will include storage at the WWTP, a pump station, booster station and branch pipelines. Irrigation water for golf courses, parks, ball fields and cemeteries will generally be applied during periods when these areas are not being utilized, typically at night. Existing storage at the golf courses will be used for irrigation. For reuse customers without storage, water will be delivered on an as needed basis. Therefore, facilities are sized to deliver the total daily demand in a 6-hour period for the customers without existing storage. Providing storage at the point of use may decrease required pipeline and pump station size because the water can be transported at a more uniform rate to fill storage tanks at the point of use.

The required improvements to implement a wastewater reuse supply for the North Reuse Project are summarized in Table 3.3-5.

Table 3.3-5. Required Facilities – Bell County WCID No. 1 North Reuse Project

Facility	Description
Treatment Upgrade	Existing WWTP meets Type 2 reuse standards, basic treatment chorine disinfection included
Pump Station(s)	Two pump stations - 339 hp and 143 HP to deliver peak demand of 3.9 MGD (Total pump capacity of 7.82 MGD to deliver portion for two golf courses with on-site storage in 18 hours and in 6 hours for other demand locations)
Storage Tank	1.3 MG at WWTP. 0.1 MG storage at booster station. Utilize existing storage at golf courses.
Pipeline	11,724 ft of 8-inch pipe 32,216 ft of 12-inch pipe

Estimated costs for the North Reuse Project are summarized in Table 3.3-6. Total costs for the project are $15,186,000 with annual costs of $1,608,000. Annual costs include debt service estimated at 3.5% for 20 years, O&M for pipelines and pump stations and pumping energy. Annual unit costs are estimated to be $835/acft or $2.56/thousand gallons. The unit cost of a reuse water supply could potentially be decreased by the addition of other users within an economical distance from the WWTP(s).

The South Reuse Project will make use of a portion of the pressurized pipeline to the Nolan Creek outfall to convey treated reuse water to potential customers east of the South WWTP. New facilities will include a pump station, booster station and branch pipelines. Pumping facilities are sized to deliver the water to ground storage tanks near the irrigation demand. Distribution pumps and pipelines would draw water from the storage tanks as needed. The improvements required to implement a wastewater reuse supply for the South Reuse Project are summarized in Table 3.3-7.

Estimated costs for the South Reuse Project are summarized in Table 3.3-8. Total project costs for the project are $11,578,000 with annual costs of $1,020,000. Annual costs include debt service estimated at 3.5% for 20 years, O&M for pipeline and pump station and pumping energy. Annual unit costs are estimated at $274/acft or $4.18/thousand gallons. The unit cost of a reuse water supply could potentially be decreased by the addition of other users within an economical distance from the WWTPs.

Table 3.3-6. Cost Estimate Summary: Bell County WCID No. 1 North Reuse Project

Item	*Estimated Costs for Facilities*
Transmission Pipeline (8 in dia., 2.2 miles and 12 in. dia, 6.1 miles)	**$5,133,000**
Transmission Pump Station(s) & Storage Tank(s)	**$4,255,000**
Storage Tanks (Other Than at Booster Pump Stations)	**$901,000**
Water Treatment Plant (9 MGD)	**$514,000**
TOTAL COST OF FACILITIES	**$10,803,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	**$3,525,000**
Environmental & Archaeology Studies and Mitigation	**$324,000**
Land Acquisition and Surveying (17 acres)	**$127,000**
Interest During Construction (3% for 1 years with a 0.5% ROI)	**$407,000**
TOTAL COST OF PROJECT	**$15,186,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	**$1,068,000**
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	**$69,000**
Intakes and Pump Stations (2.5% of Cost of Facilities)	**$84,000**
Water Treatment Plant	**$308,000**
Pumping Energy Costs (993,113 kW-hr @ 0.08 $/kW-hr)	**$79,000**
TOTAL ANNUAL COST	**$1,608,000**
Available Project Yield (acft/yr)	**1,925**
Annual Cost of Water ($ per acft), based on PF=1	**$835**
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	**$281**
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	**$2.56**
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	**$0.86**

Table 3.3-7. Required Facilities – Bell County WCID No. 1 South Reuse Project

Facility	Description
Treatment Upgrade	Existing WWTP meets Type 1 reuse standards, add chlorine disinfection to the western pipeline and at the Harker Heights Community Park storage tank
Pump Station	Transmission and booster pump station - 134 hp to deliver peak demand of 0.9 MGD to a terminal storage tank
Storage Tanks	0.9 MG tank near the Veterans Cemetery and 0.3 MG tank near Harker Heights Community Park to store one day of treated reuse water.
Pipeline	35,187 ft of 8-inch pipe

Table 3.3-8. Cost Estimate Summary: Bell County WCID No. 1 South Reuse Project

Item	*Estimated Costs for Facilities*
CAPITAL COST	
Transmission Pipeline (8 in dia., 6.7 miles)	$1,885,000
Transmission Pump Station(s) & Storage Tank(s)	$3,754,000
Storage Tanks (Other Than at Booster Pump Stations)	$2,238,000
Two Water Treatment Plants (0.9 MGD and 0.3 MGD)	$119,000
TOTAL COST OF FACILITIES	**$7,996,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$2,704,000
Environmental & Archaeology Studies and Mitigation	$269,000
Land Acquisition and Surveying (39 acres)	$299,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$310,000
TOTAL COST OF PROJECT	**$11,578,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$815,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$59,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$49,000
Water Treatment Plant	$72,000
Pumping Energy Costs (311,116 kW-hr @ 0.08 $/kW-hr)	$25,000
TOTAL ANNUAL COST	**$1,020,000**
Available Project Yield (acft/yr)	748
Annual Cost of Water ($ per acft), based on PF=1.73	$1,364
Annual Cost of Water After Debt Service ($ per acft), based on PF=1.73	$274
Annual Cost of Water ($ per 1,000 gallons), based on PF=1.73	$4.18
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1.73	$0.84

As identified in Table 3.3-9, the combined yield of the North and South Reuse Projects are 2,673 acft/yr with annual unit costs of $983/acft or $3.01 per thousand gallons.

Table 3.3-9. Total Yield and Cost for North and South Reuse Projects

Project	Average Yield (acft/yr)	Unit Cost	
		($/acft)	($/kgal)
North Reuse Project	1,925	$835	$2.56
South Reuse Project	748	$1,364	$4.18
Total	2,673	$983	$3.01

3.3.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 3.3-10, and the option meets each criterion. Supply of reuse wastewater requires a TCEQ permit. Requirements specific to pipelines needed to link wastewater treatment facilities to reuse water users may include:

- U.S. Army Corps of Engineers Section 404 permit(s) for pipeline stream crossings; discharges of fill into wetlands and waters of the United States for construction; and other activities;
- TPDES Storm Water Pollution Prevention Plan;
- TPWD Sand, Shell, Gravel, and Marl permit for construction in state-owned streambeds; and
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

Table 3.3-10. Comparison of Bell County WCID No.1 North and South Reuse Projects to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Potentially important source reducing demand for potable supplies
2. Reliability	2. High reliability
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. Reduces instream flows—low to moderate impact
2. Habitat	2. Possible low impact
3. Cultural Resources	3. None or low impact
4. Bays and Estuaries	4. None or low impact
5. Threatened and Endangered Species	5. Potential impact
6. Wetlands	6. None or low impact

Impact Category	Comment(s)
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; benefit accrues to demand centers by more efficient use of available water supplies; no effect on navigation
D. Threats to Agriculture and Natural Resources	Generally positive effect to agriculture and natural resources by avoiding need for new supplies
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Could offset the need for voluntary redistribution of other supplies

3.4 City of Bryan Lake Bryan Reuse

3.4.1 Description of Option

The City of Bryan currently irrigates the Traditions Golf Course with Type 2 treated wastewater effluent from Thompson's Creek WWTP, a small package treatment plant located near the golf course with a capacity of 2.0 MGD. The City has two other WWTPs, Burton Creek and Still Creek, that produce effluent requiring additional treatment to meet Type 1 reuse water requirements. There are several parks, ball fields, and other green spaces dispersed throughout the City that could be irrigated with reuse water if the wastewater could be treated and distributed economically. However, these green spaces do not individually have large irrigation water demands and are located a significant distance from the existing wastewater treatment plant. Therefore, irrigation reuse options were not evaluated.

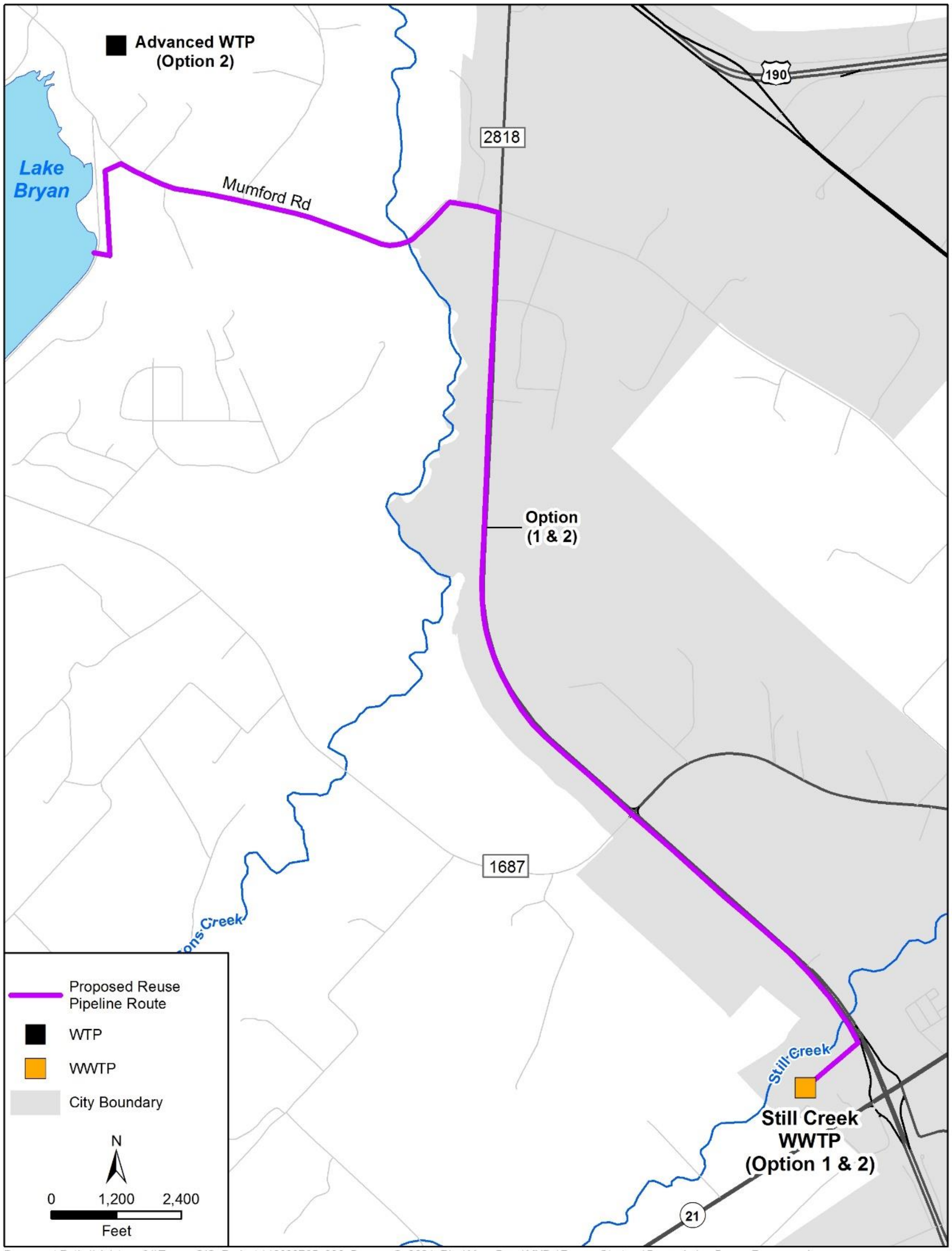
The City is considering two alternate reuse projects using treated supplies from Still Creek WWTP to either offset potable demand (Option 1) or as indirect potable reuse (Option 2). Option 1 consists of a reuse project to deliver Type 1 treated wastewater to Bryan Utilities Lake, a small lake associated with a power generation plant (Figure 3.4-1). The City has periodically supplied potable water to this lake for extended periods at a rate of up to 3,000 gpm (4.32 MGD). This option will replace a portion of this potable water demand with a wastewater reuse supply having a peak capacity of 1,500 gpm (2.16 MGD). Since Bryan Utilities Lake is used for recreational purposes, this option includes additional treatment at Still Creek WWTP to supply Type 1 reuse water to the lake. The reuse water supply will be delivered at a continuous daily rate during periods of demand, so no storage is required. The project yield is based on an average demand of 2.16 MGD for 3 months during each year.

Option 2 utilizes similar infrastructure to deliver treated effluent to Bryan Utilities Lake for blending and subsequent treatment to drinking water standards and combining it with existing groundwater supply. However, reuse supplies will be delivered at a uniform rate of 2.16 MGD. An advanced water treatment facility consisting of low-pressure membranes, reverse osmosis and advanced oxidation would be constructed nearby to treat blended supplies from Bryan Utilities Lake. The location of the WTP has not been selected and would be subject to availability of land.

3.4.2 Available Supply

The water supply that would be potentially available for Bryan would be that portion of their wastewater effluent stream that has suitable uses within an economical distance from the treatment plant. The City of Bryan has confirmed that it plans to reuse all of its treated wastewater by 2070. The Still Creek WWTP Year 2070 Estimated WWTP Effluent is 5,621 acft/yr (5.02 MGD). The Burton Creek WWTP Year 2070 Estimated WWTP Effluent is 15,209 acft/yr (13.58 MGD).

Figure 3.4-1. Bryan Reuse Option 1 and Option 2



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3.4.3 Environmental Issues

Environmental impacts could include:

- Possible low impact on instream flows below discharge points due to reduced effluent return flow rates;
- Possible impact to water quality in Bryan Utilities Lake and potential for release downstream of reuse water from Bryan Utilities Lake;
- Possible increased water quality to remaining stream flows;
- Possible high negative impact to fish and wildlife habitat with substantially reduced stream flows; and
- Possible negative impact to threatened and endangered species depending on habitat and stream flow requirements.

A summary of environmental issues is presented in Table 3.4-1.

Table 3.4-1. Environmental Issues: Bryan Reuse

Issue	Description
Implementation Measures	Development of additional wastewater treatment plant facilities, distribution pipelines, and pump stations
Environmental Water Needs / Instream Flows	Possible low impact on in-stream flows due to decreased effluent return flows; possible increased water quality to remaining stream flows
Bays and Estuaries	Possible low negative impact
Fish and Wildlife Habitat	Possible variable impacts depending on changes in volume of effluent return flows; possible high negative impact to fish and wildlife habitat with substantially reduced stream flows
Cultural Resources	Possible low impact
Threatened and Endangered Species	Possible variable impacts depending on habitat requirements for listed species.
Comments	Assumes needed infrastructure will be in urbanized areas

3.4.4 Engineering and Costing

The required improvements to implement a wastewater reuse supply for Bryan's Option 1 are summarized in Table 3.4-2. Costs presented in Table 3.4-3 provide the total Option 1 costs for developing a wastewater reuse supply to Bryan Utilities Lake. The required improvements to implement an indirect potable reuse supply for Bryan's Option 2 are summarized in Table 3.4-4. Costs presented in Table 3.4-5 provide the total Option 2 costs for developing an indirect potable reuse supply. System integration costs are not included in the estimate.

Table 3.4-2. Required Facilities – Bryan Reuse Option 1

Facility	Description
Treatment Upgrade	2.16 MGD, Scenario 2; existing WWTP requires additional tertiary treatment to meet type 1 standards and addition of chlorine for distribution
Pump Station	174 hp (Booster); 2.16 MGD capacity to deliver peak capacity at uniform rate
Storage Tank	None
Pipeline	29,000 ft of 12-inch pipe
Available Project Yield	0.54 MGD (605 acft/yr), yield is 3 months per year of peak demand supplied to lake

Table 3.4-3. Cost Estimate Summary: Option 1 Reuse for Bryan Utilities Lake Supply

Item	Estimated Costs for Facilities
Transmission Pipeline (12 in dia., 6 miles)	$2,610,000
Transmission Pump Station(s) & Storage Tank(s)	$1,249,000
Wastewater Treatment Plant Upgrades	$3,455,000
Total Cost Of Facilities	**$7,314,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$2,429,000
Environmental & Archaeology Studies and Mitigation	$214,000
Land Acquisition and Surveying (34 acres)	$838,000
Interest During Construction (4% for 1 years with a 1% ROI)	$297,000
Total Cost Of Project	**$11,092,000**
Annual Cost	
Debt Service (5.5 percent, 20 years)	$780,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$26,000
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$31,000
Water Treatment Plant (2.5% of Cost of Facilities)	$635,000
Pumping Energy Costs (128,384 kW-hr @ 0.09 $/kW-hr)	$10,000
Total Annual Cost	**$1,482,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 4	605
Annual Cost of Water ($ per acft)	$2,450
Annual Cost of Water ($ per 1,000 gallons)	$7.52

Table 3.4-4. Required Facilities – Bryan Indirect Potable Reuse Option 2

Facility	Description
Treatment Upgrade	2.16 MGD, Scenario 2; existing WWTP requires additional tertiary treatment to meet type 1 standards and addition of chlorine for distribution
New WTP	2.2 MGD Advanced WTP (low pressure membranes, RO, advanced oxidation)
Pump Station	174 hp (Booster); 2.16 MGD capacity to deliver peak capacity at uniform rate
Intake & Pump Station	43 hp; 2.3 MGD capacity to deliver from Lake Bryan to Advanced WTP
Storage Tank	None
Pipeline	31,000 ft of 12-inch pipe
Available Project Yield	2.19 MGD (2,419 acft/yr)

Table 3.4-5. Cost Estimate Summary: Option 2 Indirect Potable Reuse for Bryan

Item	Estimated Costs for Facilities
Intake Pump Stations	$3,379,000
Transmission Pipeline (12 in dia., 6 miles)	$2,784,000
Transmission Pump Station(s) & Storage Tank(s)	$1,309,000
WWTP Improvements	$3,439,000
Advanced Water Treatment Plant (2.2 MGD)	$17,558,000
Total Cost Of Facilities	**$28,469,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$9,825,000
Environmental & Archaeology Studies and Mitigation	$255,000
Land Acquisition and Surveying (41 acres)	$1,455,000
Interest During Construction (4% for 1 years with a 1% ROI)	$1,101,000
Total Cost Of Project	**$41,105,000**
Annual Cost	
Debt Service (5.5 percent, 20 years)	$2,892,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$28,000
Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$117,000
Water Treatment Plant (2.5% of Cost of Facilities)	$543,000
Advanced Water Treatment Facility	$2,213,000
Pumping Energy Costs (1,418,459 kW-hr @ 0.09 $/kW-hr)	$106,000
Purchase of Water (acft/yr @ $/acft)	$0
Total Annual Cost	**$5,899,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	2,419
Annual Cost of Water ($ per acft)	$2,439
Annual Cost of Water ($ per 1,000 gallons)	$7.48

3.4.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 3.4-6, and the option meets each criterion. The City of Bryan might select Option 1 or Option 2 as a reuse strategy.

