2 Water Conservation

2.1 Municipal Water Conservation

Water conservation is defined as those methods and practices that either reduce the demand for water supply or increase the efficiency of the supply. Water facilities are used so that supply is conserved and made available for future use. Water conservation is typically a non-capital-intensive alternative that any water supply entity can pursue.

Water supply entities and major water right holders that meet the following criteria are required by Texas Water Code and Texas Administrative Code statute to submit a Water Conservation Plan to the TCEQ:

- Entities who are requesting Texas Water Development Board (TWDB) financial assistance greater than $500,000;
- Entities with 3,300 connections or greater; or
- Surface water right holders of:
    - Greater than 1,000 acft/year (non-irrigation)
    - Greater than 10,000 acft/year (irrigation)

The purpose of a water conservation plan is to establish strategies for reducing the volume of water used from a water supply source, reduce loss or waste of water, and maintain and improve the efficiency in the use of water. According to Texas Administrative Code statute, water conservation plans must identify 5- and 10-year targets and goals for water use and water loss, including methods used to track progress in meeting targets and goals. Water conservation plans for Brazos G municipal water user groups, including the most common water conservation best management practices (BMPs) identified in the water conservation plans, are summarized in Volume I, Chapter 7.

The TWDB guidance and Texas Administrative Code 357.34 requires Regional Water Planning Groups to consider water conservation practices, including potentially applicable BMPs, for each water user group with an identified water need (shortage) in the regional water plan. For the 2021 Regional Water Plans, the TWDB requires water conservation content to be included in the Plans including directives for regional water planning groups to assess the highest level of water conservation and efficiencies achievable, report the resulting projected water use savings in gallons per capita per day, and develop conservation strategies based on this information. Furthermore, water conservation strategies should identify capital or other costs for best management practices that result in an immediate, quantifiable increase in water savings or decrease in system water use or water losses, including active plumbing retrofit programs, replacement of portions of an existing leaking water transmission or distribution network, and/or meter replacement/SCADA installation (where applicable). This section addresses the TWDB directives related to water conservation.

There are several water conservation resources that have been developed for use in developing the Regional Water Plans. The Water Conservation Implementation Task Force, created by Senate Bill 1094, provided guidance on Water Conservation Best

Management Practices (BMPs)[1]. The Task Force summarized their recommendations in a Report to the 79th Legislature[2], which included Task Force recommendations of gpcd targets and goals that should be considered by retail public water suppliers when developing water conservation plans required by the state, as follows:

- All public water suppliers that are required to prepare and submit water conservation plans should establish targets for water conservation, including specific goals for per capita water use and for water loss programs using appropriate water conservation BMPs.
- Municipal Water Conservation Plans required by the state shall include per capita water-use goals, with targets and goals established by an entity giving consideration to a minimum annual reduction of 1 percent in total gpcd, until such time as the entity achieves a total gpcd of 140 gpcd or less, or municipal water use (gpcd) goals approved by regional water planning groups.

The TWDB has continued the work of the Task Force by providing additional resources for municipal water users to assist water utilities with water conservation, including:

- Water Conservation Best Management Practice Guides
  - Municipal Water Providers, May 2019
  - Wholesale Water Providers, October 2017
- Water Conservation Plan Guidance for Utilities, developed in January 2013
  - Water Conservation Plan Checklist
  - How to Develop a Water Conservation Plan
  - Identifying Water Conservation Targets and Goals

The TWDB provided tools for Regional Water Planning Groups to consider during development of municipal water conservation recommendations for the 2021 Regional Water Plans. These resources were considered during development of the 2021 Brazos G Regional Water Plan, with Brazos G-specific results summarized below in sub-bullets.

- Utility-Provided Best Management Practices Implemented as of the 2017 reporting year
  - 49 Brazos G municipal entities have water conservation BMPs identified in the TWDB document.
- Annual Water Conservation Report Data (Years 2015 and 2016)
  - 61 Brazos G municipal entities submitted annual reports on implementation of their water conservation plan (entities range in population from 135 to 139,072)
  - 57 reported that leaks were repaired (11,316 leaks repaired in Brazos G)
  - 45 reported that they tested meters (5,454 meters tested in Brazos G)
  - 21 reported specific conservation savings (gallons)
  - 29 reported specific reuse savings (gallons)

[1] Texas Water Development Board, Water Conservation Implementation Task Force, Water Conservation Best Management Practices Guide, November 2004.

[2] Texas Water Development Board, Water Conservation Implementation Task Force Report to the 79th Legislature, November 2004. https://www.twdb.texas.gov/conservation/resources/doc/WCITF_Leg_Report.pdf

    - Total gallons conserved or reused in Brazos G = 6.06 Billion Gallons (18,600 acre-feet)
- Municipal Water Conservation Planning Tool
    - The Municipal Water Conservation Planning Tool was developed by the TWDB to assist individual water utilities with planning conservation programs. The tool allows the user to include a mix of BMPs, and produces the expected annual conservation savings and associated capital and annual costs. The tool comes with population and water demand projections (and other data such as number of connections) for many municipal water user groups. The tool includes user-based functionality to load baseline demand projections, select conservation measures (plan or single-year savings) based on implementation activity, manage scenarios (to evaluate various BMP combinations) and use this information to calculate water savings and costs.
    - 75 of the 246 Brazos G municipal water user groups (non-county other) are included in the Baseline Demand Projection, which includes population, connections, water demands, baseline per capita (gpcd), and water loss. The water demands reflect passive water conservation savings from plumbing efficiencies and appliance standards attributable to state and federal plumbing codes.

2.1.1 Description of Strategy

For regional water planning purposes, municipal water use is defined as residential and commercial water use. Municipal water is primarily for drinking, sanitation, cleaning, cooling, fire protection, and landscape watering for residential, commercial, and institutional establishments. A key parameter for assessing municipal water use within a typical city or water service area is the number of gallons used per person per day (per capita water use). The objective of water conservation is to decrease the amount of water – measured in gallons per capita per day (gpcd) – that a typical utility uses.

The current TWDB municipal water demand projections account for expected water savings due to implementation of the 1991 State Water-Efficient Plumbing Act. However, any projected water savings due to conservation programs over and above the savings associated with the 1991 Plumbing Act must be listed as a separate water management strategy. The projections assume that 100 percent of new construction includes water-efficient plumbing fixtures. Consequently, any water management strategy intended to replace inefficient plumbing fixtures installed prior to 1995 would constitute an acceleration of the effects of the 1991 Plumbing Act, but provide no additional long-term savings. Including a retrofit program as a water management strategy without first discounting the TWDB per capita water use reductions would double-count water savings, since those savings due to retrofits are already included in the base water demand projections.

In 2009, the Texas Legislature enacted House Bill (HB) 2667 establishing new minimum standards for plumbing fixtures sold in Texas beginning in 2014. HB 2667 clarifies and sets out the national standards of the American Society of Mechanical Engineers and American National Standards Institute by which plumbing fixtures will be produced and tested. This bill establishes a phase-in of high efficiency plumbing fixtures brought into Texas, which will allow manufacturers the time to change their production, at the same

time allowing retailers the opportunity to turn over their inventory. HB 2667 creates an exemption for those manufacturers that volunteer to register their products with the United States Environmental Protection Agency's WaterSense Program, which should result in additional water savings. This bill also repeals the TCEQ certification process for plumbing fixtures since the plumbing fixtures must meet national certification and testing procedures.

The TCEQ has promulgated rules to reflect this new change in law. The 2009 law requires that by January 2014, all toilets use no more than 1.28 gallons per flush (20% savings from the 1991 1.6 gallons per flush standard). Based upon an average frequency of per-person toilet use in households of 5.1 and a per-use savings of 0.32 gallons per use the supplementary savings of adopting high-efficiency toilets is 1.63 gpcd. This change is also reflected in Table 2.1-1.

Table 2.1-1. Standards for Plumbing Fixtures

Fixture	Standard
Toilets*	1.28 gallons per flush
Shower Heads	2.75 gallons per minute at 80 psi
Urinals	0.5 gallon per flush
Faucet Aerators	2.20 gallons per minute at 60 psi
Drinking Water Fountains	Shall be self-closing

*Bill 2667 of the 81st Texas Legislature, 2009

The TWDB has estimated that the effect of the new plumbing fixtures in dwellings, offices, and public places will be a reduction in per capita water use of approximately 20 gpcd, in comparison to what would have occurred with previous generations of plumbing fixtures.[3] The estimated water conservation effect of 20 gpcd was obtained from TWDB data shown in Table 2.1-2. The low flow plumbing fixtures effects that are already included in the water demand projections are deducted from the 20 gpcd plumbing fixtures potentials for municipal water demand reduction before additional conservation is suggested.