Before pursuing wastewater reuse Option 1, Bryan will need to investigate concerns that would include at a minimum:

- Amount of treated effluent available, taking into consideration downstream water commitments and discharge permit restrictions;

- Potential users, primarily individual large-scale users that could utilize non-potable water (e.g., certain industries) and irrigated lands (e.g., golf courses and park areas);
- Capital costs of constructing needed distribution systems connecting the treatment facilities to the areas of reuse; and
- Regulatory approval of a new discharge (permit) into Bryan Utilities Lake.

Before pursuing indirect potable reuse Option 2, Bryan will need to investigate concerns that would include at a minimum:

- Amount of treated effluent available, taking into consideration downstream water commitments and discharge permit restrictions;
- Capital costs of constructing needed distribution systems connecting the treatment facilities to the areas of reuse;
- Public acceptance and regulatory approval of this water management strategy; and
- Integration of surface water source into a groundwater system which may affect water quality and disinfection compatibility.

Table 3.4-6. Comparison of Bryan Reuse Options to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Potentially important source, up to 25 percent of demand
2. Reliability	2. High reliability
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. Potentially produces instream flows—low to moderate impact
2. Habitat	2. Possible low impact
3. Cultural Resources	3. None or low impact
4. Bays and Estuaries	4. None or low impact
5. Threatened and Endangered Species	5. Potential impact
6. Wetlands	6. None or low impact
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; benefit accrues to demand centers by more efficient use of available water supplies; no effect on navigation
D. Threats to Agriculture and Natural Resources	Generally positive effect to agriculture and natural resources by avoiding need for new supplies
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Could offset the need for voluntary redistribution of other supplies

Supply of indirect potable reuse would require a TCEQ discharge permit for returning treated effluent to Bryan Utilities Lake, as well as TCEQ approval of the new surface water supply from the lake. Approval of a TCEQ discharge permit would likely require water quality modeling of Bryan Utilities Lake to help determine effluent limits for dissolved oxygen, biochemical oxygen demand, ammonia-nitrogen and potentially other constituents. Requirements specific to pipelines needed to link wastewater treatment facilities to reuse water users may include:

- U.S. Army Corps of Engineers Section 404 permit(s) for pipeline stream crossings; discharges of fill into wetlands and waters of the United States for construction; and other activities;
- TPDES Storm Water Pollution Prevention Plan;
- TPWD Sand, Shell, Gravel and Marl permit for construction in state-owned streambeds; and
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

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3.5 City of Bryan – Miramont Reuse

3.5.1 Description of Option

In addition to the Lake Bryan reuse project options, the City of Bryan is also considering a reuse project to meet summer peaking needs of the Miramont Country Club from the Burton Creek WWTP. The Burton Creek WWTP is rated for 8 MGD with average daily flow of 5.6 MGD that can meet Type II reuse requirements. The Miramont uses three wells on the property to pump to onsite ponds which are used to irrigate the golf course, rights of way and landscaping. In the peak irrigation months, the Miramont is using approximately 1.6 MGD to irrigate and maintain pond levels. The Miramont's irrigation supply is currently backed up by the City's potable water system. Figure 3.5-1 shows the potential route for reuse water to Miramont Country Club.

If Type I effluent is required for the golf course, the Burton Creek WWTP would require tertiary treatment.

3.5.2 Available Supply

The City of Bryan has confirmed that it plans to reuse all of its treated wastewater by 2070. The Burton Creek WWTP Year 2070 Estimated WWTP Effluent is 15,210 acft/yr (13.58 MGD).

3.5.3 Environmental Issues

Environmental impacts could include:

- Possible low impact on instream flows below discharge points due to reduced effluent return flow rates;
- Possible increased water quality to remaining stream flows;
- Possible negative impact to fish and wildlife habitat with reduced stream flows; and
- Possible negative impact to threatened and endangered species depending on habitat and stream flow requirements.

A summary of environmental issues is presented in Table 3.5-1.

3.5.4 Engineering and Costing

The required improvements to implement a wastewater reuse supply for the Miramont Country Club are summarized in Table 3.5-2. Project and annual costs are included in Table 3.5-3. The total project cost is estimated at $3,894,000 with an average annual cost of $315,000.

Figure 3.5-1 Bryan Miramont Reuse

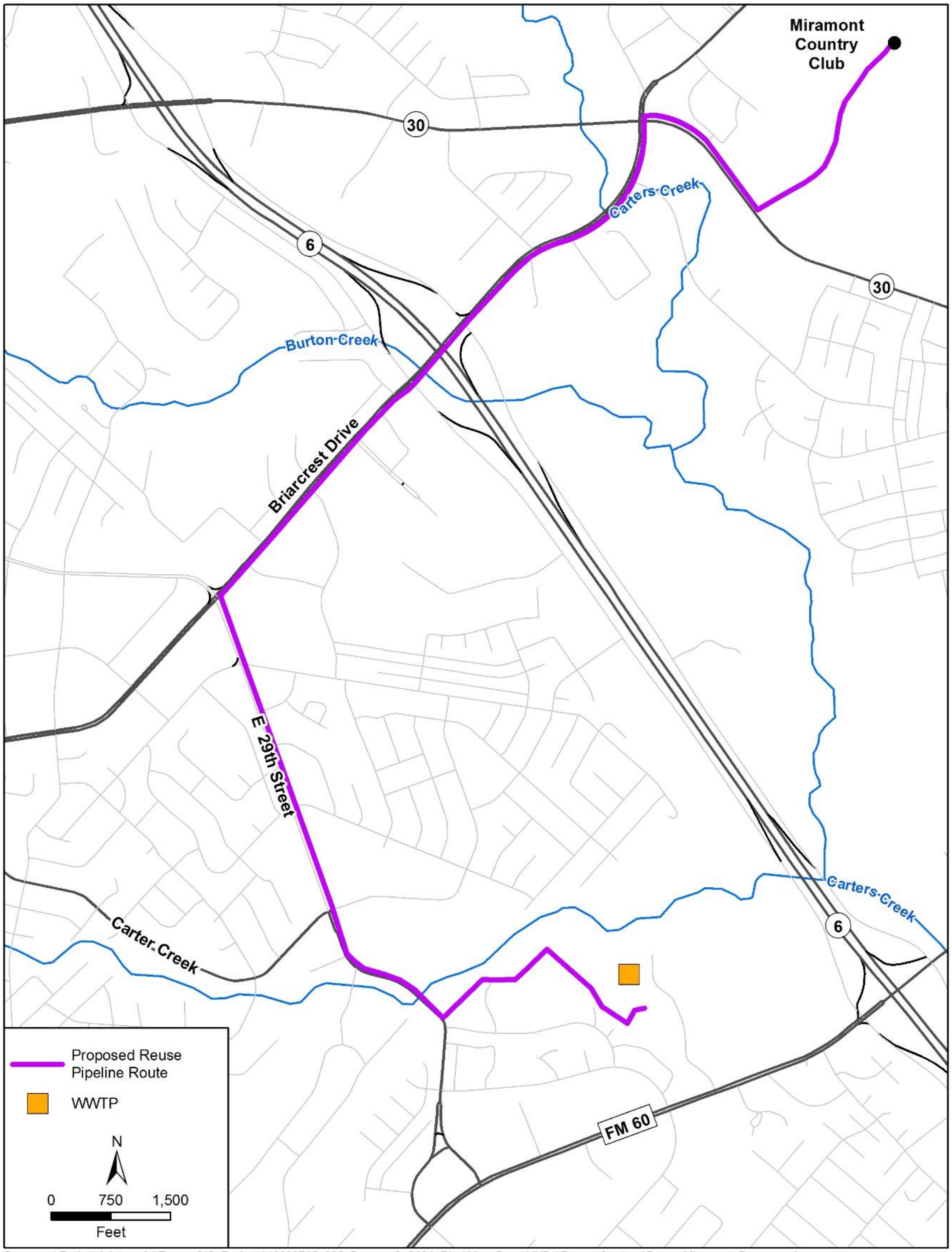

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Table 3.5-1. Environmental Issues: Bryan Miramont Reuse

Issue	Description
Implementation Measures	Development of additional wastewater treatment plant facilities, distribution pipelines, and pump stations
Environmental Water Needs / Instream Flows	Possible low impact on in-stream flows due to decreased effluent return flows; possible increased water quality to remaining stream flows
Bays and Estuaries	Possible low negative impact
Fish and Wildlife Habitat	Possible variable impacts depending on changes in volume of effluent return flows; possible high negative impact to fish and wildlife habitat with substantially reduced stream flows
Cultural Resources	Possible low impact
Threatened and Endangered Species	Possible variable impacts depending on habitat requirements for listed species.
Comments	Assumes needed infrastructure will be in urbanized areas

Table 3.5-2. Required Facilities – Bryan Miramont Reuse

Facility	Description
Treatment Upgrade	Additional chlorine for distribution
Pump Station	50 hp pump station
Storage Tank	None
Pipeline	18,600 ft of 12-inch pipe
Available Project Yield	0.54 MGD (600 acft/yr), yield is 4 months per year of peak demand

Table 3.5-3. Cost Estimate Summary: Bryan Miramont Reuse Project

Item	Estimated Costs for Facilities
Pump Station (1.6 MGD)	$585,000
Transmission Pipeline (12 in dia., 4 miles)	$2,097,000
Total Cost Of Facilities	**$2,682,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$834,000
Environmental & Archaeology Studies and Mitigation	$120,000
Land Acquisition and Surveying (22 acres)	$153,000
Interest During Construction (4% for 1 years with a 1% ROI)	$105,000
Total Cost Of Project	**$3,894,000**
Annual Cost	
Debt Service (5.5 percent, 20 years)	$274,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$21,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$15,000
Pumping Energy Costs (67906 kW-hr @ 0.09 $/kW-hr)	$5,000
Total Annual Cost	**$315,000**
Available Project Yield (acft/yr)	**600**
Annual Cost of Water ($ per acft), based on a Peaking Factor of 3	**$525**
Annual Cost of Water ($ per 1,000 gallons), based on a Peaking Factor of 3	**$1.61**

3.5.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 3.5-4, and the option meets each criterion. Before pursuing wastewater reuse, the City of Bryan will need to investigate concerns that would include at a minimum:

- Amount of treated effluent available, taking into consideration downstream water commitments and discharge permit requirements.
- Capital costs of constructing needed distribution systems connecting the treatment facilities to the areas of reuse.
- Public acceptance of this water management strategy.

Supply of reuse wastewater requires a TCEQ permit. Requirements specific to pipelines needed to link wastewater treatment facilities to reuse water users may include:

- U.S. Army Corps of Engineers Section 404 permit(s) for pipeline stream crossings; discharges of fill into wetlands and waters of the United States for construction; and other activities;
- TPDES Storm Water Pollution Prevention Plan;
- TPWD Sand, Shell, Gravel, and Marl permit for construction in state-owned streambeds; and
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

Table 3.5-4. Comparison of Bryan Miramont Reuse Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Potentially important source, up to 25 percent of demand
2. Reliability	2. High reliability
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. Produces instream flows—low to moderate impact
2. Habitat	2. Possible low impact
3. Cultural Resources	3. None or low impact
4. Bays and Estuaries	4. None or low impact
5. Threatened and Endangered Species	5. Potential impact
6. Wetlands	6. None or low impact
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; benefit accrues to demand centers by more efficient use of available water supplies; no effect on navigation
D. Threats to Agriculture and Natural Resources	Generally positive effect to agriculture and natural resources by avoiding need for new supplies
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Could offset the need for voluntary redistribution of other supplies

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3.6 Cedar Park Reuse

3.6.1 Description of Option

The City of Cedar Park WWTP has a permitted average effluent discharge of 2.5 MGD. Cedar Park is currently applying reuse as a water supply to Brushy Creek Sports Park through indirect reuse. Reuse supply available to the Sports Park is on average 32 acft/year (0.03 MGD). During peak demand the supply requirement to the Sports Park and other Public Works can be as great as 0.35 MGD. The City also has a contract with Avery Ranch golf course to provide up to 1 MGD of reuse water. The City operates a Water Reclamation Facility that treats water to Type 1 standards. The City can accommodate another 1 MGD of treated water for additional reuse applications. Two parks, Milburn Park and Fenway Park, have been identified as potential locations for additional reuse supply.

Locations of the Cedar Park WWTP plant, water reclamation facility, and proposed transmission pipelines, ground storage tanks, and pump stations are shown in Figure 3.6-1.

3.6.2 Available Supply

The planned capacity of the Cedar Park Reuse project is 1 MGD (1,120 acft/yr).

3.6.3 Environmental Issues

Environmental impacts could include:

- Possible low impact on instream flows below discharge points due to reduced effluent return flow rates;
- Possible increased water quality to remaining stream flows;
- Possible negative impact to fish and wildlife habitat with substantially reduced stream flows; and
- Possible negative impact to threatened and endangered species depending on habitat and stream flow requirements.

A summary of environmental issues is presented in Table 3.6-1.

Figure 3.6-1. Cedar Park Reuse

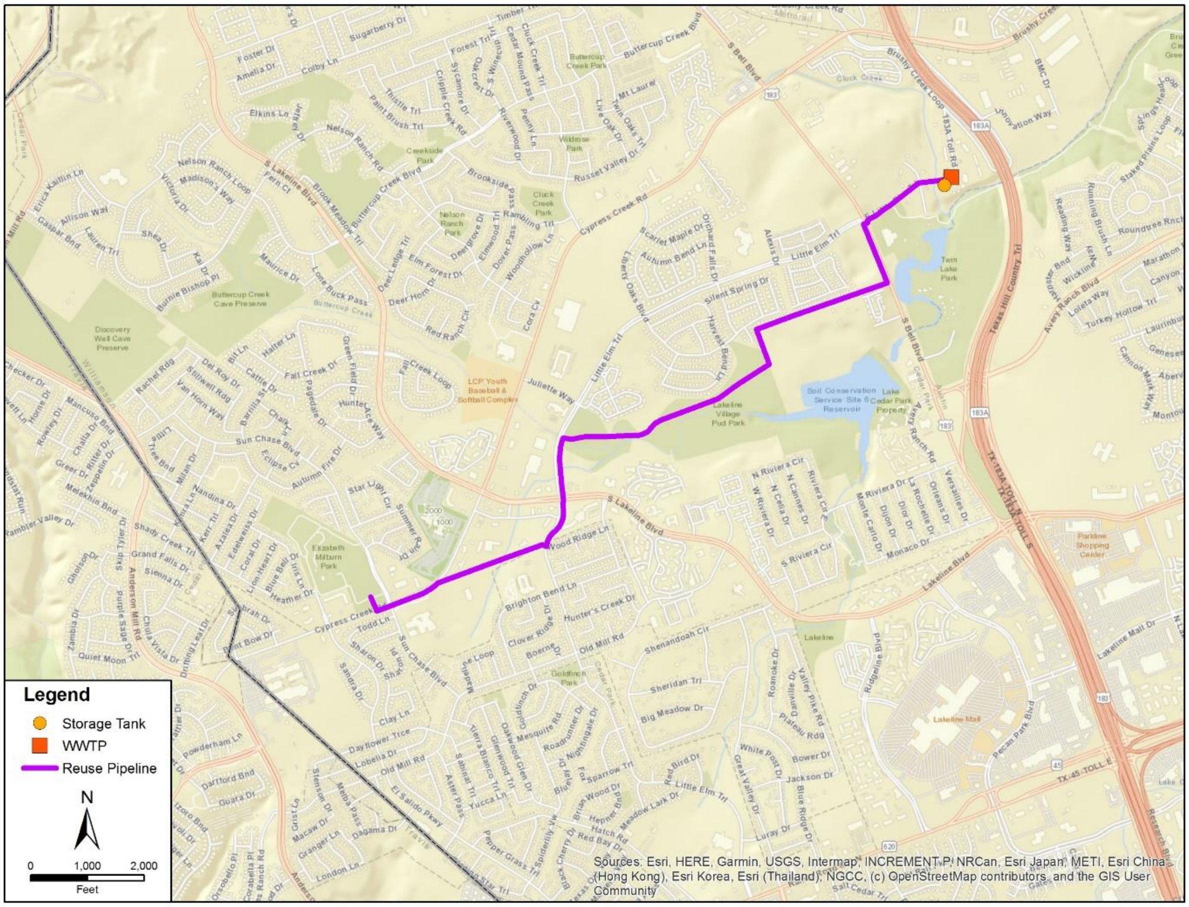

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Table 3.6-1. Environmental Issues: Cedar Park Reuse

Issue	Description
Implementation Measures	Development of additional water transmission pipelines, ground storage tanks and pump stations
Environmental Water Needs / Instream Flows	Possible low impact on in-stream flows due to decreased effluent return flows; possible increased water quality to remaining stream flows
Edwards Aquifer	Possible increased water quality to stream flows and Edwards Aquifer recharge zone. Possible low impact on recharge rates due to decreased effluent flow from the contributing zone.
Bays and Estuaries	Possible low negative impact
Fish and Wildlife Habitat	Possible variable impacts depending on changes in volume of effluent return flows; possible negative impact to fish and wildlife habitat due to reduced stream flows
Cultural Resources	Possible low impact
Threatened and Endangered Species	Possible variable impacts depending on habitat requirements for listed species.
Comments	Assumes needed infrastructure will be in urbanized areas

3.6.4 Engineering and Costing

The required improvements to implement a wastewater reuse supply Cedar Park are summarized in Table 3.6-2. The project requires a 1 MGD pump station along with a 1 MG storage tank located at the Cedar Park WWTP. A 2.84 mile, 14-inch diameter pipe would deliver the reuse supply to Fenway Park and Milburn Park. Distribution lines not included in this cost estimate would deliver irrigation supply to both parks.