Table 2.1-2. Water Conservation Potentials of Low Flow Plumbing Fixtures

Plumbing Fixture	Water Savings (gpcd)
Toilets and Showerheads	16.0
Additional Savings (High Efficiency Toilet)*	1.63
Faucet Aerators – 2.2 gallons per minute	2.0
Urinals – 1.0 gallon per minute	0.3
Drinking Fountains (self-closing)	0.1
Total	20.03 (~20 gpcd)

* TWDB, 2013

[3]"Water Conservation Impacts on Per Capita Water Use," Water Planning Information, Texas Water Development Board, Austin, Texas, 1992.

2.1.2 Brazos G Municipal Water Conservation Approach

The Brazos G Regional Water Planning Group (Brazos G RWPG) recommends additional water conservation beyond the Plumbing Act savings for all municipal water user groups with per capita use above 140 gpcd in the TWDB base gpcd[4], regardless of whether or not the entity has needs. For these entities, the goal is to reduce per capita use by 1% annually until the target is met, and then hold the 140 gpcd rate constant throughout the remainder of the planning period. For Williamson County entities, a water conservation goal of 120 gpcd is targeted with a goal of reducing per capita use by 1% annually until the target is met and then holding the 120 gpcd rate constant through the planning period.

Municipal water conservation can be achieved in a variety of ways, including using BMPs identified by the TWDB[5]:

1. System Water Audit and Water Loss,
2. Water Conservation Pricing,
3. Prohibition on Wasting Water,
4. Conservation Ordinance Planning and Development,
5. Showerhead, Aerator, and Toilet Flapper Retrofit,
6. Residential Toilet Replacement Programs with Ultra-Low-Flow toilets,
7. Residential Clothes Washer Incentive Program,
8. School Education,
9. Water Survey for Single-Family and Multi-Family Customers,
10. Landscape Irrigation Conservation and Incentives,
11. Water-Wise Landscape Design and Conversion Programs,
12. Athletic Field Conservation,
13. Golf Course Conservation,
14. Metering of all New Connections and Retrofitting of Existing Connections,
15. Wholesale Agency Assistance Programs,
16. Conservation Coordinator (updated 2019),
17. Water Reuse[6],
18. Public Information,
19. Rainwater Harvesting and Condensate Reuse[6],
20. New Construction Greywater,
21. Park Conservation,
22. Conservation Programs for Industrial, Commercial, and Institutional Accounts,
23. Residential Landscape Irrigation Evaluation,
24. Outdoor Watering Schedule (adopted 2019),
25. Custom Characterization (adopted 2019),
26. Public Outreach and Education (adopted 2019),
27. Partnerships with Nonprofit Organizations,
28. Custom Conservation Rebates (adopted 2019),
29. Plumbing Assistance for Economically Disadvantaged Customers (adopted 2019)

[4] Typically based on 2011 water use but may represent a different year based on revisions.

[5] https://www.twdb.texas.gov/conservation/BMPs/Mun/index.asp

[6] Reuse and Rainwater Harvesting are considered separate sources for purposes of regional water planning and are not classified as “conservation” in the regional water planning process.

The Brazos G RWPG does not recommend specific conservation BMPs for municipal entities, as each entity should choose those conservation strategies that best fit their individual situation.

The Brazos G RWPG considered TWDB-provided information for Brazos G Utility-Provided Best Management Practices Implemented as of the 2017 reporting year, described earlier. Based on this information, the top three most common water conservation BMPs for Brazos G municipal users includes:

- Metering of all new connections and retrofit of existing connections (40 out of 49 Brazos G respondents),
- Public information (38 out of 49 Brazos G respondents), and
- System water audit and water loss control (33 out of 49 Brazos G respondents).

2.1.3 Available Supply

Per capita water use from the 2017 State Water Plan was provided by the TWDB for 2021 Regional Water Planning purposes for each municipal WUG based on TWDB-approved population and water demand estimates for each decade from 2020 to 2070 (summarized in Volume I Chapter 2, Table 2.5). The historical per capita water use[7] in 2011 was used as a basis for projected per capita water use in decades from 2020 to 2070 that might be expected with implementation of low flow plumbing fixtures. The available supply attributed to implementation of advanced strategy is a 1% annual reduction in demand over and above that assumed in the TWDB water demand projections attributable to low flow plumbing code implementation.

[7] Based on water user surveys provided voluntarily by water provider to the TWDB.

Table 2.1-3 shows a comparison of TWDB baseline per capita rates for the 2021 Brazos G Plan to per capita rates with advanced conservation for Brazos G entities with per capita rates greater than 140 gpcd, and greater than 120 gpcd for Williamson County. Table 2.1-4 lists the additional water savings attributable to the Brazos G RWPG conservation recommendations8. The projected savings attributed to advanced conservation in Brazos G is 24,971 ac-ft/yr in 2020 and increases to 111,339 ac-ft/yr by 2070, shown by WUG in Table 2.1-4. All entities, in order to be in line with projections, will need to verify that their conservation planning measures are consistent with TCEQ standards and the TWDB projections. Beyond that, some communities with projected needs may be able to reduce or eliminate those needs with stronger conservation planning.

[8] Additional savings represents savings beyond the 1991 Plumbing Act savings.

Table 2.1-3. Comparison of TWDB Baseline Per Capita Rates for the 2021 Brazos G Plan and Per Capita Rates With Advanced Conservation

		GPCD Board Projections without Advanced Conservation							GPCD Goal with Advanced Conservation					
		Base GPCD	Projected GPCD						Projected GPCD					
WUG	COUNTY	2011	2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070
ABILENE	JONES	172	162	158	155	153	153	153	162	147	140	140	140	140
ABILENE	TAYLOR	172	162	158	155	153	153	153	162	147	140	140	140	140
ALBANY	SHACKELFORD	258	248	244	241	240	239	239	248	224	203	183	166	150
AQUA WSC	LEE	156	147	143	141	140	140	140	147	140	140	140	140	140
ARMSTRONG WSC	BELL	168	158	154	151	149	149	149	158	143	140	140	140	140
ASPERMONT	STONEWALL	250	240	236	232	232	231	231	240	217	197	178	161	145
BARTLETT	BELL	181	171	166	163	161	161	161	171	154	140	140	140	140
BARTLETT	WILLIAMSON	181	171	166	163	162	161	161	171	154	139	126	120	120
BAYLOR SUD	THROCKMORTON	206	179	179	179	179	167	167	179	161	146	140	140	140
BAYLOR SUD	YOUNG	412	197	193	189	187	189	188	197	178	161	145	140	140
BAYLOR SUD	ARCHER	206	194	191	191	188	186	185	194	175	159	143	140	140
BAYLOR SUD	BAYLOR	206	197	192	189	189	188	188	197	178	161	146	140	140
BELL COUNTY WCID 3	BELL	155	146	142	139	138	138	138	146	140	140	140	140	140
BELL MILAM FALLS WSC	WILLIAMSON	142	133	130	128	126	126	125	133	120	120	120	120	120
BELTON	BELL	165	156	152	150	149	148	148	156	141	140	140	140	140
BETHESDA WSC	JOHNSON	197	187	183	181	179	179	179	187	169	153	140	140	140
BETHESDA WSC	TARRANT	197	187	183	181	179	179	179	187	169	153	140	140	140
BISTONE MUNICIPAL WATER SUPPLY DISTRICT	LIMESTONE	364	355	350	347	346	345	346	355	321	290	263	237	215
BRECKENRIDGE	STEPHENS	161	152	147	144	142	142	142	152	140	140	140	140	140
BREMOND	ROBERTSON	174	163	159	156	155	155	155	163	148	140	140	140	140
BRENHAM	WASHINGTON	219	210	206	203	202	202	202	210	190	172	155	140	140
BRUCEVILLE EDDY	FALLS	174	165	161	158	156	156	156	165	149	140	140	140	140
BRUCEVILLE EDDY	MCLENNAN	174	165	161	158	157	156	156	165	149	140	140	140	140
BRUSHY CREEK MUD	WILLIAMSON	146	136	133	132	131	131	130	136	123	120	120	120	120
BRYAN	BRAZOS	168	158	155	152	151	151	151	158	143	140	140	140	140
CALDWELL	BURLESON	197	187	184	181	180	180	180	187	169	153	140	140	140
CAMERON	MILAM	216	206	202	198	197	197	197	206	186	169	152	140	140
CEDAR PARK	WILLIAMSON	193	184	183	182	182	182	182	184	167	151	136	123	120
CEDAR PARK	TRAVIS	193	184	183	182	182	182	182	184	167	151	140	140	140
CEGO-DURANGO WSC	FALLS	159	149	145	142	141	141	141	149	140	140	140	140	140
CENTRAL TEXAS COLLEGE DISTRICT	BELL	160	153	151	138	138	138	138	153	140	140	140	140	140
CENTRAL TEXAS COLLEGE DISTRICT	CORYELL	160	151	147	145	143	143	143	151	140	140	140	140	140
CHISHOLM TRAIL SUD	BURNET	174	165	163	163	162	161	162	165	149	140	140	140	140
CISCO	EASTLAND	168	158	154	151	149	149	149	158	143	140	140	140	140
CLEBURNE	JOHNSON	172	163	159	156	155	155	155	163	147	140	140	140	140
CLIFTON	BOSQUE	173	163	158	155	154	154	154	163	147	140	140	140	140
COLLEGE STATION	BRAZOS	155	146	142	140	139	138	138	146	140	140	140	140	140
COOLIDGE	LIMESTONE	156	146	143	140	139	139	139	146	140	140	140	140	140
CORYELL CITY WATER SUPPLY DISTRICT	CORYELL	154	146	143	141	140	140	140	146	140	140	140	140	140
CORYELL CITY WATER SUPPLY DISTRICT	MCLENNAN	154	146	142	141	140	139	140	146	140	140	140	140	140
COUNTY-OTHER, BELL	BELL	162	150	145	144	144	144	143	150	140	140	140	140	140
COUNTY-OTHER, WILLIAMSON	WILLIAMSON	148	139	135	134	133	133	133	139	125	120	120	120	120
CRAWFORD	MCLENNAN	191	182	178	174	173	172	172	182	164	149	140	140	140
CROSS COUNTRY WSC	BOSQUE	158	150	146	143	143	142	142	150	140	140	140	140	140
CROSS COUNTRY WSC	MCLENNAN	158	149	146	144	142	142	142	149	140	140	140	140	140
CROSS PLAINS	CALLAHAN	162	152	147	144	143	143	143	152	140	140	140	140	140
DOUBLE DIAMOND UTILITIES	HILL	215	206	202	200	198	198	198	206	186	168	152	140	140
DOUBLE DIAMOND UTILITIES	JOHNSON	215	205	204	196	197	199	197	205	185	168	152	140	140
EAST CRAWFORD WSC	MCLENNAN	312	303	299	297	295	295	295	303	274	248	224	203	183
FERN BLUFF MUD	WILLIAMSON	190	183	181	180	179	179	179	183	165	150	135	122	120
FLAT WSC	CORYELL	201	191	189	186	185	184	185	191	173	156	141	140	140
FORT GATES WSC	CORYELL	187	177	174	172	171	170	170	177	160	145	140	140	140
FORT HOOD	BELL	215	204	200	197	197	197	197	204	185	167	151	140	140

Table 2.1-3 (Continued)

		GPCD Board Projections without Advanced Conservation							GPCD Goal with Advanced Conservation					
		Base GPCD	Projected GPCD						Projected GPCD					
WUG	COUNTY	2011	2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070
FORT HOOD	CORYELL	215	204	200	197	197	197	196	204	185	167	151	140	140
FORT WORTH	JOHNSON	185	0	0	0	170	170	169	0	0	0	170	140	140
GATESVILLE	CORYELL	229	220	216	213	212	212	212	220	199	180	162	147	140
GEORGETOWN	BELL	205	196	194	193	192	192	192	196	177	160	145	140	140
GEORGETOWN	WILLIAMSON	205	196	194	193	192	192	192	196	178	161	145	131	120
GEORGETOWN	BURNET	205	198	194	193	193	193	192	198	179	162	146	140	140
GIDDINGS	LEE	188	178	174	171	170	170	170	178	161	145	140	140	140
GLEN ROSE	SOMERVELL	200	190	187	184	183	183	182	190	172	156	141	140	140
GORDON	ERATH	206	202	189	179	198	193	188	202	182	165	149	140	140
GORDON	PALO PINTO	206	197	193	191	189	189	189	197	178	161	145	140	140
GRAHAM	YOUNG	266	256	252	249	247	247	247	256	232	210	190	172	155
HAMILTON	HAMILTON	162	153	149	146	144	143	143	153	140	140	140	140	140
HAMLIN	JONES	178	168	163	160	160	159	159	168	152	140	140	140	140
HARKER HEIGHTS	BELL	182	174	170	169	168	167	167	174	157	142	140	140	140
HEARNE	ROBERTSON	161	151	147	143	143	142	142	151	140	140	140	140	140
HEWITT	MCLENNAN	165	156	152	149	148	148	148	156	141	140	140	140	140
HIGHLAND PARK WSC	BOSQUE	264	254	251	249	247	246	246	254	230	208	188	170	154
HIGHLAND PARK WSC	MCLENNAN	264	252	250	247	247	246	244	252	228	206	186	169	153
HILLSBORO	HILL	200	190	186	183	182	182	182	190	172	156	141	140	140
JAYTON	KENT	164	154	151	147	145	145	145	154	140	140	140	140	140
JONAH WATER SUD	WILLIAMSON	137	126	123	121	120	120	120	126	120	120	120	120	120
KEMPNER WSC	BELL	164	156	153	151	150	150	150	156	141	140	140	140	140
KEMPNER WSC	CORYELL	164	156	153	151	150	150	150	156	141	140	140	140	140
KEMPNER WSC	LAMPASAS	164	156	153	151	150	150	150	156	141	140	140	140	140
KEMPNER WSC	BURNET	164	155	153	151	150	150	149	155	140	140	140	140	140
KNOX CITY	KNOX	195	184	179	177	178	177	177	184	167	151	140	140	140
LAWN	TAYLOR	186	177	174	170	169	168	168	177	160	145	140	140	140
LEXINGTON	LEE	169	159	155	152	151	151	151	159	143	140	140	140	140
LITTLE ELM VALLEY WSC	BELL	171	161	158	156	154	154	154	161	146	140	140	140	140
LITTLE ELM VALLEY WSC	FALLS	171	160	159	155	153	157	155	160	145	140	140	140	140
LORENA	MCLENNAN	154	145	141	139	137	137	137	145	140	140	140	140	140
MANSFIELD	JOHNSON	252	245	242	241	240	240	240	245	221	200	181	164	148
MANVILLE WSC	WILLIAMSON	148	139	136	135	134	134	134	139	126	120	120	120	120
MARLIN	FALLS	254	244	239	236	235	235	235	244	220	199	180	163	147
MINERAL WELLS	PALO PINTO	155	146	142	139	137	137	137	146	140	140	140	140	140
MINERAL WELLS	PARKER	155	145	142	139	137	137	137	145	140	140	140	140	140
MOUNTAIN PEAK SUD	JOHNSON	290	280	277	275	274	274	273	280	253	229	207	187	169
MOUNTAIN PEAK SUD	ELLIS	290	280	277	275	274	274	273	280	253	229	207	187	170
MUNDAY	KNOX	180	170	165	162	162	162	162	170	154	140	140	140	140
MUSTANG VALLEY WSC	BOSQUE	206	197	193	191	189	189	189	197	178	161	146	140	140
MUSTANG VALLEY WSC	CORYELL	206	191	179	202	189	189	189	191	173	156	142	140	140
NAVASOTA	GRIMES	184	175	171	168	166	166	166	175	158	143	140	140	140
NORTH BOSQUE WSC	MCLENNAN	235	227	224	222	221	221	221	227	205	185	168	152	140
NORTH MILAM WSC	FALLS	167	158	158	141	134	134	170	158	142	140	140	140	140
NORTH MILAM WSC	MILAM	167	158	154	151	150	149	149	158	143	140	140	140	140
PFLUGERVILLE	WILLIAMSON	155	148	147	146	146	145	145	148	134	121	120	120	120
PFLUGERVILLE	TRAVIS	155	148	146	146	145	145	145	148	140	140	140	140	140
POSSUM KINGDOM WSC	PALO PINTO	392	383	379	376	375	374	374	383	346	313	283	256	231
POSSUM KINGDOM WSC	STEPHENS	392	379	376	372	378	378	374	379	343	310	281	254	230
PRAIRIE HILL WSC	LIMESTONE	157	148	143	141	139	139	139	148	140	140	140	140	140
PRAIRIE HILL WSC	MCLENNAN	157	148	144	140	140	139	138	148	140	140	140	140	140
RANGER	EASTLAND	171	161	157	153	153	152	152	161	146	140	140	140	140
RED RIVER AUTHORITY OF TEXAS	KNOX	229	217	216	214	209	209	208	217	196	178	161	145	140
ROBINSON	MCLENNAN	181	172	168	166	165	165	165	172	155	140	140	140	140

Table 2.1-3 (Concluded)