Table 3.6-2. Required Facilities – Cedar Park Reuse

Facility	Description
Pump Stations	300 HP at Cedar Park WWTP; 1 MGD capacity for peak deliver at uniform rate to Fenway and Milburn Parks
Storage Tanks	1 MG; balancing storage at Cedar Park WWTP
Pipelines	15,000 ft of 14-inch pipe; from Cedar Park WWTP to Fenway and Milburn Park
Available Project Yield	1.0 MGD (1,140 acft/yr)

The total costs for developing a wastewater reuse supply for Fenway Park and Milburn Park are shown in Table 3.6-3. The project will have an estimated total capital cost of $7,184,000 and an annual cost of $608,000. This cost translates to a $543 per acft or $1.67 per 1,000 gallons unit cost of the reuse water.

Table 3.6-3. Cost Estimate Summary: Cedar Park Reuse

Item	*Estimated Costs for Facilities*
Primary Pump Station (1 MGD)	$1,956,000
Transmission Pipeline (14 in dia., 2.84 miles)	$1,819,000
Storage Tanks (Other Than at Booster Pump Stations)	$1,297,000
Total Cost Of Facilities	**$5,072,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,684,000
Environmental & Archaeology Studies and Mitigation	$100,000
Land Acquisition and Surveying (31 acres)	$135,000
Interest During Construction (4% for 1 years with a 1% ROI)	$193,000
Total Cost Of Project	**$7,184,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$505,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$31,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$49,000
Pumping Energy Costs (276,085 kW-hr @ 0.08 $/kW-hr)	$23,000
Total Annual Cost	**$608,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	1,120
Annual Cost of Water ($ per acft)	$543
Annual Cost of Water ($ per 1,000 gallons)	**$1.67**

Table 3.6-4. Comparison of Cedar Park Reuse Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient for intended uses
2. Reliability	2. High reliability
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. Reduces instream flows—possible low impact
2. Habitat	2. Possible low impact
3. Cultural Resources	3. None or low impact
4. Bays and Estuaries	4. None or low impact
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; benefit accrues to demand centers by more efficient use of available water supplies; no effect on navigation
D. Threats to Agriculture and Natural Resources	Generally positive effect to agriculture and natural resources by avoiding need for new supplies
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Could offset the need for voluntary redistribution of other supplies

Supply of reuse wastewater requires a TCEQ permit. Requirements specific to pipelines needed to link wastewater treatment facilities to reuse water users may include:

- TCEQ authorization to reuse domestic wastewater under 30 TAC Chapter 210 (“210 authorization”);
- U.S. Army Corps of Engineers Section 404 permit(s) for pipeline stream crossings; discharges of fill into wetlands and waters of the United States for construction; and other activities;
- TPDES Storm Water Pollution Prevention Plan;
- TPWD Sand, Shell, Gravel and Marl permit for construction in state-owned streambeds; and
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

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3.7 City of Cleburne Reuse

3.7.1 Description of Option

The City of Cleburne obtains its water supply from Lake Pat Cleburne, Lake Aquilla, and groundwater from the Trinity Aquifer. Lake Pat Cleburne, which is owned and operated by the City, impounds runoff from Nolan Creek for storage and use. The city also has contracted with the Brazos River Authority (BRA) for water supply from Lake Aquilla (5,300 acft/yr), from the BRA System (4,700 acft/yr), and from the BRA System with a Lake Whitney diversion (5,000 acft/yr). The city owns and operates six wells that produce water from the Trinity Aquifer.

The City of Cleburne has embraced the beneficial use of reuse water as a viable water management strategy to meet anticipated future shortages. The city plans to reuse available wastewater supplies to help meet its projected deficit in the year 2070 and has received an authorization from TCEQ for 8,440 acre feet (7.5 MGD) to allow reuse of all authorized discharges.

3.7.2 Available Supply

The City currently supplies 1.2 MGD (1,344 acft/yr) of reuse water directly to a Brazos Electric Power Cooperative power plant located north of the city for use as cooling water. The City of Cleburne owns and operates the existing reuse water treatment facility located on the City's wastewater treatment plant site. The facility is rated for 2.5 MGD capacity and utilizes inclined plate clarification technology to produce a Type 1 effluent. A 16-inch diameter reuse water transmission line exists along the east side of the city to convey reuse water from the wastewater facility to the power plant and for irrigation of a sports complex.

In addition to the existing reuse line, the city plans to develop a new West Loop Reclaimed Water Line and Pump Station to meet other identified reuse water needs. This project would include a 20-inch diameter reclaimed water pipeline on the west side of the city (Figure 3.7-1), which would carry water from the existing treatment facility to Lake Pat Cleburne functioning as a form of indirect potable reuse (IPR). The West Loop Reuse Pipeline will be sized to convey 6 MGD but will only carry 2 MGD at the time of completion because of high TDS levels in the wastewater treatment plant's influent. However, the City of Cleburne plans to construct a small, 1.25 MGD industrial wastewater treatment plant in the north of the city, which will supply direct reuse to its industrial customers. This new treatment facility will also reduce the TDS levels in the existing WWTP's influent allowing the city to capitalize on the West Loop's full 6 MGD capacity. Due to treatment losses, it is estimated that this 1.25 MGD treatment facility will provide 0.80 MGD to the city's industrial customers. A 16-inch diameter extension of the West Loop that would carry water north of Lake Pat Cleburne is also being considered by the city but has not been decided on. Coupled with a booster pump station and treatment plant expansion, this extension could convey an additional 2.5 MGD to potential reuse customers.

The West Loop will be sized to meet a peak daily capacity of 6.0 MGD. Demands for the reuse water are anticipated to increase from 3.2 MGD in 2020 to 4.9 MGD by 2045 as indicated in Table 3.7-1.

Table 3.7-1. Projected Reuse Demands for Cleburne Reuse Project

Reuse Customers	Year 2045
Municipal Water Supply	2,240
Brazos Electric Power Plant	1,232
James Hardie Manufacturing	919
Municipal Golf Course & Airport	582
Cleburne ISD	358
Sports Complex	112
Future Commercial Development	67
Total Demand (acft/yr)	5,511

3.7.3 Environmental Issues

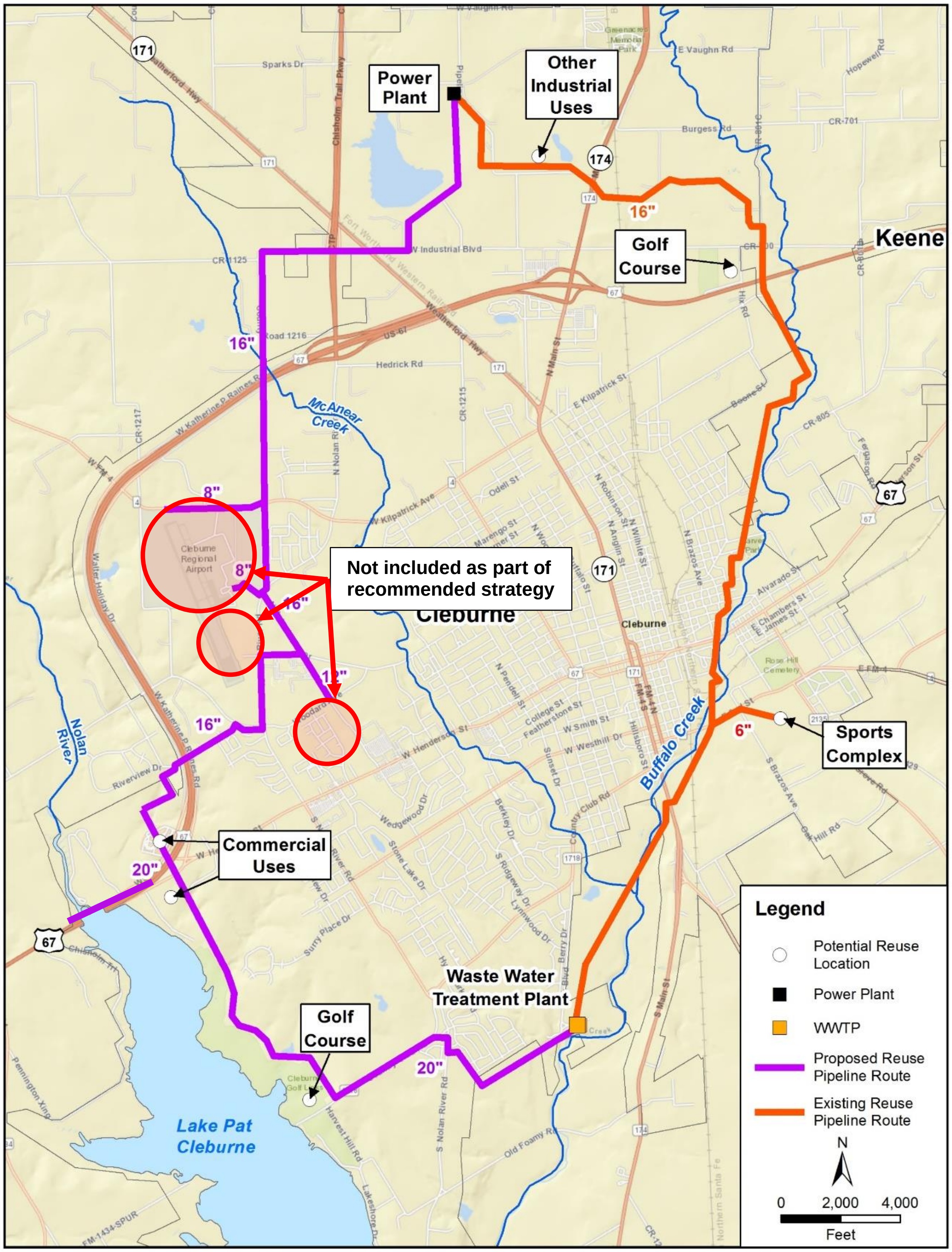
The City of Cleburne has filed for, and received, an authorization from TCEQ to reuse all effluent discharged pursuant to TPDES Permit No. 10006-001 and new outfall 003. The city is also in the process of amending its Chapter 210 Use of Reclaimed Water authorization to supply reuse water for irrigation to the sports complex facility planned east of the city, and to supplement industrial scenarios for fracking. Additional future reuse will require further amendment of the city's reuse authorization.

Expansion of the reuse water treatment facilities would involve relatively low environmental impacts:

- Reduced effluent discharges to the wastewater outfall could have a low impact on environmental water needs and instream flows.
- For potential future reuse within areas a reasonable distance from the existing reclaimed water pipeline, pipeline construction would be limited since available capacity in the existing 16-inch reclaimed water pipeline is currently underutilized.
- Reduced effluent discharges would reduce the BOD stream loading.

A summary of environmental issues is presented in Table 3.7-2.

Figure 3.7-1. Cleburne Reuse



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Note: Costs do not include the, two 8-inch lines and one 12-inch line shown above, but they are shown for completeness for City of Cleburne's information.

Table 3.7-2. Environmental Issues: Cleburne Reuse

Issue	Description
Implementation Measures	Development of additional wastewater treatment plant facilities, distribution pipelines, and pump stations
Environmental Water Needs / Instream Flows	Possible low impact on in-stream flows due to decreased effluent return flows; possible increased water quality to remaining stream flows
Bays and Estuaries	Possible low negative impact
Fish and Wildlife Habitat	Possible variable impacts depending on changes in volume of effluent return flows; possible high negative impact to fish and wildlife habitat with substantially reduced stream flows
Cultural Resources	Possible low impact
Threatened and Endangered Species	Possible variable impacts depending on habitat requirements for listed species.
Comments	Assumes needed infrastructure will be in urbanized areas

3.7.4 Engineering and Costing

The facilities needed to provide reuse water for the proposed expansion of the existing reuse water system and the new west loop include the following:

- Construction of 4.5 mile 20-inch diameter west loop to deliver reuse water to Lake Pat Cleburne;
- Expanded reuse water pump station
- Effluent outfall to Lake Pat Cleburne; and
- Construction of north industrial wastewater desalination plant.

As uses of reuse water increase over time, booster pump stations may also be required along the existing 16-inch reuse water line to allow for increased conveyance capacity. Estimated costs to expand the reuse water system as described above are summarized in Table 3.7-3. The project will be phased into two projects. Phase One total capital costs are $10,202,000 with annual costs of $895,000 and unit costs $400/acft or $1.23/ thousand gallons. Phase Two total capital costs are $28,978,000 with annual costs of $2,955,000 and unit costs $550/acft or $1.69/ thousand gallons.

Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 3.7-5, and the option meets each criterion. Implementation of this strategy is relatively straightforward and will include the required permit and reuse authorization amendments mentioned previously in addition to right-of-way and easement acquisition for reuse water piping, authorization for creek and river crossings, and financing.

Table 3.7-3. Cost Estimate Summary Cleburne Reuse Phase 1

Item	Estimated Costs for Facilities
Primary Pump Station (2 MGD)	$1,541,000
Transmission Pipeline (20 in dia., 4.5 miles)	$5,284,000
TOTAL COST OF FACILITIES	**$6,825,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$2,398,000
Environmental & Archaeology Studies and Mitigation	
Interest During Construction (3% for 1 years with a 0.5% ROI)	$274,000
TOTAL COST OF PROJECT	**$10,202,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$53,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$39,000
Pumping Energy Costs (0 kW-hr @ 0.08 $/kW-hr)	$85,000
TOTAL ANNUAL COST	**$895,000**
Available Project Yield (acft/yr)	2,240
Annual Cost of Water ($ per acft), based on PF=1	$400
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$79

Table 3.7-4. Cost Estimate Summary Cleburne Reuse Phase 2

Item	*Estimated Costs for Facilities*
Primary Pump Station (6 MGD)	$8,934,000
Transmission Pipeline (16 in dia., 8.3 miles)	$7,550,000
Transmission Pump Station(s) & Storage Tank(s)	$3,150,000
TOTAL COST OF FACILITIES	**$19,634,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$6,495,000
Environmental & Archaeology Studies and Mitigation	$417,000
Land Acquisition and Surveying (27 acres)	$1,409,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$769,000
TOTAL COST OF PROJECT	**$28,724,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$2,021,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$92,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$260,000
Water Treatment Plant	$200,000
Pumping Energy Costs (1485685 kW-hr @ 0.08 $/kW-hr)	$362,000
TOTAL ANNUAL COST	**$2,935,000**
Available Project Yield (acft/yr)	5,377
Annual Cost of Water ($ per acft), based on PF=1	$546
Annual Cost of Water After Debt Service ($ per acft), based on PF=1	$170
Annual Cost of Water ($ per 1,000 gallons), based on PF=1	$1.67
Annual Cost of Water After Debt Service ($ per 1,000 gallons), based on PF=1	$0.52

Table 3.7-5. Comparison of Cleburne Reuse Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Potentially important source, up to 25 percent of demand
2. Reliability	2. High reliability
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. Produces instream flows—low to moderate impact
2. Habitat	2. Possible low impact
3. Cultural Resources	3. None or low impact
4. Bays and Estuaries	4. None or low impact
5. Threatened and Endangered Species	5. Potential impact
6. Wetlands	6. None or low impact
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; benefit accrues to demand centers by more efficient use of available water supplies; no effect on navigation
D. Threats to Agriculture and Natural Resources	Generally positive effect to agriculture and natural resources by avoiding need for new supplies
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Could offset the need for voluntary redistribution of other supplies

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3.8 City of College Station Non-Potable Reuse

3.8.1 Description of Option

The City of College Station is currently applying reuse as a water supply from the Carters Creek WWTP for irrigation at Veterans Park and other customers. The City has obtained TCEQ Reclaimed Water Type 1 permits to utilize treated wastewater from the Lick Creek and Carters Creek WWTPs. The City is considering expanding the reuse system and is conducting a strategy study to determine the most cost effective system. One option (called the Irrigation Option) is to provide 103 acft/yr irrigation supply to Post Oak Mall, Central Park and a planned Industrial Park located to the west of Carters Creek WWTP. Although average annual demand for these three facilities totals approximately 103 acft/yr, the reuse system must be sized to meet the peak irrigation demand during the summer months, which is about 0.25 MGD or 282 acft/yr.