		GPCD Board Projections without Advanced Conservation							GPCD Goal with Advanced Conservation					
		Base GPCD	Projected GPCD						Projected GPCD					
WUG	COUNTY	2011	2020	2030	2040	2050	2060	2070	2020	2030	2040	2050	2060	2070
ROBY	FISHER	175	166	162	160	157	157	157	166	150	140	140	140	140
ROCKDALE	MILAM	184	174	170	167	165	165	165	174	158	143	140	140	140
ROUND ROCK	WILLIAMSON	152	143	141	139	139	139	138	143	129	120	120	120	120
ROUND ROCK	TRAVIS	152	143	140	139	139	139	138	143	140	140	140	140	140
SALADO WSC	BELL	292	283	279	277	276	276	276	283	255	231	209	189	171
SNOOK	BURLESON	307	297	293	289	288	288	287	297	269	243	220	199	180
SOMERVILLE	BURLESON	170	159	155	152	152	152	151	159	144	140	140	140	140
SOUTHWEST MILAM WSC	WILLIAMSON	152	143	139	137	136	136	135	143	129	120	120	120	120
SPORTSMANS WORLD MUD	PALO PINTO	898	885	886	880	880	881	881	885	801	724	655	592	536
STAMFORD	HASKELL	237	236	210	210	210	230	223	236	214	193	175	158	143
STAMFORD	JONES	237	227	222	219	218	218	218	227	205	186	168	152	140
STRAWN	PALO PINTO	182	172	168	165	163	163	163	172	155	141	140	140	140
TAYLOR	WILLIAMSON	157	147	143	141	139	139	139	147	133	121	120	120	120
TDCJ LUTHER UNITS	GRIMES	183	175	172	171	170	170	170	175	158	143	140	140	140
TDCJ W PACK UNIT	GRIMES	218	210	208	206	205	205	205	210	190	172	155	141	140
TEMPLE	BELL	229	219	216	214	213	212	212	219	198	180	162	147	140
TEXAS A&M UNIVERSITY	BRAZOS	487	476	472	469	468	468	468	476	431	390	352	319	288
TEXAS STATE TECHNICAL COLLEGE	MCLENNAN	1378	1369	1365	1362	1361	1360	1360	1369	1238	1120	1013	916	828
THROCKMORTON	THROCKMORTON	205	195	191	187	187	187	187	195	177	160	144	140	140
TWIN CREEK WSC	ROBERTSON	167	158	154	152	151	150	150	158	143	140	140	140	140
VALLEY MILLS	BOSQUE	184	174	170	167	166	165	165	174	157	142	140	140	140
VALLEY MILLS	MCLENNAN	184	155	162	170	172	161	166	155	140	140	140	140	140
VENUS	JOHNSON	174	167	164	163	163	162	162	167	151	140	140	140	140
VENUS	ELLIS	174	165	166	160	162	164	163	165	150	140	140	140	140
WACO	MCLENNAN	220	211	207	204	202	202	202	211	191	172	156	141	140
WALSH RANCH MUD	WILLIAMSON	257	249	245	244	244	243	243	249	225	204	184	166	151
WELLBORN SUD	BRAZOS	170	160	157	155	154	154	154	160	145	140	140	140	140
WELLBORN SUD	ROBERTSON	170	160	157	155	154	154	154	160	145	140	140	140	140
WEST	MCLENNAN	160	151	147	144	142	141	141	151	140	140	140	140	140
WHITNEY	HILL	180	171	167	165	163	163	163	171	155	140	140	140	140
WILLIAMSON COUNTY MUD 10	WILLIAMSON	196	191	189	189	189	189	188	191	173	156	141	128	120
WILLIAMSON COUNTY MUD 11	WILLIAMSON	185	180	178	178	178	178	178	180	163	147	133	120	120
WILLIAMSON COUNTY MUD 9	WILLIAMSON	188	180	177	176	176	176	176	180	162	147	133	120	120
WINDSOR WATER	MCLENNAN	156	146	143	139	138	138	138	146	140	140	140	140	140
WOODWAY	MCLENNAN	352	342	337	334	333	333	333	342	309	280	253	229	207

Table 2.1-4. Estimated Annual Water Savings for WUGs with Recommended Conservation

County Name	Water User Group	Additional Water Saved-W/Advanced Conservation (acft)					
		2020	2030	2040	2050	2060	2070
ABILENE	JONES	0	70	95	86	86	88
ABILENE	TAYLOR	0	1,554	2,102	1,915	1,909	1,935
ALBANY	SHACKELFORD	0	50	98	146	191	233
AQUA WSC	LEE	0	11	4	0	0	0
ARMSTRONG WSC	BELL	0	35	37	33	35	36
ASPERMONT	STONEWALL	0	19	37	56	73	89
BARTLETT	BELL	0	13	29	31	34	37
BARTLETT	WILLIAMSON	0	15	32	52	65	70
BAYLOR SUD	THROCKMORTON	0	0	1	1	0	0
BAYLOR SUD	YOUNG	0	6	10	15	18	18
BAYLOR SUD	ARCHER	0	3	6	8	8	8
BAYLOR SUD	BAYLOR	0	14	29	44	49	50
BELL COUNTY WCID 3	BELL	0	22	0	0	0	0
BELL MILAM FALLS WSC	WILLIAMSON	0	4	4	4	4	5
BELTON	BELL	0	323	323	325	352	384
BETHESDA WSC	JOHNSON	0	327	735	1,190	1,331	1,487
BETHESDA WSC	TARRANT	0	186	408	639	690	742
BISTONE MUNICIPAL WSD	LIMESTONE	0	20	40	62	83	104
BRECKENRIDGE	STEPHENS	0	51	29	16	15	14
BREMOND	ROBERTSON	0	13	21	21	23	24
BRENHAM	WASHINGTON	0	367	755	1,170	1,592	1,648
BRUCEVILLE EDDY	FALLS	0	15	31	29	31	33
BRUCEVILLE EDDY	MCLENNAN	0	64	98	96	100	105
BRUSHY CREEK MUD	WILLIAMSON	0	233	263	243	238	237
BRYAN	BRAZOS	0	1,311	1,606	1,719	1,988	2,489
CALDWELL	BURLESON	0	83	167	239	242	246
CAMERON	MILAM	0	107	218	339	449	465
CEDAR PARK	WILLIAMSON	0	1,672	3,197	4,626	5,932	6,250
CEDAR PARK	TRAVIS	0	215	442	586	583	582
CEGO-DURANGO WSC	FALLS	0	6	3	2	1	1
CENTRAL TEXAS COLLEGE DISTRICT	BELL	0	1	0	0	0	0
CENTRAL TEXAS COLLEGE DISTRICT	CORYELL	0	6	4	3	3	3
CHISHOLM TRAIL SUD	BURNET	0	7	13	14	16	17
CISCO	EASTLAND	0	52	52	44	42	42
CLEBURNE	JOHNSON	0	561	942	1,018	1,171	1,302
CLIFTON	BOSQUE	0	53	76	71	71	71
COLLEGE STATION	BRAZOS	0	234	0	0	0	0
COOLIDGE	LIMESTONE	0	4	0	0	0	0
CORYELL CITY WATER SUPPLY DISTRICT	CORYELL	0	17	7	0	0	0

Table 2.1-4 (Continued)

County Name	Water User Group	Additional Water Saved-W/Conservation (acft)*					
		2020	2030	2040	2050	2060	2070
CORYELL CITY WATER SUPPLY DISTRICT	MCLENNAN	0	3	1	0	0	0
COUNTY-OTHER, BELL	BELL	0	17	14	14	30	43
COUNTY-OTHER, WILLIAMSON	WILLIAMSON	0	288	948	1,390	2,923	4,281
CRAWFORD	MCLENNAN	0	11	21	28	27	28
CROSS COUNTRY WSC	BOSQUE	0	6	3	3	2	2
CROSS COUNTRY WSC	MCLENNAN	0	18	11	7	6	6
CROSS PLAINS	CALLAHAN	0	10	6	4	5	4
DOUBLE DIAMOND UTILITIES	HILL	0	35	71	108	139	144
DOUBLE DIAMOND UTILITIES	JOHNSON	0	3	4	7	9	16
EAST CRAWFORD WSC	MCLENNAN	0	30	61	94	129	164
FERN BLUFF MUD	WILLIAMSON	0	101	197	285	367	382
FLAT WSC	CORYELL	0	9	20	32	36	40
FORT GATES WSC	CORYELL	0	33	73	93	101	110
FORT HOOD	BELL	0	293	582	885	1,094	1,094
FORT HOOD	CORYELL	0	239	472	718	887	886
FORT WORTH	JOHNSON	0	0	0	0	267	333
GATESVILLE	CORYELL	0	384	852	1,386	1,988	2,392
GEORGETOWN	BELL	0	65	146	240	296	325
GEORGETOWN	WILLIAMSON	0	2,884	7,106	12,854	20,175	28,862
GEORGETOWN	BURNET	0	8	18	31	39	41
GIDDINGS	LEE	0	95	199	237	238	240
GLEN ROSE	SOMERVELL	0	52	108	169	179	184
GORDON	ERATH	0	0	1	2	2	2
GORDON	PALO PINTO	0	12	24	36	42	43
GRAHAM	YOUNG	0	231	463	708	962	1,210
HAMILTON	HAMILTON	0	30	19	12	11	11
HAMLIN	JONES	0	30	55	57	57	58
HARKER HEIGHTS	BELL	0	559	1,274	1,498	1,656	1,819
HEARNE	ROBERTSON	0	43	22	19	17	17
HEWITT	MCLENNAN	0	247	236	227	240	258
HIGHLAND PARK WSC	BOSQUE	0	11	22	33	43	53
HIGHLAND PARK WSC	MCLENNAN	0	5	9	14	18	22
HILLSBORO	HILL	0	157	320	493	516	523
JAYTON	KENT	0	8	5	4	4	4
JONAH WATER SUD	WILLIAMSON	0	84	32	0	0	0
KEMPNER WSC	BELL	0	29	30	29	30	32
KEMPNER WSC	CORYELL	0	53	54	53	55	59
KEMPNER WSC	LAMPASAS	0	140	139	135	140	145
KEMPNER WSC	BURNET	0	12	11	11	12	12
KNOX CITY	KNOX	0	17	36	52	53	54

Table 2.1-4 (Continued)

County Name	Water User Group	Additional Water Saved-W/Conservation (acft)*					
		2020	2030	2040	2050	2060	2070
LAWN	TAYLOR	0	10	20	23	23	23
LEXINGTON	LEE	0	20	23	21	21	21
LITTLE ELM VALLEY WSC	BELL	0	24	36	37	40	44
LITTLE ELM VALLEY WSC	FALLS	0	1	2	2	2	2
LORENA	MCLENNAN	0	3	0	0	0	0
MANSFIELD	JOHNSON	0	87	223	407	641	922
MANVILLE WSC	WILLIAMSON	0	172	293	335	396	474
MARLIN	FALLS	0	151	296	432	583	730
MINERAL WELLS	PALO PINTO	0	30	0	0	0	0
MINERAL WELLS	PARKER	0	4	0	0	0	0
MOUNTAIN PEAK SUD	JOHNSON	0	113	264	451	677	936
MOUNTAIN PEAK SUD	ELLIS	0	314	766	1,444	2,293	3,360
MUNDAY	KNOX	0	17	35	36	35	36
MUSTANG VALLEY WSC	BOSQUE	0	38	79	120	137	138
MUSTANG VALLEY WSC	CORYELL	0	0	2	2	2	2
NAVASOTA	GRIMES	0	110	219	236	238	242
NORTH BOSQUE WSC	MCLENNAN	0	57	131	219	319	413
NORTH MILAM WSC	FALLS	0	0	0	0	0	1
NORTH MILAM WSC	MILAM	0	18	19	18	18	18
PFLUGERVILLE	WILLIAMSON	0	6	16	21	24	29
PFLUGERVILLE	TRAVIS	0	596	672	774	870	969
POSSUM KINGDOM WSC	PALO PINTO	0	77	155	233	311	383
POSSUM KINGDOM WSC	STEPHENS	0	3	6	9	12	14
PRAIRIE HILL WSC	LIMESTONE	0	3	1	0	0	0
PRAIRIE HILL WSC	MCLENNAN	0	3	0	0	0	0
RANGER	EASTLAND	0	33	40	38	37	37
RED RIVER AUTHORITY OF TEXAS	KNOX	0	3	5	7	9	10
ROBINSON	MCLENNAN	0	220	504	557	612	672
ROBY	FISHER	0	9	15	13	13	13
ROCKDALE	MILAM	0	89	180	198	202	209
ROUND ROCK	WILLIAMSON	0	1,934	4,192	5,026	4,972	4,951
ROUND ROCK	TRAVIS	0	1	0	0	0	0
SALADO WSC	BELL	0	178	379	597	831	1,074
SNOOK	BURLESON	0	25	50	78	104	129
SOMERVILLE	BURLESON	0	20	25	27	29	31
SOUTHWEST MILAM WSC	WILLIAMSON	0	25	54	61	73	85
SPORTSMANS WORLD MUD	PALO PINTO	0	13	24	36	48	59
STAMFORD	HASKELL	0	0	1	1	3	3
STAMFORD	JONES	0	68	136	212	285	342
STRAWN	PALO PINTO	0	11	23	22	23	24

Table 2.1-4 (Concluded)

County Name	Water User Group	Additional Water Saved-W/Conservation (acft)*					
		2020	2030	2040	2050	2060	2070
TAYLOR	WILLIAMSON	0	215	466	490	530	578
TDCJ LUTHER UNITS	GRIMES	0	25	54	61	64	66
TDCJ W PACK UNIT	GRIMES	0	36	75	116	159	166
TEMPLE	BELL	0	1,868	4,232	7,057	10,263	12,469
TEXAS A&M UNIVERSITY	BRAZOS	0	560	1,072	1,557	2,006	2,415
TEXAS STATE TECHNICAL COLLEGE	MCLENNAN	0	88	180	274	370	466
THROCKMORTON	THROCKMORTON	0	14	26	40	44	44
TWIN CREEK WSC	ROBERTSON	0	21	23	23	23	25
VALLEY MILLS	BOSQUE	0	21	43	46	46	47
VALLEY MILLS	MCLENNAN	0	1	1	2	1	2
VENUS	JOHNSON	0	59	115	126	139	156
VENUS	ELLIS	0	2	3	4	5	6
WACO	MCLENNAN	0	2,583	5,360	8,389	11,642	12,436
WALSH RANCH MUD	WILLIAMSON	0	16	32	48	61	74
WELLBORN SUD	BRAZOS	0	355	501	533	591	655
WELLBORN SUD	ROBERTSON	0	69	90	89	92	95
WEST	MCLENNAN	0	21	12	6	5	5
WHITNEY	HILL	0	38	76	74	75	77
WILLIAMSON COUNTY MUD 10	WILLIAMSON	0	65	126	182	233	261
WILLIAMSON COUNTY MUD 11	WILLIAMSON	0	73	142	206	264	266
WILLIAMSON COUNTY MUD 9	WILLIAMSON	0	45	90	131	169	170
WINDSOR WATER	MCLENNAN	0	2	0	0	0	0
WOODWAY	MCLENNAN	0	308	635	988	1,357	1,730
	Total Region G:	**0**	**24,971**	**47,829**	**68,967**	**92,264**	**111,339**

* Note: This conservation is in addition to savings attributed to the 1991 Water Efficient Plumbing Fixtures Act.

2.1.4 Environmental Issues

No substantial environmental impacts are anticipated, as water conservation is typically a non-capital intensive alternative that is not associated with direct physical impacts to the natural environment. A summary of the few potential environmental issues that might arise for this alternative are presented in Table 2.1-5.

Table 2.1-5. Environmental Issues: Municipal Water Conservation

Issue	Description
Implementation Measures	Voluntary reduction, reduced diversions, changing water pricing, mandatory restrictions (landscaping ordinances, watering days), reducing unaccounted for water
Environmental Water Needs / Instream Flows	No substantial impact identified, assuming relatively low reduction in diversions and return flows; substantial reductions in municipal and industrial diversions from water conservation would potentially result in low to moderate positive impacts as more stream flow would be available for environmental water needs and instream flows
Bays and Estuaries	No substantial impact identified, assuming relatively low reduction in diversions and return flows
Fish and Wildlife Habitat	No substantial impact identified, assuming relatively low reductions in diversions and return flows; potential low to moderate positive impact to aquatic and riparian habitats with substantial reductions as more stream flow would be available to these habitats; potential moderate positive benefits from implementation of site-specific xeriscape landscaping
Cultural Resources	No substantial impacts anticipated.
Threatened and Endangered Species	No substantial impact identified, assuming relatively low reduction in diversions and return flows; potential low to moderate positive impact to aquatic and riparian threatened and endangered species (where they occur) with substantial diversion reductions
Comments	Assumes no substantial change in infrastructure with attendant landscape impacts; further assumes that infrastructure improvements which do occur will largely be in urbanized settings

2.1.5 Engineering and Costing

The TWDB requires that costs and water supply estimates be developed for each recommended water management strategy. For the BMPs listed above in Section 2.1.2, water savings (yield) and costs to implement these strategies reported in TWDB guidance documents are summarized in Table 2.1-5. Costs and savings presented are general and often sparse, based on a range of variables affecting implementation and level of success.

Table 2.1-6. Costs and Savings of Municipal Water Conservation Techniques (BMPs)

Best Management Practices	Water Savings Estimates				Cost Estimates				Assumptions/Notes
	Min	Max	Avg	Savings Metric	Min	Max	Avg	Cost Metric	
Water Conservation Pricing/Seasonal or Inverted Block Rates	1	3	2	%	-	-	10	%	Average reduction in water use of 1 to 3% for every 10% increase in the average monthly water bill
Metering of All New Connections and Retrofit of Existing Connections	-	-	-	-	-	-	-	-	
System Water Audit and Water Loss Control	-	-	-	-	-	-	-	-	
Landscape Irrigation Conservation and Incentives	-	-	15	%	-	-	-	-	
Athletic Field Conservation	-	-	-	-	-	-	-	-	
Golf Course Conservation	15	100	58	%	-	-	-	-	Savings and costs highly variable based measures taken - from implementing a CCIS to switching from potable to non-potable
School Education	-	-	-	-	1	35	18	per student	
Public Information	-	-	-	-	1	3	2	per customer	
Water Reuse	-	100	-	%	-	-	-	-	
Prohibitions on Wasting Water	-	-	-	-	-	-	-	-	
Residential Toilet Replacement Programs	-	-	11	gpcd	70	100	85	per toilet	
Showerhead, Aerator, and Toilet Flapper Retrofit	6	13	9	gpd per device	10	50	30	per customer	5.5 gpd of permanent savings for showerheads and faucet aerators; 12.8 gpd for toilet flapper for 5 years (device life span)
Water Wise Landscape Design and Conversion Programs	-	-	-	-	0	1	1	per sq ft	Costs reflect customer rebates - does not include staff labor cost, which ranges between $50 to $100 per conversion
Custom Conservation Rebates	-	-	-	-	-	-	-	-	
Plumbing Assistance for Economically Disadvantaged Customers	300	262,080	131,190	gal/yr	-	-	-	-	
Rainwater Harvesting and Condensate Reuse	-	-	-	-	-	-	-	-	
Source TWDB: https://www.twdb.texas.gov/conservation/BMPs/Mun/index.asp									