The location of the current system and possible future expansion is shown in Figure 3.8-1. As shown on the map, Veterans Park and Crescent Pointe are north of Carters Creek WWTP within the current service area; and, the Post Oak Mall, Central Park and a planned Industrial Park are to the west of Carters Creek WWTP. A summary of irrigation demand for existing and planned customers is included in Table 3.8-1.

3.8.2 Available Supply

The water supply that would be potentially available for College Station would be that portion of their wastewater effluent stream that has suitable uses within an economical distance from the treatment plant. The annual effluent flow from the Carters Creek WWTP for the year 2017 was 6,887 acft/yr (6.15 MGD).

College Station wastewater treatment plants include Carters Creek and Lick Creek WWTPs. The combined Year 2070 Estimated WWTP Effluent for these plants is 24,703 acft/yr (22.05 MGD).

Figure 3.8-1. College Station Non-Potable Reuse

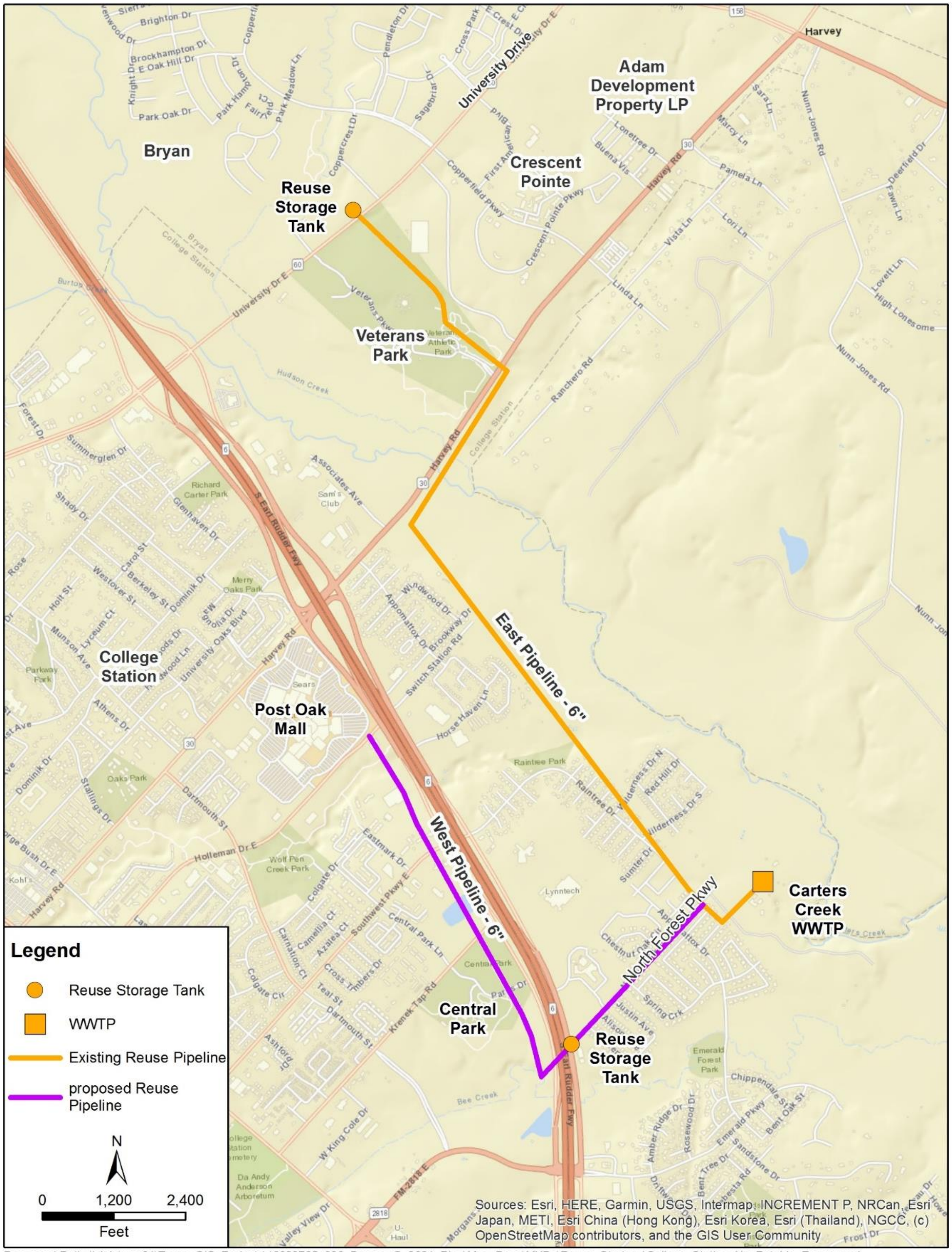

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Table 3.8-1. Water Reuse Demands for College Station Non-Potable Reuse Project

Reuse Customer	Current (acft/yr)	Proposed (acft/yr)
Veteran's Park	141	
Crescent Pointe	13	
Central Park		57
Post Oak Mall		33
Planned Industrial Park		13
Total	154	103

3.8.3 Environmental Issues

Environmental impacts could include:

- Possible low impact on instream flows below discharge points due to reduced effluent return flow rates;
- Possible increased water quality to remaining stream flows;
- Possible high negative impact to fish and wildlife habitat with substantially reduced stream flows; and
- Possible negative impact to threatened and endangered species depending on habitat and stream flow requirements.

A summary of environmental issues is presented in Table 3.8-2.

Table 3.8-2. Environmental Issues: College Station Non-Potable Reuse

Issue	Description
Implementation Measures	Development of additional wastewater treatment plant facilities, distribution pipelines, reuse storage tanks, and pump stations
Environmental Water Needs / Instream Flows	Possible low impact on in-stream flows due to decreased effluent return flows; possible increased water quality to remaining stream flows
Bays and Estuaries	Possible low negative impact
Fish and Wildlife Habitat	Possible variable impacts depending on changes in volume of effluent return flows; possible high negative impact to fish and wildlife habitat with substantially reduced stream flows
Cultural Resources	Possible low impact
Threatened and Endangered Species	Possible variable impacts depending on habitat requirements for listed species.
Comments	Assumes needed infrastructure will be in urbanized areas

3.8.4 Engineering and Costing

The irrigation option will include a pump station at the wastewater treatment plant, a pipeline for customers west of Texas Hwy 6, and ground storage at the end of the pipeline to balance the daily supply and hourly demand. The distribution facilities are sized to deliver the total daily demand in a 12-hour period. Pumping facilities are sized to deliver the water to a ground storage tank near the irrigation demand. Distribution pumps and pipelines would draw water from the storage tank as needed. The required improvements to implement a wastewater reuse supply for College Station are summarized in Table 3.8-3. The total costs for expanding the reuse system are shown in Table 3.8-4. The unit cost of a reuse supply could potentially be decreased by the addition of other users within an economical distance from the WWTP(s).

Table 3.8-3. Required Facilities – College Station Reuse for Veterans Park Irrigation

Facility	Description
Treatment Upgrade	0.09 MGD, Scenario 1; existing WWTP meets type 1 reuse standards, requiring only the addition of chlorine for distribution
Pump Station(s)	Expansion of existing reuse pump station with dedicated pumps - 5 HP to deliver average demand of 0.09 MGD in 12 hours
Storage Tank	0.18; Store one days treated reuse water at the end of the pipeline
Pipeline	11,278 ft of 6-inch pipe
Available Project Yield	0.09 MGD (103 acft/yr)

3.8.5 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 3.8-5 and the option meets each criterion. Before pursuing wastewater reuse, College Station will need to investigate concerns that would include at a minimum:

- Amount of treated effluent that is available and not committed under separate contracts;
- Potential other users, primarily individual large-scale users that could utilize non-potable water (e.g., certain industries) and irrigated lands (e.g., golf courses and park areas); and
- Capital costs of constructing needed distribution systems connecting the treatment facilities to the areas of reuse.

Supply of reuse wastewater requires a TCEQ permit. Requirements specific to pipelines needed to link wastewater treatment facilities to reuse water users may include:

- U.S. Army Corps of Engineers Section 404 permit(s) for pipeline stream crossings; discharges of fill into wetlands and waters of the United States for construction; and other activities;
- Texas Pollutant Discharge Elimination System (TPDES) Storm Water Pollution Prevention Plan;
- TPWD Sand, Shell, Gravel and Marl permit for construction in state-owned streambeds; and

- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

Table 3.8-4. Cost Estimate Summary: College Station Non-Potable Reuse

Item	Estimated Costs for Facilities
Transmission Pipeline (6 in dia., 2 miles)	$800,000
Primary Pump Station(s) & Storage Tank(s)	$773,000
Storage Tanks (Other Than at Booster Pump Stations)	$937,000
Water Treatment Plant (0.1 MGD)	$23,000
Total Cost Of Facilities	**$2,533,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$846,000
Environmental & Archaeology Studies and Mitigation	$53,000
Surveying (17 acres)	$25,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$96,000
Total Cost Of Project	**$3,553,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$250,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$17,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$19,000
Water Treatment Plant (2.5% of Cost of Facilities)	$14,000
Pumping Energy Costs (35784 kW-hr @ 0.09 $/kW-hr)	$1,000
Total Annual Cost	**$301,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 2.725	**103**
Annual Cost of Water ($ per acft)	**$2,922**
Annual Cost of Water ($ per 1,000 gallons)	**$8.97**

Table 3.8-5. Comparison of College Station Non-Potable Reuse Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Potentially important source, up to 25 percent of demand
2. Reliability	2. High reliability
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. Produces instream flows—low to moderate impact
2. Habitat	2. Possible low impact
3. Cultural Resources	3. None or low impact
4. Bays and Estuaries	4. None or low impact
5. Threatened and Endangered Species	5. Possible impact
6. Wetlands	6. None or low impact
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; benefit accrues to demand centers by more efficient use of available water supplies; no effect on navigation
D. Threats to Agriculture and Natural Resources	Generally positive effect to agriculture and natural resources by avoiding need for new supplies
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Could offset the need for voluntary redistribution of other supplies

3.9 College Station Direct Potable Reuse

3.9.1 Description

The City of College Station is considering two options to utilize its treated wastewater for potable uses. One option that is described in Chapter 8.2 purifies the city's treated effluent and utilizes an aquifer storage and recovery (ASR) wellfield to store potable supplies for peaking demands. The second option described in this section, purifies the supplies and blends it back with the City's treated water sources for subsequent distribution. The concept for the City of College Station (College Station) Direct Potable Reuse project is to:

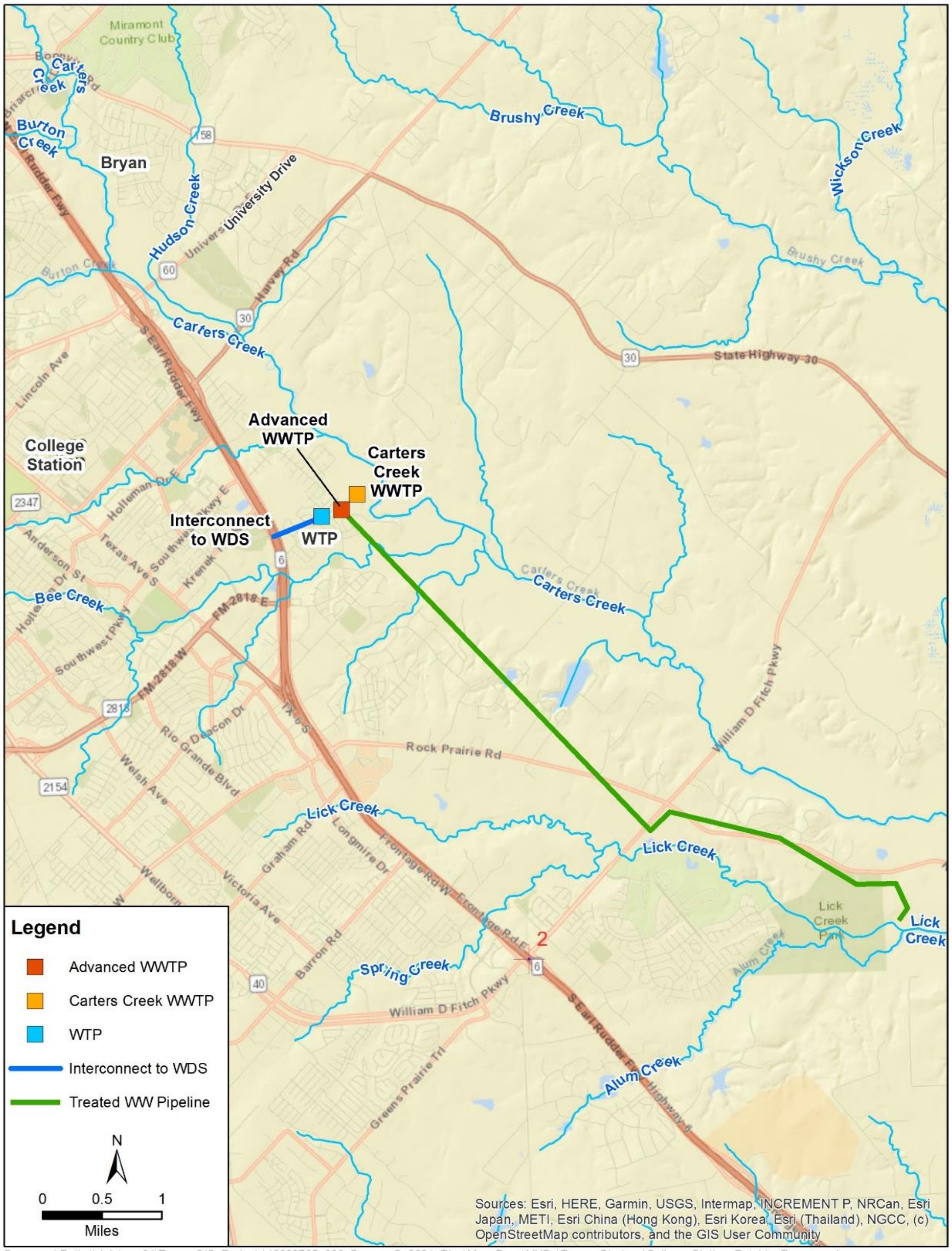
- Utilize existing wastewater effluent as the source of water for direct potable reuse. For 2013-2017, the average effluent discharges from Carters Creek WWTP and Lick Creek WWTP were 6.13 and 1.22 million gallons per day (MGD), respectively.
- A new Water Treatment Plant and Advance Wastewater Treatment Plant (AWWTP) would be located near the Carters Creek WWTP. Effluent from the much smaller Lick Creek WWTP would be transported to the AWWTP through a new pipeline.
- The AWWTP would treat the treated wastewater effluent with: (1) Low Pressure Membrane, (2) Reverse Osmosis, and (3) Oxidation before sending the water through a WTP as additional buffer and credit toward required log removal.

A schematic showing the location of the project is shown in Figure 3.9-1. New facilities required for this option are the pump station and wastewater transmission pipeline from Lick Creek WTP and Carters Creek WTP, advanced water treatment plant, interconnects between AWWTP, WTP and College Station's distribution system.

3.9.2 Available Yield

College Station wastewater treatment plants include Carters Creek and Lick Creek WWTPs. The combined Year 2070 Estimated WWTP Effluent for these WWTP plants is 24,703 acft/yr (22.05 MGD).

Figure 3.9-1. Location of College Station's Direct Potable Reuse Project



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3.9.3 Environmental Issues

A summary of environmental issues is presented in Table 3.9-1.

Table 3.9-1. Environmental Issues: College Station Direct Potable Reuse

Issue	Description
Implementation Measures	Development of additional wastewater treatment and advanced water treatment plant facilities, transmission and distribution pipelines, and pump stations
Environmental Water Needs / Instream Flows	Possible low to moderate impact on in-stream flows due to decreased effluent return flows; possible increased water quality to remaining stream flows
Bays and Estuaries	Possible low negative impact
Fish and Wildlife Habitat	Possible variable impacts depending on changes in volume of effluent return flows; possible high negative impact to fish and wildlife habitat with substantially reduced stream flows
Cultural Resources	Possible low impact
Threatened and Endangered Species	Possible variable impacts depending on habitat requirements for listed species.
Comments	Assumes needed infrastructure will be in urbanized areas

3.9.4 Engineering and Costing

The major facilities required for these projects include:

- Pump station and transmission pipeline from Lick Creek WWTP;
- Advanced Wastewater Treatment Plant;
- Water Treatment Plant; and
- Transmission pipeline and interconnect between AWWTP and distribution system.

Estimates were prepared for capital and project costs, annual debt service, operation and maintenance, power, land, and environmental mitigation. These costs are summarized in Table 3.9-2. The annual costs, including debt service, operation and maintenance, and power, is estimated to be $1,325 per acft for the College Station project.

3.9.5 Implementation

Implementation of the DPR water management strategy for College Station includes the following issues:

- Close coordination with TCEQ to define treatment criteria for expected 5.5 log removal cryptosporidium, 6 log removal giardia, 8 log removal virus after secondary/tertiary WWTP;
- Acquiring permits from TCEQ for the Water Treatment Plant facilities construction and operations;
- Initial and operational cost; and
- Development of a management plan to efficiently use the reuse supply; and

- Currently, several log removal required by TCEQ: 5.5 log crypto, 6 log giardia, 8 log virus (after secondary/tertiary WWTP) means that the city would need to provide additional treatment barriers beyond an AWWTP in order to achieve expected log removals. This analysis assumes construction of a new WTP to provide the additional log removals.