Municipal water conservation costs for this strategy were based on the TWDB Municipal Water Conservation Planning Tool developed to assist individual water utilities with planning conservation programs. The tool allows the user to include a mix of BMPs, and produces the expected annual conservation savings and associated capital and annual costs. The tool comes with population and water demand projections (and other data such as number of connections) for municipal water user groups. The tool includes user-based functionality to load baseline demand projections, select conservation measures (plan or single-year savings) based on implementation activity, manage scenarios (to evaluate various BMP combinations) and use this information to calculate water savings and costs. The tool includes the following pre-defined BMPs:

- High Efficiency (HE) Toilet Rebate
- Bathroom Retrofit
- Showerhead and Aerator Kit
- Clothes Washer Rebate

- Home Water Reports
- Irrigation Audits- High Users
- High Efficiency Sprinkler Nozzle Rebate
- Smart Irrigation Controller Rebate
- WaterWise Landscape Rebate
- Rainwater Harvesting Rebate, and
- Rain Barrel

The costs to implement these BMPs ranges from $271 to $1,358 per acft saved, with the showerhead kit being the most economical ($271 per acft saved) and clothes washer rebates and rain barrels being the most expensive at $1,358 and $1,265 per acft, respectively. Since the TWDB tool only included 75 of the 246 Brazos G individual discrete municipal water user groups, three Brazos G water user groups were selected to represent a range of Small, Medium and Large utilities for costing purposes.

The City of Hico records in the TWDB tool were considered representative of "Small" Brazos G municipal water users; the City of Taylor was considered representative of "Medium" Brazos G municipal water users; and the City of Waco was considered representative of "Large." Although the TWDB tool does not present costs for the most common water conservation BMPs from local water conservation plans in the Brazos G Area, the following BMPs from the TWDB tool were selected to estimate a unit cost for municipal water conservation: HE Toilet Rebate, Bathroom Retrofit, Showerhead and Aerator Kit, Home Water Reports, and WaterWise Landscape Rebate. The costs to implement these BMPs was $560 per acft water saved and did not vary much amongst small, medium, and large users.

The total program costs for municipal entities having per capita use greater than 140 gpcd (and greater than 120 gpcd for Williamson County) are presented in Table 2.1-7. Total conservation potential costs for Brazos G are estimated at $26,783,993 in 2040 and increasing to $62,350,091 by 2070. The CBRWPG has expressed a desire to offer BMPs to encourage conservation while maintaining flexibility for municipal users to adopt strategies that suit them the best.

These annual costs have been capitalized over a 20 year period at 3.5% interest rate by assuming that 70% of the annual costs for a municipal water conservation program are associated with repayment of debt issued to fund the initial capital expenditures. Capital costs are also shown in Table 2.1-7.

Table 2.1-7. Estimated Cost of Conservation to Achieve Water Savings Identified in Table 2.1-4

County Name	Water User Group	Costs of Water Savings (at $560 per acft saved)						Capital Costs ($)
		2020	2030	2040	2050	2060	2070	
ABILENE	JONES	0	$39,346	$53,106	$48,235	$48,326	$49,197	$528,000
ABILENE	TAYLOR	0	$870,006	$1,177,301	$1,072,304	$1,068,831	$1,083,692	$11,713,000
ALBANY	SHACKELFORD	0	$28,174	$54,976	$81,965	$107,034	$130,213	$1,295,000
AQUA WSC	LEE	0	$5,983	$2,244	$225	$0	$0	$60,000
ARMSTRONG WSC	BELL	0	$19,738	$20,989	$18,589	$19,339	$20,178	$209,000
ASPERMONT	STONEWALL	0	$10,820	$20,664	$31,593	$40,917	$49,856	$496,000
BARTLETT	BELL	0	$7,310	$16,179	$17,094	$18,920	$20,834	$207,000
BARTLETT	WILLIAMSON	0	$8,224	$18,155	$29,057	$36,589	$39,358	$392,000
BAYLOR SUD	THROCKMORTON	0	$161	$306	$363	$275	$275	$4,000
BAYLOR SUD	YOUNG	0	$3,191	$5,771	$8,641	$10,132	$9,956	$101,000
BAYLOR SUD	ARCHER	0	$1,547	$3,166	$4,361	$4,605	$4,517	$46,000
BAYLOR SUD	BAYLOR	0	$8,089	$15,983	$24,855	$27,704	$27,825	$277,000
BELL COUNTY WCID 3	BELL	0	$12,044	$0	$0	$0	$0	$120,000
BELL MILAM FALLS WSC	WILLIAMSON	0	$2,326	$2,150	$1,978	$2,508	$2,661	$26,000
BELTON	BELL	0	$180,728	$180,662	$182,018	$197,153	$215,317	$2,142,000
BETHESDA WSC	JOHNSON	0	$183,304	$411,557	$666,452	$745,285	$832,721	$8,284,000
BETHESDA WSC	TARRANT	0	$103,985	$228,622	$357,846	$386,227	$415,772	$4,136,000
BISTONE MUNICIPAL WSD	LIMESTONE	0	$11,116	$22,676	$34,952	$46,741	$58,043	$577,000
BRECKENRIDGE	STEPHENS	0	$28,388	$16,070	$9,154	$8,221	$8,113	$282,000
BREMOND	ROBERTSON	0	$7,514	$11,700	$12,021	$12,605	$13,365	$133,000
BRENHAM	WASHINGTON	0	$205,297	$422,922	$654,982	$891,575	$922,943	$9,182,000
BRUCEVILLE EDDY	FALLS	0	$8,330	$17,176	$16,377	$17,258	$18,226	$181,000
BRUCEVILLE EDDY	MCLENNAN	0	$35,951	$55,151	$54,005	$55,747	$58,576	$583,000
BRUSHY CREEK MUD	WILLIAMSON	0	$130,416	$147,459	$136,259	$133,459	$132,899	$1,467,000
BRYAN	BRAZOS	0	$733,963	$899,502	$962,914	$1,113,524	$1,393,972	$13,868,000
CALDWELL	BURLESON	0	$46,529	$93,416	$133,824	$135,682	$137,650	$1,369,000
CAMERON	MILAM	0	$60,061	$122,024	$190,045	$251,609	$260,663	$2,593,000
CEDAR PARK	WILLIAMSON	0	$936,185	$1,790,141	$2,590,558	$3,322,193	$3,500,159	$34,822,000
CEDAR PARK	TRAVIS	0	$120,642	$247,301	$328,415	$326,735	$326,175	$3,267,000
CEGO-DURANGO WSC	FALLS	0	$3,496	$1,410	$894	$795	$610	$35,000
CENTRAL TEXAS COLLEGE DISTRICT	BELL	0	$485	$0	$0	$0	$0	$5,000
CENTRAL TEXAS COLLEGE DISTRICT	CORYELL	0	$3,168	$2,048	$1,488	$1,488	$1,488	$32,000

Table 2.1-7 (Continued)