This water supply option has been compared to the plan development criteria, as shown in Table 3.9-3, and the option meets each criterion.

Table 3.9-2. Cost Estimate Summary: College Station DPR Project Option

Item	Estimated Costs for Facilities
Pump Stations (7.7 MGD)	$4,134,000
Transmission Pipelines (24 in dia., 0.5 miles and 10 in dia., 6.6 miles)	$3,207,000
Two Water Treatment Plant (7.4 MGD)	$18,671,000
Advanced Water Treatment Facility (7.4 MGD)	$33,929,000
Integration, Relocations, & Other	$250,000
TOTAL COST OF FACILITIES	**$60,191,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$20,907,000
Environmental & Archaeology Studies and Mitigation	$351,000
Land Acquisition and Surveying (43 acres)	$475,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$2,253,000
TOTAL COST OF PROJECT	**$84,177,000**
ANNUAL COST	
Debt Service (3.5 percent, 20 years)	$5,923,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$35,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$103,000
Water Treatment Plant	$1,348,000
Pumping Energy Costs (3,396,219 kW-hr @ 0.08 $/kW-hr)	$272,000
Purchase of Water (acft/yr @ $/acft)	$0
TOTAL ANNUAL COST	**$10,909,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	**8,232**
Annual Cost of Water ($ per acft)	**$1,325**
Annual Cost of Water ($ per 1,000 gallons)	**$1.86**

Table 3.9-3. Comparison of College Station DPR Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Does not fully shortages
2. Reliability	2. High reliability
3. Cost	3. High
B. Environmental factors	
1. Environmental Water Needs	1. Low to moderate impact
2. Habitat	2. Low to moderate impact
3. Cultural Resources	3. None or low impact
4. Bays and Estuaries	4. Low impact
5. Threatened and Endangered Species	5. Possible impact
6. Wetlands	6. None or low impact
C. Impact on Other State Water Resources	None
D. Threats to Agriculture and Natural Resources	None
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered in an attempt to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	None

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3.10 City of Georgetown Reuse

3.10.1 Description of Option

The City of Georgetown has an annual effluent discharge of 1.3 MGD from the Dove Springs Wastewater Treatment Plant (WWTP). Dove Springs WWTP has a permitted average effluent discharge at 2.5 MGD. Georgetown applies treated effluent as a source of reuse water with average reuse volume equal to 0.75 MGD in a year. Another 0.55 MGD of treated water could potentially be used for reuse purposes. Two potential options for reuse were considered. The preferred reuse option would be to connect a reclaimed water supply line from Dove Springs WWTP to the existing reclaimed irrigation lines. The proposed reuse pipeline from Dove springs WWTP would be 2.41 miles. Dove Springs WWTP is assumed to treat effluent to a Type 1 quality.

Locations of the Dove Springs WWTP plant, ground storage tank, pump stations and transmission pipeline are shown in Figure 3.10-1.

3.10.2 Available Supply

The planned capacity of the Georgetown Reuse project is 1.3 MGD (1,456 acft/yr).

3.10.3 Environmental Issues

Environmental impacts could include:

- Possible low impact on instream flows below discharge points due to reduced effluent return flow rates;
- Possible increased water quality to remaining stream flows;
- Possible low impact on recharge rates in Edwards Aquifer due to reduced effluent return flow rates;
- Possible negative impact to fish and wildlife habitat with substantially reduced stream flows; and
- Possible negative impact to threatened and endangered species depending on habitat and stream flow requirements.

A summary of environmental issues is presented in Table 3.10-1.

Figure 3.10-1 Georgetown Reuse

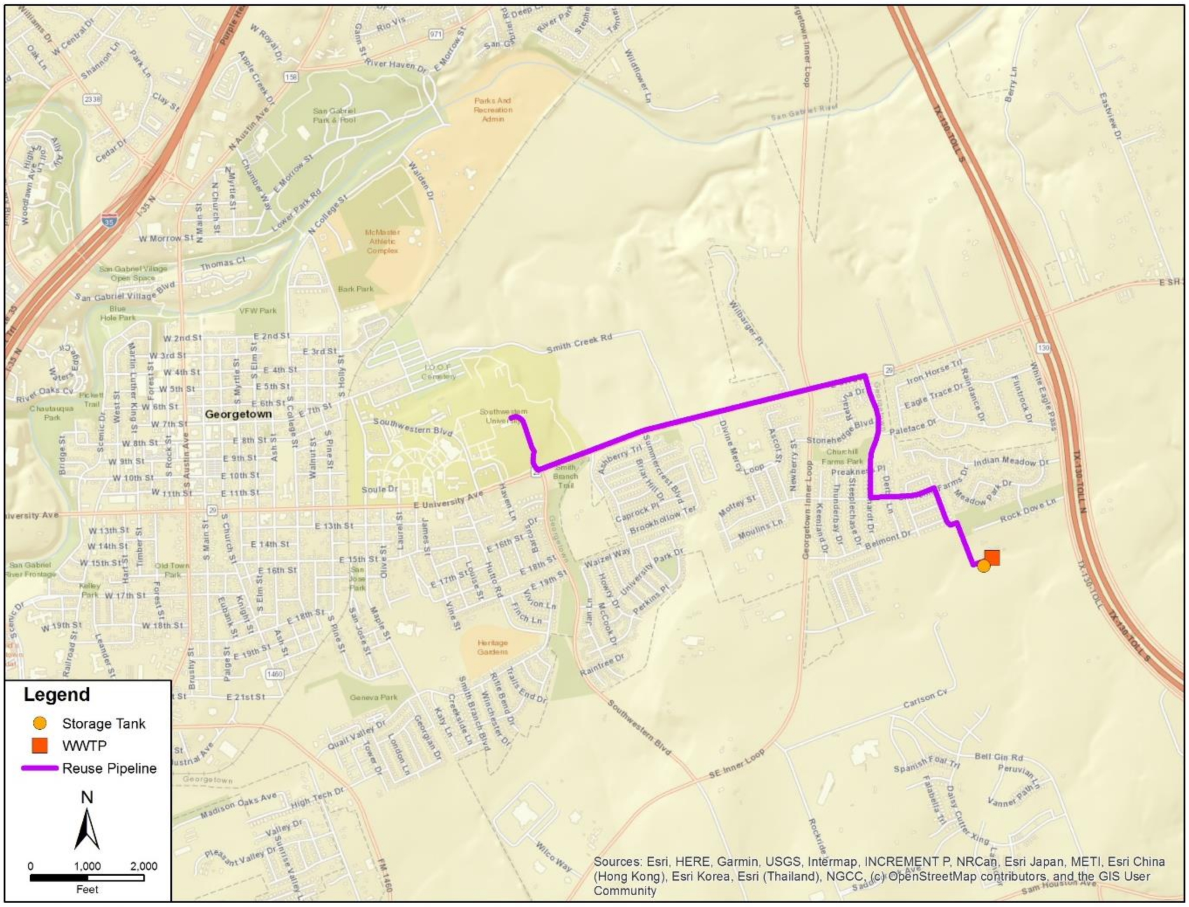

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Table 3.10-1. Environmental Issues: Georgetown Reuse

Issue	Description
Implementation Measures	Development of additional ground storage tank, transmission pipeline, and pump stations
Environmental Water Needs / Instream Flows	Possible low impact on in-stream flows due to decreased effluent return flows; possible increased water quality to remaining stream flows
Edwards Aquifer	Possible increased water quality to stream flows and Edwards Aquifer recharge zone. Possible low impact on recharge rates due to decreased effluent flow
Bays and Estuaries	Possible low negative impact
Fish and Wildlife Habitat	Possible variable impacts depending on changes in volume of effluent return flows; possible negative impact to fish and wildlife habitat due to reduced stream flows
Cultural Resources	Possible low impact
Threatened and Endangered Species	Possible variable impacts depending on habitat requirements for listed species.
Comments	Assumes needed infrastructure will be in urbanized areas

3.10.4 Engineering and Costing

The required improvements to implement a wastewater reuse supply Georgetown are summarized in Table 3.10-2. The project requires a 5.2 MGD pump station along with a storage tank located at the Dove Springs WWTP. A 2.35 mile, 16-inch diameter pipe would deliver the reuse supply to the existing reuse system. This section does not include costs for potential distribution lines from the proposed reuse pipeline system.

Table 3.10-2. Required Facilities –Georgetown Reuse

Facility	Description
Pump Stations	160 HP at Dove Springs WWTP; 5.2 MGD capacity to deliver at peak capacity at uniform rate.
Storage Tanks	1.3 MG; balancing storage at Dove Springs WWTP.
Pipelines	12,800 ft of 16-inch pipe; from Dove Springs to East View High School
Available Project Yield	1.3 MGD (1,456 acft/yr)

The total costs for developing a wastewater reuse supply from Dove Springs WWTP are shown in Table 3.10-3. The project will have an estimated total capital cost $6,270,000 and an annual cost of $508,000. This cost translates to a $349 per acft or $1.07 per 1,000 gallons unit cost of the reuse water.

Supply of reuse wastewater requires a TCEQ permit. Requirements specific to pipelines needed to link wastewater treatment facilities to reuse water users may include:

- TCEQ authorization to reuse domestic wastewater under 30 TAC Chapter 210 (“210 authorization”);
- U.S. Army Corps of Engineers Section 404 permit(s) for pipeline stream crossings; discharges of fill into wetlands and waters of the United States for construction; and other activities;
- TPDES Storm Water Pollution Prevention Plan;
- TPWD Sand, Shell, Gravel and Marl permit for construction in state-owned streambeds; and
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

Table 3.10-3. Cost Estimate Summary: Georgetown Reuse

Item	*Estimated Costs for Facilities*
Primary Pump Station (1.3 MGD)	$1,202,000
Transmission Pipeline (18 in dia., 2.41 miles)	$1,812,000
Storage Tanks (Other Than at Booster Pump Stations)	$1,429,000
Total Cost Of Facilities	**$4,443,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,464,000
Environmental & Archaeology Studies and Mitigation	$111,000
Land Acquisition and Surveying (19 acres)	$84,000
Interest During Construction (3% for 1 years with a 0.5% ROI)	$168,000
Total Cost Of Project	**$6,270,000**
Annual Cost	
Debt Service (3.5 percent, 20 years)	$441,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$32,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$30,000
Pumping Energy Costs (55500 kW-hr @ 0.08 $/kW-hr)	$5,000
Total Annual Cost	**$508,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	**1,456**
Annual Cost of Water ($ per acft)	**$349**
Annual Cost of Water ($ per 1,000 gallons)	**$1.07**

Table 3.10-4. Comparison of Georgetown Reuse Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient for intended uses
2. Reliability	2. High reliability
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. Reduces instream flows—possible low impact
2. Habitat	2. Possible low impact
3. Cultural Resources	3. None or low impact
4. Bays and Estuaries	4. None or low impact
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; benefit accrues to demand centers by more efficient use of available water supplies; no effect on navigation
D. Threats to Agriculture and Natural Resources	Generally positive effect to agriculture and natural resources by avoiding need for new supplies
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Could offset the need for voluntary redistribution of other supplies

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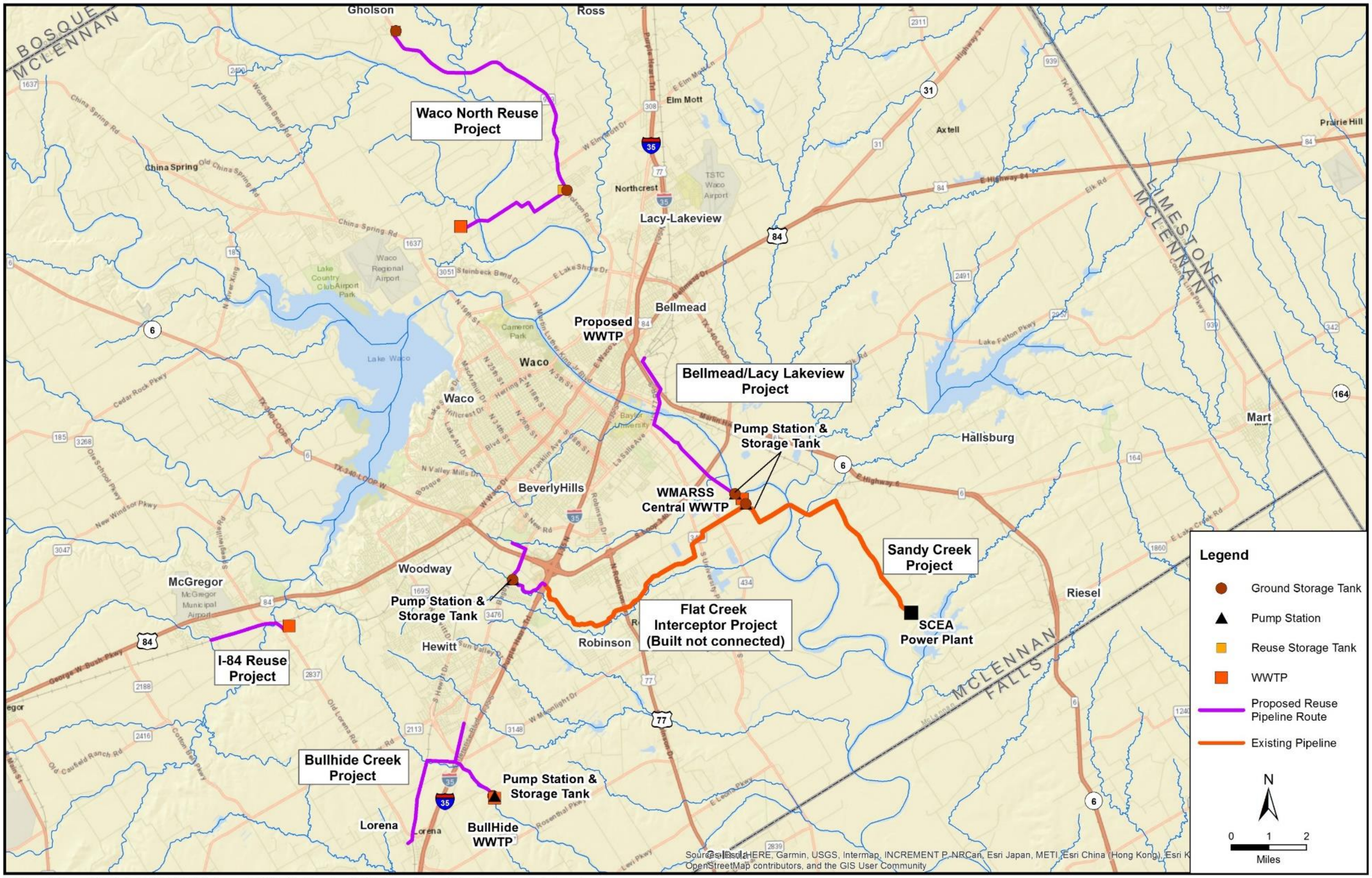
3.11 Waco WMARSS Reuse Projects

Since the 2011 Brazos G Regional Plan, Waco Metropolitan Area Regional Sewerage System (WMARSS) has constructed the Sandy Creek Energy Associates (SCEA) Project which provides 15,000 acft/yr of treated effluent from the WMARSS Central Wastewater Treatment Plant to the SCEA power plant. WMARSS continues to consider the development of four wastewater reuse systems to supply reuse water to customers. These reuse systems are referred to as the Waco North China Spring reuse, Flat Creek Interceptor Project and Bull Hide (3.5MGD) through the Bull Hide Creek, I-84 reuse and Bellmead/Lacy Lakeview reuse projects. Future projects would consider supplying an additional 3,920 acft/yr.

Assuming simultaneous implementation of the other reuse projects, potential available supply from the Flat Creek Reuse Project would be 7,114 acft/yr in 2020, and the full 7,847 acft/yr (7 MGD) capacity sometime prior to 2030. The Year 2011 effluent from WMARSS was 25,355 acft/yr (22.6 MGD). The Year 2070 estimated effluent from WMARSS is 36,370 acft/yr (32.5 MGD). These options consist of integrated reuse projects to deliver Type 1 reuse water from the existing WMARSS Central Wastewater Treatment Plant located southeast of Waco along the Brazos River and from the Bull Hide WWTP.

Locations of each of the Waco reuse projects including treatment plants, proposed transmission pipelines, ground storage tanks, and pump stations are shown in Figure 3.11-1. Descriptions of each of the options are included in Sections 3.11.1 through 3.11.5.

Figure 3.11-1. Locations of Waco Area Reuse Projects



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3.11.1 WMARSS Bellmead/Lacy-Lakeview Reuse

Description of Option

WMARSS is considering the development of a wastewater reuse system to supply reuse water to customers within the Cities of Bellmead and Lacy-Lakeview. This option consists of an integrated reuse project to deliver Type 1 reuse water from the existing WMARSS Central WWTP located southeast of Waco along the Brazos River. Treated reuse water would be transported to the industrial and municipal sectors of Bellmead and Lacy Lakeview. Locations of the WMARSS Central WWTP plant, and proposed transmission pipelines, ground storage tanks, and pump stations are shown in Figure 3.11-2.

The transmission system will be capable of delivering 2 MGD (2,242 acft/yr) of treated reuse water from the WMARSS Central WWTP. Supplies to the two cities are divided equally at 50% of the planned system capacity. This Type 1 reuse water may be utilized for landscape irrigation at existing or future parks, schools, ball fields, and other green spaces. Reuse water may also potentially supply existing or future industrial customers.