County Name	Water User Group	Costs of Water Savings (at $560 per acft saved)						Capital Costs ($)
		2020	2030	2040	2050	2060	2070	
CHISHOLM TRAIL SUD	BURNET	0	$4,011	$7,479	$8,019	$8,701	$9,438	$94,000
CISCO	EASTLAND	0	$29,356	$29,231	$24,576	$23,456	$23,456	$292,000
CLEBURNE	JOHNSON	0	$314,170	$527,611	$569,977	$655,741	$729,070	$7,253,000
CLIFTON	BOSQUE	0	$29,445	$42,731	$39,912	$39,749	$39,805	$425,000
COLLEGE STATION	BRAZOS	0	$131,155	$0	$0	$0	$0	$1,305,000
COOLIDGE	LIMESTONE	0	$2,455	$272	$0	$0	$0	$24,000
CORYELL CITY WATER SUPPLY DISTRICT	CORYELL	0	$9,423	$3,742	$156	$0	$0	$94,000
CORYELL CITY WATER SUPPLY DISTRICT	MCLENNAN	0	$1,405	$838	$182	$0	$0	$14,000
COUNTY-OTHER, BELL	BELL	0	$9,569	$7,643	$7,957	$16,658	$24,191	$241,000
COUNTY-OTHER, WILLIAMSON	WILLIAMSON	0	$161,462	$530,658	$778,376	$1,636,995	$2,397,334	$23,850,000
CRAWFORD	MCLENNAN	0	$6,128	$11,921	$15,665	$15,347	$15,589	$156,000
CROSS COUNTRY WSC	BOSQUE	0	$3,149	$1,755	$1,416	$1,306	$1,164	$31,000
CROSS COUNTRY WSC	MCLENNAN	0	$9,899	$6,057	$3,806	$3,148	$3,226	$98,000
CROSS PLAINS	CALLAHAN	0	$5,387	$3,291	$2,391	$2,666	$2,260	$54,000
DOUBLE DIAMOND UTILITIES	HILL	0	$19,708	$39,718	$60,506	$77,616	$80,616	$802,000
DOUBLE DIAMOND UTILITIES	JOHNSON	0	$1,478	$2,364	$3,871	$5,153	$8,933	$89,000
EAST CRAWFORD WSC	MCLENNAN	0	$16,656	$34,035	$52,745	$72,264	$92,035	$916,000
FERN BLUFF MUD	WILLIAMSON	0	$56,839	$110,401	$159,586	$205,481	$214,100	$2,130,000
FLAT WSC	CORYELL	0	$5,242	$11,055	$18,000	$20,155	$22,199	$221,000
FORT GATES WSC	CORYELL	0	$18,271	$40,971	$52,298	$56,675	$61,787	$615,000
FORT HOOD	BELL	0	$163,877	$325,749	$495,520	$612,547	$612,547	$6,094,000
FORT HOOD	CORYELL	0	$133,589	$264,203	$401,812	$496,901	$496,341	$4,944,000
FORT WORTH	JOHNSON	0	$0	$0	$0	$149,240	$186,204	$1,852,000
GATESVILLE	CORYELL	0	$215,242	$477,374	$776,034	$1,113,137	$1,339,592	$13,327,000
GEORGETOWN	BELL	0	$36,288	$81,875	$134,651	$165,991	$182,276	$1,813,000
GEORGETOWN	WILLIAMSON	0	$1,615,098	$3,979,465	$7,198,483	$11,298,264	$16,162,702	$160,798,000
GEORGETOWN	BURNET	0	$4,366	$10,341	$17,421	$21,581	$22,878	$228,000
GIDDINGS	LEE	0	$52,980	$111,538	$132,735	$133,385	$134,243	$1,336,000
GLEN ROSE	SOMERVELL	0	$28,898	$60,585	$94,655	$100,198	$103,132	$1,026,000
GORDON	ERATH	0	$146	$300	$1,113	$1,231	$1,143	$12,000
GORDON	PALO PINTO	0	$6,625	$13,389	$20,366	$23,571	$24,143	$240,000
GRAHAM	YOUNG	0	$129,298	$259,305	$396,735	$538,634	$677,710	$6,742,000
HAMILTON	HAMILTON	0	$16,895	$10,735	$6,815	$6,255	$6,255	$168,000
HAMLIN	JONES	0	$16,824	$31,024	$31,750	$31,730	$32,500	$323,000
HARKER HEIGHTS	BELL	0	$313,002	$713,241	$839,130	$927,292	$1,018,527	$10,133,000
HEARNE	ROBERTSON	0	$23,914	$12,577	$10,897	$9,777	$9,777	$238,000
HEWITT	MCLENNAN	0	$138,568	$131,977	$126,958	$134,402	$144,415	$1,437,000
HIGHLAND PARK WSC	BOSQUE	0	$6,030	$12,189	$18,329	$24,048	$29,811	$297,000
HIGHLAND PARK WSC	MCLENNAN	0	$2,522	$5,022	$7,734	$10,024	$12,200	$121,000
HILLSBORO	HILL	0	$87,718	$179,420	$276,289	$289,015	$292,621	$2,911,000
JAYTON	KENT	0	$4,507	$2,827	$2,267	$2,267	$2,267	$45,000

Table 2.1-7 (Continued)

County Name	Water User Group	Costs of Water Savings (at $560 per acft saved)						Capital Costs ($)
		2020	2030	2040	2050	2060	2070	
JONAH WATER SUD	WILLIAMSON	0	$46,891	$17,698	$103	$0	$0	$467,000
KEMPNER WSC	BELL	0	$16,077	$16,648	$16,126	$17,043	$17,893	$178,000
KEMPNER WSC	CORYELL	0	$29,844	$29,982	$29,859	$30,845	$33,203	$330,000
KEMPNER WSC	LAMPASAS	0	$78,583	$77,891	$75,747	$78,234	$81,357	$809,000
KEMPNER WSC	BURNET	0	$6,717	$6,193	$6,272	$6,702	$6,924	$69,000
KNOX CITY	KNOX	0	$9,452	$20,248	$29,369	$29,590	$30,073	$299,000
LAWN	TAYLOR	0	$5,619	$10,944	$13,018	$12,908	$13,062	$130,000
LEXINGTON	LEE	0	$11,025	$12,601	$11,591	$11,812	$11,790	$125,000
LITTLE ELM VALLEY WSC	BELL	0	$13,360	$20,033	$20,874	$22,626	$24,818	$247,000
LITTLE ELM VALLEY WSC	FALLS	0	$779	$947	$925	$1,376	$1,354	$14,000
LORENA	MCLENNAN	0	$1,777	$0	$0	$0	$0	$18,000
MANSFIELD	JOHNSON	0	$48,803	$124,900	$228,097	$359,186	$516,488	$5,138,000
MANVILLE WSC	WILLIAMSON	0	$96,465	$163,839	$187,595	$222,015	$265,185	$2,638,000
MARLIN	FALLS	0	$84,617	$165,517	$242,036	$326,406	$408,716	$4,066,000
MINERAL WELLS	PALO PINTO	0	$16,524	$0	$0	$0	$0	$164,000
MINERAL WELLS	PARKER	0	$2,312	$0	$0	$0	$0	$23,000
MOUNTAIN PEAK SUD	JOHNSON	0	$63,384	$147,940	$252,788	$379,196	$523,975	$5,213,000
MOUNTAIN PEAK SUD	ELLIS	0	$175,743	$428,846	$808,563	$1,284,026	$1,881,736	$18,721,000
MUNDAY	KNOX	0	$9,453	$19,535	$19,997	$19,866	$20,174	$201,000
MUSTANG VALLEY WSC	BOSQUE	0	$21,546	$44,397	$67,126	$76,692	$77,296	$769,000
MUSTANG VALLEY WSC	CORYELL	0	$104	$877	$991	$1,022	$1,022	$10,000
NAVASOTA	GRIMES	0	$61,652	$122,747	$132,201	$133,182	$135,447	$1,348,000
NORTH BOSQUE WSC	MCLENNAN	0	$31,966	$73,373	$122,562	$178,740	$231,191	$2,300,000
NORTH MILAM WSC	FALLS	0	$161	$11	$0	$0	$396	$4,000
NORTH MILAM WSC	MILAM	0	$10,300	$10,897	$9,822	$9,802	$10,133	$108,000
PFLUGERVILLE	WILLIAMSON	0	$3,638	$8,994	$11,549	$13,514	$16,148	$161,000
PFLUGERVILLE	TRAVIS	0	$333,636	$376,543	$433,313	$487,184	$542,393	$5,396,000
POSSUM KINGDOM WSC	PALO PINTO	0	$42,956	$86,850	$130,719	$174,065	$214,628	$2,135,000
POSSUM KINGDOM WSC	STEPHENS	0	$1,735	$3,248	$5,196	$6,627	$7,777	$77,000
PRAIRIE HILL WSC	LIMESTONE	0	$1,899	$484	$0	$0	$0	$19,000
PRAIRIE HILL WSC	MCLENNAN	0	$1,542	$148	$0	$0	$0	$15,000
RANGER	EASTLAND	0	$18,667	$22,531	$21,411	$20,851	$20,851	$224,000
RED RIVER AUTHORITY OF TEXAS	KNOX	0	$1,524	$2,873	$3,903	$5,136	$5,471	$54,000
ROBINSON	MCLENNAN	0	$123,429	$282,196	$311,757	$342,962	$376,263	$3,743,000
ROBY	FISHER	0	$4,960	$8,152	$7,032	$7,032	$7,032	$81,000
ROCKDALE	MILAM	0	$49,787	$100,957	$110,661	$113,303	$116,966	$1,164,000
ROUND ROCK	WILLIAMSON	0	$1,082,969	$2,347,691	$2,814,744	$2,784,504	$2,772,744	$28,003,000
ROUND ROCK	TRAVIS	0	$498	$0	$0	$0	$0	$5,000
SALADO WSC	BELL	0	$99,912	$212,065	$334,183	$465,532	$601,676	$5,986,000
SNOOK	BURLESON	0	$13,981	$27,916	$43,409	$58,377	$72,274	$719,000

Table 2.1-7 (Concluded)