Available Supply

The planned capacity of the WMARSS Bellmead/Lacy Lakeview Reuse project is 2 MGD (2,242 acft/yr).

Environmental Issues

Environmental impacts could include:

- Possible low impact on instream flows below discharge points due to reduced effluent return flow rates;
- Possible increased water quality to remaining stream flows;
- Possible negative impact to fish and wildlife habitat with substantially reduced stream flows; and
- Possible negative impact to threatened and endangered species depending on habitat and stream flow requirements.

A summary of environmental issues is presented in Table 3.11-1.

Figure 3.11-2. WMARSS Bellmead/Lacy-Lakeview Reuse

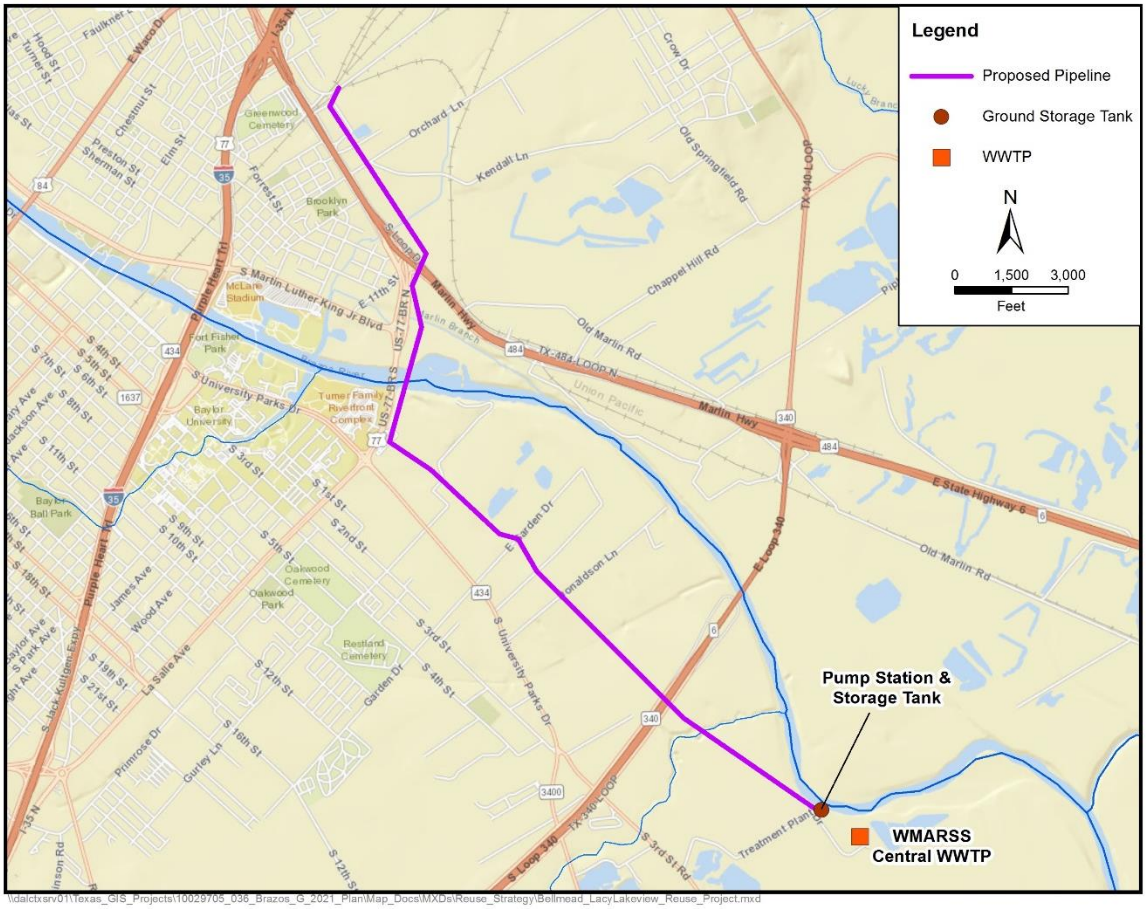

Table 3.11-1. Environmental Issues: WMARSS Bellmead/Lacy-Lakeview Reuse

Issue	Description
Implementation Measures	Development of additional wastewater treatment plant facilities, distribution pipelines, and pump stations
Environmental Water Needs / Instream Flows	Possible low impact on in-stream flows due to decreased effluent return flows; possible increased water quality to remaining stream flows
Bays and Estuaries	Possible low negative impact
Fish and Wildlife Habitat	Possible variable impacts depending on changes in volume of effluent return flows; possible negative impact to fish and wildlife habitat due to reduced stream flows
Cultural Resources	Possible low impact
Threatened and Endangered Species	Possible variable impacts depending on habitat requirements for listed species.
Comments	Assumes needed infrastructure will be in urbanized areas

Engineering and Costing

The required improvements to implement a wastewater reuse supply for Bellmead and Lacy-Lakeview are summarized in Table 3.11-2. The project requires a 2 MGD pump station along with a 1.5 MG storage tank located at the WMARSS Central WWTP. A 5 mile, 12-inch diameter pipe would deliver the reuse supply to the Bellmead city limits. Distribution lines not included in this cost estimate would deliver supply to Lacy-Lakeview and customers of the two cities.

Table 3.11-2. Required Facilities – WMARSS Bellmead/Lacy-Lakeview Reuse

Facility	Description
Pump Stations	124 HP at WMARSS Central WWTP; 2 MGD capacity to deliver at uniform rate to Bellmead
Storage Tanks	1.5 MG; balancing storage at WMARSS Central WWTP
Pipelines	51,000 ft of 12-inch pipe; from WMARSS Central WWTP to I-35 Pump Station
Available Project Yield	2.0 MGD (2,240 acft/yr); total yield for all Bellmead/Lacy-Lakeview projects supplied

The total costs for developing a wastewater reuse supply for Bellmead and Lacy-Lakeview are shown in Table 3.11-3. The project will have an estimated total project cost of $8,038,000 and an annual cost of $949,000. This cost translates to a unit cost of $424 per acft or $1.30 per 1,000 gallons.

Table 3.11-3. Cost Estimate Summary: WMARSS Bellmead/Lacy Lakeview Reuse

Item	*Estimated Costs for Facilities*
Transmission Pipeline (12 in dia., 5 miles)	$2,619,000
Transmission Pump Station(s) & Storage Tank(s)	$1,089,000
Storage Tanks (Other Than at Booster Pump Stations)	$1,956,000
Total Cost Of Facilities	**$5,664,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,851,00
Environmental & Archaeology Studies and Mitigation	$144,000
Land Acquisition and Surveying (31 acres)	$107,000
Interest During Construction (4% for 1 years with a 1% ROI)	$272,000
Total Cost Of Project	**$8,038,000**
Annual Cost	
Debt Service (5.5 percent, 20 years)	$673,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities) Intake, Pipeline, Pump Station (1% of Cost of Facilities)	$46,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	27,000
Pumping Energy Costs (664,977 kW-hr @ 0.09 $/kW-hr) Pumping Energy Costs (714391 kW-hr @ 0.09 $/kW-hr)	$60,000
Purchase of Water (2,240 acft/yr @ 63.66 $/acft)Purchase of Water (2240 acft/yr @ 54.44 $/acft)	$143,000
Total Annual Cost	**$949,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	**2,240**
Annual Cost of Water ($ per acft)	**$424**
Annual Cost of Water ($ per 1,000 gallons)	**$1.30**

Table 3.11-4. Comparison of WMARSS Bellmead/Lacy-Lakeview Reuse Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient for intended uses
2. Reliability	2. High reliability
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. Reduces instream flows—possible low impact
2. Habitat	2. Possible low impact
3. Cultural Resources	3. None or low impact
4. Bays and Estuaries	4. None or low impact
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; benefit accrues to demand centers by more efficient use of available water supplies; no effect on navigation
D. Threats to Agriculture and Natural Resources	Generally positive effect to agriculture and natural resources by avoiding need for new supplies
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Could offset the need for voluntary redistribution of other supplies

Supply of reuse wastewater requires a TCEQ permit. Requirements specific to pipelines needed to link wastewater treatment facilities to reuse water users may include:

- TCEQ authorization to reuse domestic wastewater under 30 TAC Chapter 210 (“210 authorization”);
- U.S. Army Corps of Engineers Section 404 permit(s) for pipeline stream crossings; discharges of fill into wetlands and waters of the United States for construction; and other activities;
- TPDES Storm Water Pollution Prevention Plan;
- TPWD Sand, Shell, Gravel and Marl permit for construction in state-owned streambeds; and
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

3.11.2 WMARSS Bull Hide Creek Reuse

Description of Option

WMARSS is considering the development of a wastewater reuse system to supply reuse water to customers within the Cities of Hewitt and Lorena. This option consists of an integrated reuse project to deliver Type 1 reuse water from the WMARSS Bull Hide Creek WWTP located approximately 1.2 miles southeast of I-35 on Bull Hide Creek. Treated reuse water from this satellite plant would be transported to the industrial and municipal sectors of Hewitt and Lorena. Locations of the proposed reuse treatment plant, transmission pipelines, ground storage tanks, and pump stations are shown in Figure 3.11-3.

The potential reuse water demand for the City of Hewitt and Lorena is based upon hydraulic constraints of the transmission system. The transmission system will be capable of delivering 1.5 MGD (1,681 acft/yr) of treated reuse water from the WMARSS Bull Hide Creek WWTP. The planned system provides Hewitt with 1,233 acft/yr (1.1 MGD) of reuse water and 448 acft/yr (0.4 MGD) of reuse water to Lorena. This Type 1 reuse water may be utilized for landscape irrigation at existing or future parks, schools, ball fields, and other green spaces. Reuse water may also potentially supply existing or future industrial customers.

Available Supply

The capacity for the WMARSS Bull Hide Creek WWTP is 1.5 MGD (1,681 acft/yr).

Environmental Issues

Environmental impacts could include:

- Possible low impact on instream flows below discharge points due to reduced effluent return flow rates;
- Possible increased water quality to remaining stream flows;
- Possible negative impact to fish and wildlife habitat due to reduced stream flows; and
- Possible negative impact to threatened and endangered species depending on habitat and stream flow requirements.

A summary of environmental issues is presented in Table 3.11-5.

Figure 3.11-3. WMARSS Bull Hide Creek Reuse

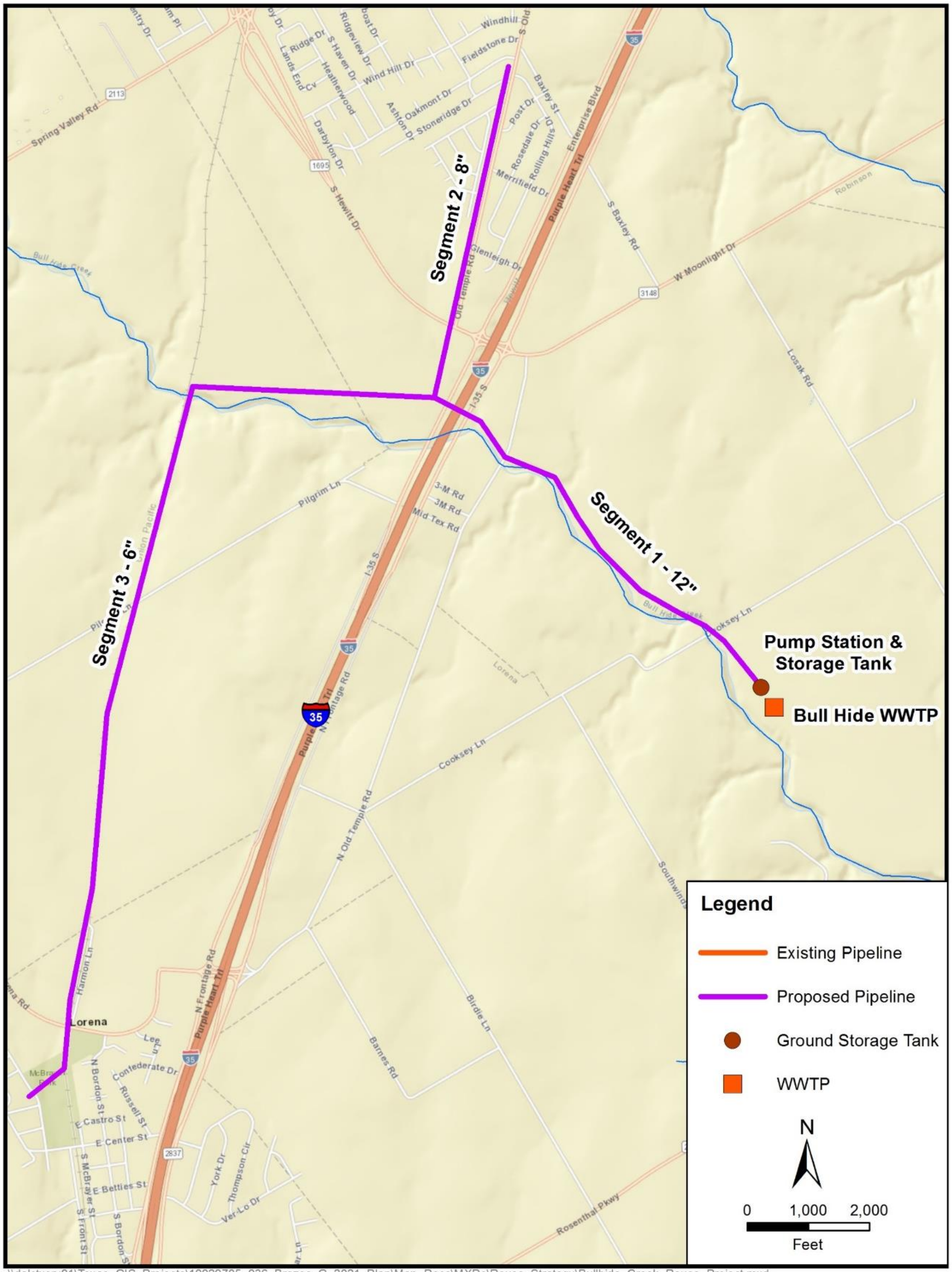

Table 3.11-5. Environmental Issues: WMARSS Bull Hide Creek Reuse

Issue	Description
Implementation Measures	Development of additional wastewater treatment plant facilities, distribution pipelines, and pump stations
Environmental Water Needs / Instream Flows	Possible low impact on in-stream flows due to decreased effluent return flows; possible increased water quality to remaining stream flows
Bays and Estuaries	Possible low negative impact
Fish and Wildlife Habitat	Possible variable impacts depending on changes in volume of effluent return flows; possible negative impact to fish and wildlife habitat due to reduced stream flows
Cultural Resources	Possible low impact
Threatened and Endangered Species	Possible variable impacts depending on habitat requirements for listed species.
Comments	Assumes needed infrastructure will be in urbanized areas

Engineering and Costing

The required improvements to implement a wastewater reuse supply for Hewitt and Lorena are summarized in Table 3.11-6. The project requires a 1.5 MGD pump station along with a 1.5 MG storage tank located at the WMARSS Bull Hide Creek WWTP site. The transmission pipeline system is separated into three separate components. The first segment is a 12-inch pipe capable of transporting 1.5 MGD of reuse water from the proposed WWTP site. Segment 2 is an 8-inch pipe that splits of from the main line to provide reuse water to the City of Hewitt. Segment 2 is capable of delivering 1.1 MGD based on hydraulic constraints of the system. Segment 3 transports the remaining 0.4 MGD of reuse water through a 6-inch pipe to the City of Lorena.

Table 3.11-6. Required Facilities – WMARSS Bull Hide Creek Reuse

Facility	Description
Pump Stations	111 HP at WMARSS Bull Hide Creek WWTP; 1.5 MGD capacity to deliver at uniform rate to Hewitt and Lorena
Storage Tanks	1.5 MG; balancing storage at WMARSS Bull Hide Creek WWTP
Pipelines	Segment 1; 1.3 miles of 12-inch pipe; from proposed WMARSS Bull Hide Creek WWTP to Segment 2/Segment 3 intersection Segment 2; 1.0 mile of 8-inch pipe; from Segment 1 intersection to Hewitt Segment 3; 3.0 miles of 6-inch pipe from Segment 1 intersection to Lorena
Available Project Yield	1.5 MGD (1,681 acft/yr); total yield for all Hewitt and Lorena projects supplied

Costs presented in Table 3.11-7 provide the total option costs for developing a wastewater reuse supply for Hewitt and Lorena. The project will have an estimated total project cost of $7,349,000 and an annual cost of $912,000. This cost translates to a unit cost of $543 per acft or $1.66 per 1,000 gallons.

Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 3.11-8, and the option meets each criterion. Before pursuing wastewater reuse, the WMARSS entities will need to investigate concerns that would include at a minimum:

- Amount and timing of treated effluent available.
- Potential users, primarily individual large-scale users that could utilize non-potable water (e.g., certain industries) and irrigated lands (e.g., golf courses and park areas).
- Capital costs of constructing needed distribution systems connecting the treatment and transmission facilities to the ultimate points of end use.

Table 3.11-7. Cost Estimate Summary: WMARSS Bull Hide Creek Reuse

Item	Estimated Costs for Facilities
Transmission Pipeline (12 in dia., 5 miles)	$1,053,000
Transmission Pump Station(s) & Storage Tank(s)	$1,981,000
Storage Tanks (Other Than at Booster Pump Stations)	$928,000
Total Cost Of Facilities	**$5,089,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$1,702,000
Environmental & Archaeology Studies and Mitigation	$174,000
Land Acquisition and Surveying (39 acres)	$135,000
Interest During Construction (4% for 1 years with a 1% ROI)	$249,000
Total Cost Of Project	**$7,349,000**
Annual Cost	
Debt Service (5.5 percent, 20 years)	$615,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$40,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$26,000
Water Treatment Plant (2.5% of Cost of Facilities)	$69,000
Pumping Energy Costs (652,313 kW-hr @ 0.09 $/kW-hr)	$55,000
Purchase of Water (1,681 acft/yr @ 54.44 $/acft)	$107,000
Total Annual Cost	**$912,000**
Available Project Yield (acft/yr), based on a Peaking Factor of 1	**1,681**
Annual Cost of Water ($ per acft)	**$543**
Annual Cost of Water ($ per 1,000 gallons)	**$1.66**

Table 3.11-8. Comparison of WMARSS Bull Hide Creek Reuse Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient for intended uses
2. Reliability	2. High reliability
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. Reduces instream flows—possible low impact
2. Habitat	2. Possible low impact
3. Cultural Resources	3. None or low impact
4. Bays and Estuaries	4. None or low impact
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; benefit accrues to demand centers by more efficient use of available water supplies; no effect on navigation
D. Threats to Agriculture and Natural Resources	Generally positive effect to agriculture and natural resources by avoiding need for new supplies
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Could offset the need for voluntary redistribution of other supplies

Supply of reuse wastewater requires a TCEQ permit. Requirements specific to pipelines needed to link wastewater treatment facilities to reuse water users may include:

- TCEQ authorization to reuse domestic wastewater under 30 TAC Chapter 210 (“210 authorization”);
- U.S. Army Corps of Engineers Section 404 permit(s) for pipeline stream crossings; discharges of fill into wetlands and waters of the United States for construction; and other activities;
- TPDES Storm Water Pollution Prevention Plan;
- TPWD Sand, Shell, Gravel and Marl permit for construction in state-owned streambeds; and
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

3.11.3 WMARSS Flat Creek Reuse

Description of Option

WMARSS is considering the development of a wastewater reuse system to supply reuse water to customers within the City of Waco. This option consists of an integrated reuse project to deliver Type 1 reuse water from the existing WMARSS Central WWTP located southeast of Waco along the Brazos River. Treated reuse water from the WMARSS Central WWTP would be transported to the industrial and municipal sectors of Waco and the Cottonwood Creek Golf Course. Locations of the existing reuse treatment plant, and proposed transmission pipelines, ground storage tanks, and pump stations are shown in Figure 3.11-4. Approximately 42,000 feet of 20-inch diameter pipeline has been constructed extending from the WMARSS Central WWTP to Interstate I-35.

The potential reuse water demand for the City of Waco is assumed to be the entire amount of available yield (7,847 acft/yr) from the WMARSS Central WWTP. This Type 1 reuse water may be utilized for landscape irrigation at existing or future parks, schools, ball fields, and other green spaces. Reuse water may also potentially supply existing or future industrial customers. Discussions with industrial customers indicate that public-private partnerships may be viable project funding option. The transmission system will be capable of delivering 7 MGD (7,847 acft/yr) of treated reuse water from the WMARSS Central WWTP.

Available Supply

The WMARSS system is contracted to supply 15,000 acft/yr (13.4 MGD) of the treated effluent from the WMARSS system to the SCEA Power Plant (Section 3.6.1). An additional 3,920 acft/yr (3.5 MGD) would be supplied through the Bull Hide Creek and Bellmead/Lacy Lakeview reuse projects. The Year 2011 effluent from WMARSS was 25,355 acft/yr (22.62 MGD). The Year 2070 estimated effluent from WMARSS is 36,370 acft/yr (32.5 MGD). Assuming simultaneous implementation of the other reuse projects, potential available supply from the Flat Creek Reuse Project would be the full 7,847 acft/yr (7 MGD) capacity sometime by 2020.

Environmental Issues

Environmental impacts could include:

- Possible low impact on instream flows below discharge points due to reduced effluent return flow rates;
- Possible increased water quality to remaining stream flows;
- Possible negative impact to fish and wildlife habitat due to reduced stream flows; and
- Possible negative impact to threatened and endangered species depending on habitat and stream flow requirements.

A summary of environmental issues is presented in Table 3.11-9.

Figure 3.11-4. WMARSS Flat Creek Reuse

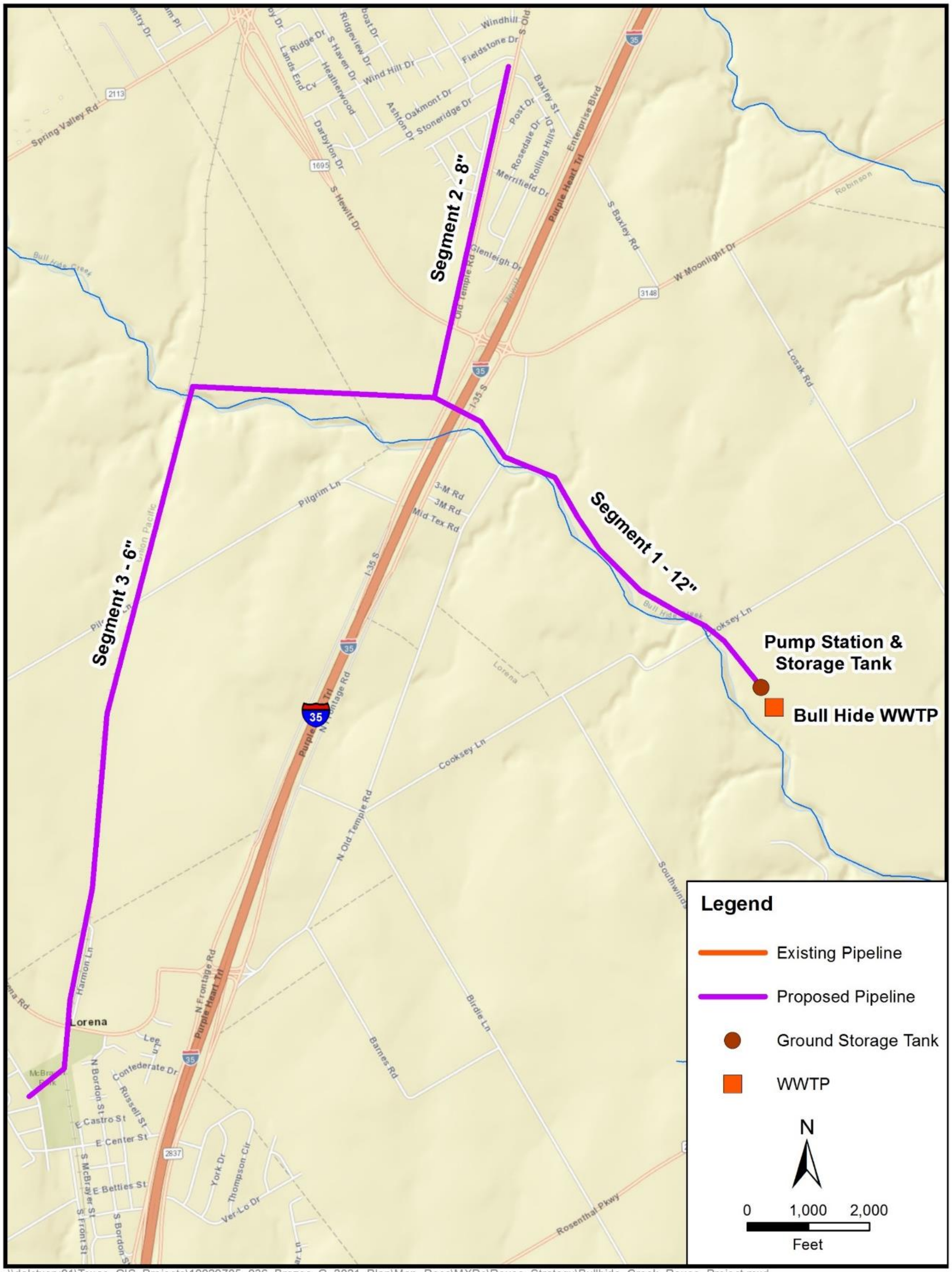

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Table 3.11-9. Environmental Issues: WMARSS Flat Creek Reuse

Issue	Description
Implementation Measures	Development of additional wastewater treatment plant facilities, distribution pipelines, and pump stations
Environmental Water Needs / Instream Flows	Possible low impact on in-stream flows due to decreased effluent return flows; possible increased water quality to remaining stream flows
Bays and Estuaries	Possible low negative impact
Fish and Wildlife Habitat	Possible variable impacts depending on changes in volume of effluent return flows; possible negative impact to fish and wildlife habitat due to reduced stream flows
Cultural Resources	Possible low impact
Threatened and Endangered Species	Possible variable impacts depending on habitat requirements for listed species.
Comments	Assumes needed infrastructure will be in urbanized areas

Engineering and Costing

The required improvements to implement a wastewater reuse supply for Waco are summarized in Table 3.11-10. The project requires a 7 MGD pump station along with two 1.5 MG storage tanks located at the WMARSS Central WWTP. A 6,000 ft, 20-inch diameter pipe connects the existing pipeline to a 1 MG storage tank located west of I-35. Distribution lines to connect the 20-inch pipeline to industrial customers within the City of Waco are not included in this cost estimate. At the I-35 site, a 1500 gpm pump station would deliver up to 2 MGD of reuse water through a 6,720 ft, 12-inch diameter pipe to Cottonwood Creek Golf Course for irrigation purposes.

Table 3.11-10. Required Facilities – WMARSS Flat Creek Reuse

Facility	Description
Pump Stations	5000 gpm at WMARSS Central WWTP; 7 MGD capacity to deliver at uniform rate to Waco and Storage Tanks at I-35 Pump Station 1500 gpm at I-35 Site; 2 MGD capacity to deliver at uniform rate to Cottonwood Creek Golf Course
Storage Tanks	2, 1.5 MG tanks to provide balancing storage at WMARSS Central WWTP 1 MG tank to provide balancing storage at I-35 Pump Station
Pipelines	6,000 ft of 20-inch pipe; from WMARSS Central WWTP to I-35 Pump Station 6,720 ft of 12-in pipe; from I-35 Pump Station to Cottonwood Creek Golf Course
Available Project Yield	7.0 MGD (7,847 acft/yr); total yield for all Flat Creek projects supplied

Costs presented in Table 3.11-11 provide the total option costs for developing a wastewater reuse supply for Waco and Cottonwood Creek Golf Course. The project will have an estimated total project cost of $20,014,000 and an annual cost of $2,746,000. This cost translates to a unit cost of $350 per acft or $1.07 per 1,000 gallons, upon utilization of the full 7 MGD (7,847 acft/yr).

Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table **3.11-12**, and the option meets each criterion. Before pursuing wastewater reuse, the WMARSS entities will need to investigate concerns that would include at a minimum:

- Amount and timing of treated effluent available.
- Potential users, primarily individual large-scale users that could utilize non-potable water (e.g., certain industries) and irrigated lands (e.g., golf courses and park areas).
- Capital costs of constructing needed distribution systems connecting the treatment facilities to the areas of reuse.

Supply of reuse wastewater requires a TCEQ permit. Requirements specific to pipelines needed to link wastewater treatment facilities to reuse water users may include:

- TCEQ authorization to reuse domestic wastewater under 30 TAC Chapter 210 ("210 authorization");
- U.S. Army Corps of Engineers Section 404 permit(s) for pipeline stream crossings; discharges of fill into wetlands and waters of the United States for construction; and other activities;
- TPDES Storm Water Pollution Prevention Plan;
- TPWD Sand, Shell, Gravel and Marl permit for construction in state-owned streambeds; and
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

Table 3.11-11. Cost Estimate Summary: WMARSS Flat Creek Reuse

Item	Estimated Costs for Facilities
Capital Costs	
Upgrade to WMARSS Intake & Pump Station (7 MGD)	$1,923,000
Two Ground Storage Tanks @ WMARSS (1.5 MG)	$3,033,000
Transmission Pipeline (20 in dia., 1 miles)	$974,000
Transmission Pipeline (12 in dia.,1.3 miles)	$586,500
Transmission Pump Station @ I-35 (2 MGD)	$1,426,000
Ground Storage Tank @ I-35 (1.0 MG)	$1,297,000
Total Cost Of Facilities	**$8,995,000**
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$4,887,000
Environmental & Archaeology Studies and Mitigation	$120,000
Land Acquisition and Surveying (16 acres)	$143,000
Interest During Construction (4% for 1 years with a 1% ROI)	$677,000
Total Cost Of Project	**$20,014,000**
Annual Cost	
Debt Service (5.5 percent, 20 years)	$1,675,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$59,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$207,000
Pumping Energy Costs (3,384,493 kW-hr @ 0.09 $/kW-hr)	$305,000
Purchase of Water (7,847 acft/yr @ 63.66 $/acft)	$500,000
Total Annual Cost	**$2,746,000**
Available Project Yield (acft/yr)	**7,847**
Annual Cost of Water ($ per acft)	**$350**
Annual Cost of Water ($ per 1,000 gallons)	**$1.07**

Table 3.11-12. Comparison of Flat Creek Reuse Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Sufficient for intended uses
2. Reliability	2. High reliability
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. Reduces instream flows—possible low impact
2. Habitat	2. Possible low impact
3. Cultural Resources	3. None or low impact
4. Bays and Estuaries	4. None or low impact
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; benefit accrues to demand centers by more efficient use of available water supplies; no effect on navigation
D. Threats to Agriculture and Natural Resources	Generally positive effect to agriculture and natural resources by avoiding need for new supplies
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Could offset the need for voluntary redistribution of other supplies

3.11.4 Waco North – China Spring WWTP

Description of Option

The City of Waco is considering the development of a sattelite wastewater treatment plant for the area known as China Spring in the north portion of the city. The area is isolated hydraulically from the rest of the regional sewerage and it is more cost effective to develop a regional wastewater treatment plant than deliver the wastewater to the central WMARSS facility. This option consists of an integrated reuse project to deliver Type 1 reuse water from a new satellite wastewater treatment plant located north of Waco, which would divert wastewater from a collection main of the WMARSS. Treated reuse water from this satellite plant would be transported to Chalk Bluff WSC and the City of Gholson. The new satellite reuse treatment plant and transmission pipeline locations are shown in Figure 3.11-5.

The potential reuse water demand for Chalk Bluff WSC and the City of Gholson is estimated at 30 percent of their 2070 water demand for purposes of this option. This Type 1 reuse water may be utilized for landscape irrigation at existing or future parks, schools, ball fields, and other green spaces. Reuse water may also potentially supply existing or future industrial customers. For this option the transmission system to supply reuse water for these entities also includes capacity to supply 1,264 acft/yr of reuse water for use by Mining entities within the vicinity of the reuse transmission pipelines. The amount of reuse water supplied to each entity for this option is summarized in Table 3.11-13.

Available Supply

The wastewater treatment plant is currently under design with an average flow of 1,120 acft/yr (1.0 MGD) at 2050. The amount of reuse water available for Waco China Spring WWTP reuse will be limited by the wastewater flow in the collector main feeding the new satellite reuse treatment plant. The entire wastewater stream could be used for reuse.

Environmental Issues

Environmental impacts could include:

- Possible low impact on instream flows below discharge points of WMARSS due to reduced effluent return flow rates;
- Possible increased water quality to remaining stream flows;
- Possible low impact to fish and wildlife habitat with reduced stream flows; and
- Possible negative impact to threatened and endangered species depending on habitat and stream flow requirements.

A summary of environmental issues is presented in Table 3.11-14.

Figure 3.11-5. China Spring WWTP and Waco North Reuse

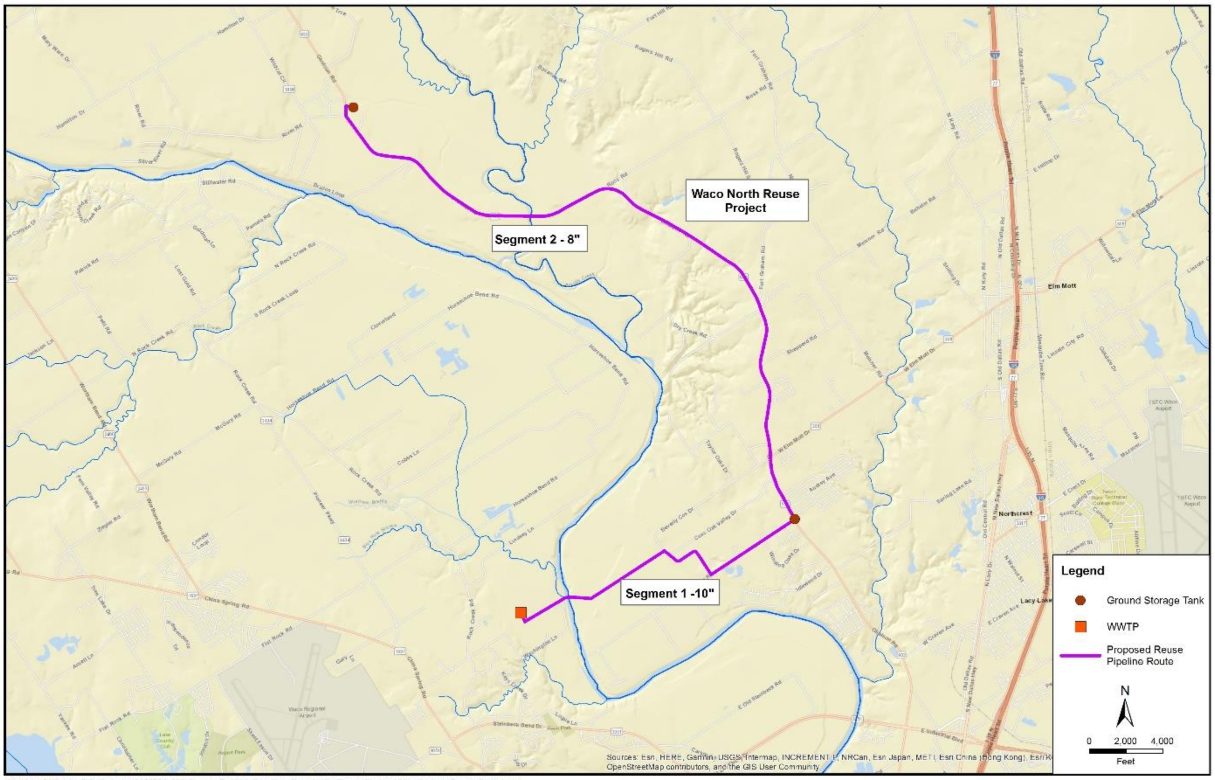


Table 3.11-13. Waco North Potential Reuse Water Demand

Entity	2070 Demand (acft/yr)	Reuse Water Demand (acft/yr)
Chalk Bluff WSC	243	73
Gholson WSC	450	135
McLennan County Mining	4,216	1,264
Total		**3,709**

Table 3.11-14. Environmental Issues: Waco North – China Spring WWTP Reuse

Issue	Description
Implementation Measures	Development of additional wastewater treatment plant facilities, distribution pipelines, and pump stations
Environmental Water Needs / Instream Flows	Possible low impact on in-stream flows due to decreased effluent return flows; possible increased water quality to remaining stream flows
Bays and Estuaries	Possible low negative impact
Fish and Wildlife Habitat	Possible variable impacts depending on changes in volume of effluent return flows; possible low negative impact to fish and wildlife habitat with reduced stream flows
Cultural Resources	Possible low impact
Threatened and Endangered Species	Possible variable impacts depending on habitat requirements for listed species.
Comments	Assumes needed infrastructure will be in urbanized areas and sited to avoid wetlands, waters of the U.S. and cultural resources, where possible.

Engineering and Costing

This option has a total project cost of $25,888,000 and an annual cost of $2,951,000. Many of the required improvements to implement a reuse supply for this option are shared between the multiple entities. These shared facilities include the China Spring satellite wastewater treatment plant, pump stations, and transmission pipelines. The shared facilities are sized to supply the combined demand for the entities served by each improvement.

The costs to develop the entire project are shown in Table 3.11-15. Due to the economy of scale, significant cost savings are realized by utilizing shared larger improvements for the treatment and delivery of reuse water to all entities supplied by the China Spring - Waco North water supply option.

The required improvements to implement wastewater reuse supplies for Chalk Bluff WSC and Gholson are summarized in Table 3.11-16 through Table 3.11-18. Storage and irrigation pumping are included for Chalk Bluff WSC and Gholson.

Costs presented in Table 3.11-15 provide the total option costs for developing a wastewater reuse supply for Chalk Bluff WSC, Gholson and Mining. The demand from McLennan County Mining is divided between pipeline Segments 1 and 2. Inclusion of the Mining shared use of these transmission facilities greatly decreases the unit cost for transmission of reuse water to Chalk Bluff WSC and Gholson. Without participation from Mining or other non-municipal demand (irrigation, manufacturing) in this reuse water supply option, supplying the relatively small quantity of reuse water demanded by Chalk Bluff WSC and Gholson would likely not be economical.

Table 3.11-15. Cost Estimate Summary: WMARSS Waco North Reuse

Item	Estimated Costs for Facilities
Primary Pump Stations (1.1 MGD)	$1,001,000
Transmission Pipeline (10 in dia., 11 miles)	$4,772,000
Storage Tanks (Other Than at Booster Pump Stations)	$3,100,000
Water Treatment Plants (1.0 MGD)	$9,318,000
Total Cost Of Facilities	$18,191,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$6,128,000
Environmental & Archaeology Studies and Mitigation	$369,000
Land Acquisition and Surveying (65 acres)	$324,000
Interest During Construction (4% for 1 years with a 1% ROI)	$876,000
Total Cost Of Project	$25,888,000
Annual Cost	
Debt Service (5.5 percent, 20 years)	$2,166,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$79,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$25,000
Water Treatment Plant (2.5% of Cost of Facilities)	$642,000
Pumping Energy Costs (437,254 kW-hr @ 0.09 $/kW-hr)	$39,000
Total Annual Cost	$2,951,000
Available Project Yield (acft/yr), based on a Peaking Factor of 1	1,120
Annual Cost of Water ($ per acft)	$2,635
Annual Cost of Water ($ per 1,000 gallons)	$8.08

Table 3.11-16. Required Facilities –China Spring- Waco North

Facility	Description
WWTP	New 1.0 MGD satellite reuse WWTP
Pump Station	80 hp; 1.0 MGD capacity to deliver at uniform rate to storage tanks at Chalk Bluff WSC and Gholson with 27 psi residual pressure
Storage Tank	1 MG; balancing storage at new satellite reuse plant; 0.1 MG tanks for Gholson and Chalk Bluff WSC
Pipeline	18,250 ft of 10-inch pipe; 40,702 ft of 8-inch pipe
Available Project Yield	Total yield is 1.0 MGD: 1.0 MGD (1,120 acft/yr) delivered, and 1.0 MGD available at plant.

Table 3.11-17. Required Facilities – Chalk Bluff WSC

Facility	Description
Treatment Upgrade	Purchase 0.07 MGD treated reuse water from Waco
Pump Station	52 hp; 0.26 MGD capacity to deliver peak daily capacity in 6 hours at 60 psi; shared use of segment 1 pump station
Storage Tank	0.07 MG; Store one days treated reuse water at tank near Chalk Bluff WSC demand
Pipeline	Shared use of pipeline segment 1
Available Project Yield	0.07 MGD (73 acft/yr), yield is based on 30 percent of total year 2070 demand to be used for irrigation and/or industrial customers

Table 3.11-18. Required Facilities – Gholson

Facility	Description
Treatment Upgrade	Purchase 0.12 MGD treated reuse water from Waco
Pump Station	79 hp; 0.48 MGD capacity to deliver peak daily capacity in 6 hours at 60 psi; shared use of segment 1 pump station
Storage Tank	0.12 MG; Store one days treated reuse water at tank in Gholson
Pipeline	Shared use of pipeline segments 1 and 2
Available Project Yield	0.12 MGD (135 acft/yr), yield is based on 30 percent of total year 2070 demand to be used for irrigation and/or industrial customers

Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 3.11-19, and the option meets each criterion. Before pursuing wastewater reuse, the Waco North entities will need to investigate concerns that would include at a minimum:

- Amount of treated effluent available, taking into consideration downstream water commitments and discharge permit requirements.
- Potential users, primarily individual large-scale users that could utilize non-potable water (e.g., certain industries) and irrigated lands (e.g., golf courses and park areas).
- Capital costs of constructing needed distribution systems connecting the treatment facilities to the areas of reuse.

Supply of reuse wastewater requires a TCEQ permit. Requirements specific to pipelines needed to link wastewater treatment facilities to reuse water users may include:

- U.S. Army Corps of Engineers Section 404 permit(s) for pipeline stream crossings; discharges of fill into wetlands and waters of the United States for construction; and other activities;
- TPDES Storm Water Pollution Prevention Plan;
- TPWD Sand, Shell, Gravel and Marl permit for construction in state-owned streambeds; and
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

Table 3.11-19. Comparison of Waco North China Spring Reuse Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Potentially important source, up to 25 percent of demand
2. Reliability	2. High reliability
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. Produces instream flows—low to moderate impact
2. Habitat	2. Possible low impact
3. Cultural Resources	3. None or low impact
4. Bays and Estuaries	4. None or low impact
5. Threatened and Endangered Species	5. Potential impact
6. Wetlands	6. None or low impact
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; benefit accrues to demand centers by more efficient use of available water supplies; no effect on navigation
D. Threats to Agriculture and Natural Resources	Generally positive effect to agriculture and natural resources by avoiding need for new supplies
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Could offset the need for voluntary redistribution of other supplies

3.11.5 WMARSS I-84 Indirect Potable Reuse

Description of Option

The City of Waco is pursuing the development of a satellite wastewater treatment plant known as I-84 Corridor WWTP to service rapid growth in the I-84 area west of Waco. Conveying water from the I-84 area to existing WMARSS wastewater plants would be costly and inefficient; and therefore, a satelite 1.5 MGD (1,680 acft/yr) WWTP is being planned for construction. The treated effluent from the proposed WWTP will outfall into the Harris Creek, a tributary to Lake Waco. Discharge from the plant will be treated to Level I standards for indirect potable reuse.

The treated effluent from the plant would mix with the natural streamflow of Harris Creek and travel 5.8 miles to Lake Waco. Travel time to Lake Waco and residence time in the lake will need to be determined. From the reservoir, the indirect reuse supply would be blended with water in the lake and supplement the WTP intake for the Mt. Carmel Drinking Water Treatment Plant. The new satellite reuse treatment plant, transmission pipeline, and outfall are shown in Figure 3.11-6.

Available Supply

The wastewater treatment plant is currently under design with an average flow of 1,680 acft/yr (1.5 MGD) at 2050. All flow will be considered indirect reuse supply. The amount of reuse water available for Waco I-84 WWTP indirect reuse will be limited by the wastewater flow in the collector main feeding the new satellite wastewater treatment plant. The entire wastewater stream could be considered for reuse.

Environmental Issues

Environmental impacts could include:

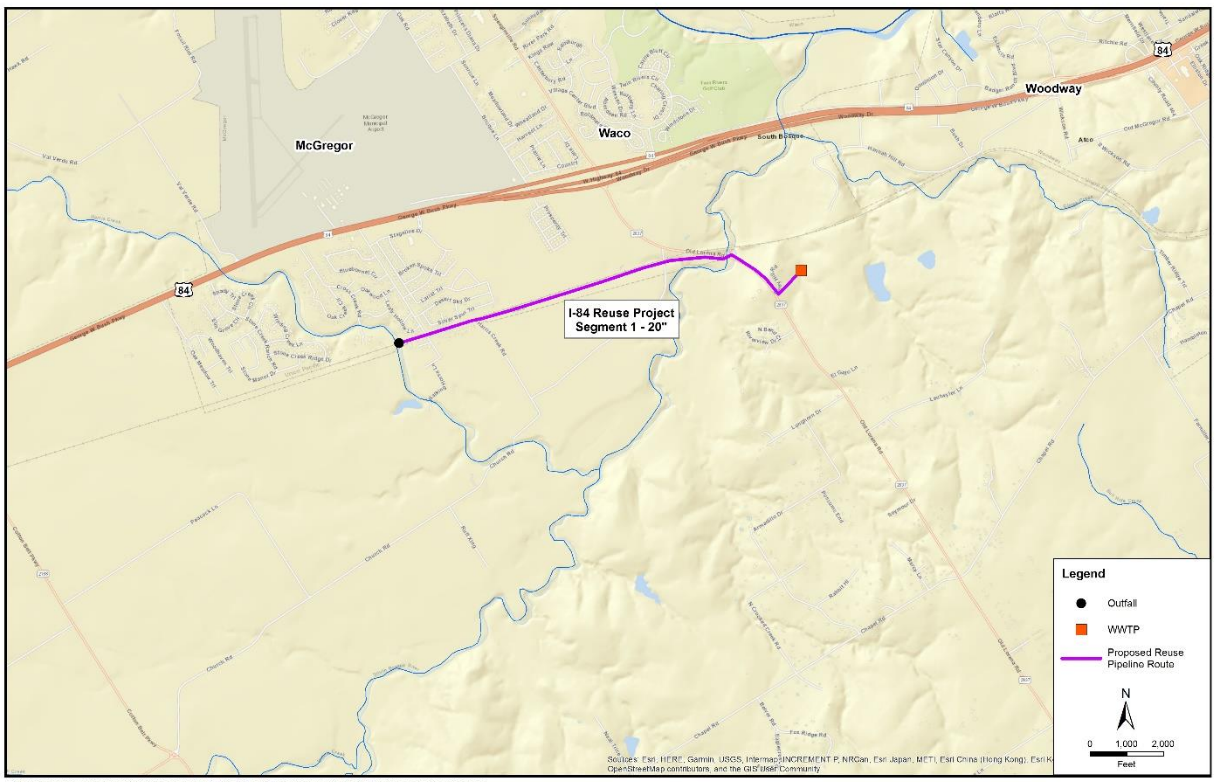
- Possible low impact on instream flows below discharge points on Harris Creek due to increased effluent return flow rates;
- Possible decreased water quality to stream flows;
- Possible low impact to fish and wildlife habitat with increased stream flows; and
- Possible negative impact to threatened and endangered species depending on habitat and stream flow requirements.

A summary of environmental issues is presented in Table 3.11-20.

Table 3.11-20. Environmental Issues: WMARSS I-84 Reuse

Issue	Description
Implementation Measures	Development of additional wastewater treatment plant facilities, discharge pipelines, and pump stations
Environmental Water Needs / Instream Flows	Possible low impact on in-stream flows due to increased effluent return flows; possible decreased water quality to stream flows
Bays and Estuaries	Possible low negative impact
Fish and Wildlife Habitat	Possible variable impacts depending on changes in volume of effluent return flows.
Cultural Resources	Possible low impact
Threatened and Endangered Species	Possible variable impacts depending on habitat requirements for listed species.
Comments	Assumes needed infrastructure will be in urbanized areas and sited to avoid wetlands, waters of the U.S. and cultural resources, where possible.

Figure 3.11-6. WMARSS I-84 Indirect Reuse



Engineering and Costing

This option has a total project cost of $28,249,000 and an annual cost of $6,234,000. A summary of costs is included in Table 3.11-21.

Table 3.11-21. Cost Estimate Summary: WMARSS Waco I-84 Indirect Potable Reuse

Item	Estimated Costs for Facilities
Primary Pump Stations (1.5 MGD)	$600,000
Transmission Pipeline (12 in dia., 2.3 miles)	$3,010,000
Wastewater Treatment Plants (1.5 MGD)	$13,928,000
Total Cost Of Facilities	$17,538,000
Engineering and Feasibility Studies, Legal Assistance, Financing, Bond Counsel, and Contingencies (30% for pipes & 35% for all other facilities)	$6,161,000
Environmental & Archaeology Studies and Mitigation	$1,237,000
Land Acquisition and Surveying (65 acres)	$1,344,000
Interest During Construction (4% for 1 years with a 1% ROI)	$1,473,000
Total Cost Of Project	$28,249,000
Annual Cost	
Debt Service (5.5 percent, 20 years)	$1,988,000
Operation and Maintenance	
Pipeline, Wells, and Storage Tanks (1% of Cost of Facilities)	$35,000
Intakes and Pump Stations (2.5% of Cost of Facilities)	$15,000
Water Treatment Plant (2.5% of Cost of Facilities)	$3,976,000
Pumping Energy Costs (436,285 kW-hr @ 0.09 $/kW-hr)	$229,000
Total Annual Cost	$6,234,000
Available Project Yield (acft/yr), based on a Peaking Factor of 1	1,680
Annual Cost of Water ($ per acft)	$3,711
Annual Cost of Water ($ per 1,000 gallons)	$11.39

Table 3.11-22. Required Facilities –Waco I-84

Facility	Description
WWTP	New 1.5 MGD satellite WWTP
Pump Station	31 hp; 1.5 MGD capacity to deliver at uniform rate to outfall on Harrison Creek
Pipeline	12,038 ft of 12-inch pipe
Available Project Yield	Total yield is 1.5 MGD: 1.5 MGD (1,680 acft/yr) delivered to outfall

Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 3.11-23, and the option meets each criterion. Before pursuing wastewater reuse, the Waco I-84 entities will need to investigate concerns that would include at a minimum:

- Environmental impact of the effluent and increased flow in the rivers and streams.
- Water quality impacts on the surrounding area.

Supply of reuse wastewater requires a TCEQ permit. Requirements specific to pipelines needed to link wastewater treatment facilities to reuse water users may include:

- U.S. Army Corps of Engineers Section 404 permit(s) for pipeline stream crossings; discharges of fill into wetlands and waters of the United States for construction; and other activities;
- TPDES Storm Water Pollution Prevention Plan;
- TPWD Sand, Shell, Gravel and Marl permit for construction in state-owned streambeds; and
- Aquatic Resource Relocation Plan (ARRP) and a relocation permit may be required from TPWD if a dewatering event is required during construction.

Table 3.11-23. Comparison of Waco I-84 Reuse Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Potentially important source, up to 25 percent of demand
2. Reliability	2. High reliability
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. Produces instream flows—low to moderate impact
2. Habitat	2. Possible low impact
3. Cultural Resources	3. None or low impact
4. Bays and Estuaries	4. None or low impact
5. Threatened and Endangered Species	5. Potential impact
6. Wetlands	6. None or low impact
C. Impact on Other State Water Resources	No apparent negative impacts on state water resources; benefit accrues to demand centers by more efficient use of available water supplies; no effect on navigation
D. Threats to Agriculture and Natural Resources	Generally positive effect to agriculture and natural resources by avoiding need for new supplies
E. Equitable Comparison of Strategies Deemed Feasible	Option is considered to meet municipal and industrial shortages
F. Requirements for Interbasin Transfers	Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	Could offset the need for voluntary redistribution of other supplies