County Name	Water User Group	Costs of Water Savings (at $560 per acft saved)						Capital Costs ($)
		2020	2030	2040	2050	2060	2070	
SOMERVILLE	BURLESON	0	$11,161	$14,110	$15,223	$16,194	$17,144	$171,000
SOUTHWEST MILAM WSC	WILLIAMSON	0	$14,082	$30,407	$34,396	$40,872	$47,447	$472,000
SPORTSMANS WORLD MUD	PALO PINTO	0	$7,052	$13,466	$20,356	$26,766	$32,921	$328,000
STAMFORD	HASKELL	0	$0	$358	$752	$1,569	$1,811	$18,000
STAMFORD	JONES	0	$37,927	$76,360	$118,609	$159,454	$191,702	$1,907,000
STRAWN	PALO PINTO	0	$6,320	$12,832	$12,407	$12,836	$13,319	$133,000
TAYLOR	WILLIAMSON	0	$120,291	$260,891	$274,387	$296,974	$323,771	$3,221,000
TDCJ LUTHER UNITS	GRIMES	0	$14,228	$30,196	$34,171	$35,611	$37,074	$369,000
TDCJ W PACK UNIT	GRIMES	0	$20,347	$41,986	$65,163	$88,817	$92,773	$923,000
TEMPLE	BELL	0	$1,045,905	$2,369,770	$3,951,925	$5,747,423	$6,982,884	$69,470,000
TEXAS A&M UNIVERSITY	BRAZOS	0	$313,383	$600,421	$871,819	$1,123,129	$1,352,435	$13,455,000
TEXAS STATE TECHNICAL COLLEGE	MCLENNAN	0	$49,556	$100,841	$153,629	$207,027	$261,221	$2,599,000
THROCKMORTON	THROCKMORTON	0	$7,666	$14,385	$22,487	$24,825	$24,825	$247,000
TWIN CREEK WSC	ROBERTSON	0	$11,642	$13,153	$13,003	$12,995	$13,811	$137,000
VALLEY MILLS	BOSQUE	0	$12,039	$24,266	$25,721	$25,766	$26,041	$259,000
VALLEY MILLS	MCLENNAN	0	$453	$792	$1,033	$803	$1,133	$11,000
VENUS	JOHNSON	0	$32,985	$64,175	$70,360	$78,105	$87,586	$871,000
VENUS	ELLIS	0	$1,074	$1,639	$2,310	$2,981	$3,596	$36,000
WACO	MCLENNAN	0	$1,446,640	$3,001,593	$4,697,693	$6,519,450	$6,964,137	$69,284,000
WALSH RANCH MUD	WILLIAMSON	0	$8,976	$18,052	$26,768	$34,090	$41,218	$410,000
WELLBORN SUD	BRAZOS	0	$198,990	$280,826	$298,660	$330,988	$366,986	$3,651,000
WELLBORN SUD	ROBERTSON	0	$38,596	$50,305	$49,697	$51,394	$53,454	$532,000
WEST	MCLENNAN	0	$11,651	$6,635	$3,212	$2,676	$2,788	$116,000
WHITNEY	HILL	0	$21,109	$42,318	$41,530	$41,905	$43,126	$429,000
WILLIAMSON COUNTY MUD 10	WILLIAMSON	0	$36,128	$70,774	$102,053	$130,288	$145,999	$1,452,000
WILLIAMSON COUNTY MUD 11	WILLIAMSON	0	$40,648	$79,533	$115,348	$147,872	$148,771	$1,480,000
WILLIAMSON COUNTY MUD 9	WILLIAMSON	0	$25,423	$50,281	$73,161	$94,866	$95,115	$946,000
WINDSOR WATER	MCLENNAN	0	$1,268	$0	$0	$0	$0	$13,000
WOODWAY	MCLENNAN	0	$172,428	$355,402	$553,058	$759,670	$968,857	$9,639,000
	Total Brazos G:	**0**	**$13,980,366**	**$26,778,221**	**$38,613,067**	**$51,657,779**	**$62,340,135**	**$624,971,000**

2.1.6 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 2.1-8, and the option meets each criterion.

Table 2.1-8. Comparison of Municipal Water Conservation Option to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Variable, dependent on current per capita rate
2. Reliability	2. Variable, dependent on public acceptance
3. Cost	3. Reasonable
B. Environmental factors	
1. Environmental Water Needs	1. None or low impact
2. Habitat	2. No apparent negative impact
3. Cultural Resources	3. None
4. Bays and Estuaries	4. None or low impact
5. Threatened and Endangered Species	5. None or low impact
6. Wetlands	6. None or low impact
C. Impact on Other State Water Resources	• No apparent negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	• None
E. Equitable Comparison of Strategies Deemed Feasible	• Option is considered to meet municipal shortages
F. Requirements for Interbasin Transfers	• Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	• Not applicable

2.1.7 Water Loss Reduction

The TWDB provided results of their 2010 Water Loss Audit on December 5, 2011 for regional water planning groups to consider when developing the regional water plans (Texas Administrative Code §357.34 (f)(2)D). Furthermore, water management strategy evaluations for the 2021 Brazos G Plan are to take into account anticipated water losses associated with each strategy when calculating the quantify of water delivered and treated, according to TWDB guidelines (Texas Administrative Code §357.34 (d)(3)A). The reported water losses include both real and apparent losses. Real Loss is water lost through distribution system leakage and line breaks; Apparent Loss includes water that was not read accurately by a meter, unauthorized consumption, including water taken by theft, and data analysis errors. The best opportunity for water savings for Brazos G entities is by implementing water management strategies to reduce Real Loss.

Municipal water entities seeking infrastructure replacement programs to reduce water loss may be eligible for state supported programs, including State Water Implementation Fund for Texas (SWIFT), which has been allocated $2 billion to make financing of water projects more affordable and provide consistent state financial assistance for development of water supply projects identified in the State Water Plan.

The Brazos G RWPG considered TWDB-provided water loss information for Brazos G entities and water conservation BMP for pipeline replacement for municipal entities that report real losses greater than 15% of water system input volume. In the 2016 Brazos G Regional Water Plan, water loss reduction for municipal water user groups that prorated real losses greater than 15% of water system input volume through a pipeline replacement program was evaluated and costs were calculated. The total annual cost of pipeline replacement varied from $18,480 to $128 million, with annual unit costs ranging from $12,710 to $1.8 million per acft of water saved. Based on results from the 2016 Brazos G Plan, pipeline replacement was deemed too costly to implement and therefore is not considered in the 2021 Brazos G Plan.

2.2 Irrigation Water Conservation

2.2.1 Description of Strategy

Irrigation water use is the use of freshwater that is pumped from aquifers and/or diverted from streams and reservoirs of the planning area and applied directly to grow crops, orchards, and hay and pasture in the study area. Irrigation water is typically applied to land by: (1) flowing or flooding water down furrows; and (2) the use of sprinklers. When groundwater is used, irrigation wells are usually located within the fields to be irrigated. For surface water supplies, typically water is diverted from the source and conveyed by canals and pipelines to the fields. For both groundwater and surface water, the conservation objective is to reduce the quantity of water that is lost to deep percolation and evaporation between the originating points (wells in the case of groundwater, and stream diversion points in the case of surface water), and the irrigated crops in the fields. Thus, the focus is upon investments in irrigation application equipment, instruments, and conveyance facility improvements (canal lining and pipelines) to reduce seepage losses, deep percolation, and evaporation of water, and management of the irrigation processes to improve efficiencies of irrigation water use and reduce the quantities of water needed to accomplish irrigation.

2.2.2 Available Yield

All irrigators in the Brazos G Region are encouraged to conserve water.

The Brazos G RWPG recommends conservation for irrigation WUGs with projected irrigation water needs during the planning period from 2020 to 2070. A voluntary target is recommended for these irrigation entities with needs to reduce water demands by 3% by 2020, 5% by 2030, and 7% from 2040-2070. In the Brazos G Area, twenty counties are projected to have irrigation needs (shortages) during the 2020 to 2070 planning period.

This conservation can be achieved in a variety of ways, including using BMPs identified by the TWDB[9], such as:

1. Irrigation Scheduling;
2. Volumetric Measurement of Irrigation Water Use;
3. Crop Residue Management and Conservation Tillage;
4. On-farm Irrigation audit;
5. Furrow Dikes;
6. Land Leveling;
7. Contour Farming;
8. Conservation of Supplemental Irrigated Farmland to Dry-Land Farmland;
9. Brush Control/Management;
10. Lining of On-Farm Irrigation ditches;
11. Replacement of On-/farm Irrigation Ditches with Pipelines;
12. Low Pressure Center Pivot Sprinkler Irrigation Systems;
13. Drip/Micro-Irrigation System;
14. Gated and Flexible Pipe for Field Water Distribution Systems;
15. Surge Flow Irrigation for Field Water Distribution Systems;
16. Linear Move Sprinkler Irrigation Systems;

[9] TWDB website: https://www.twdb.texas.gov/conservation/BMPs/Ag/index.asp

17. Lining of District Irrigation Canals;
18. Replacement of District Irrigation canals and Lateral canals with Pipelines;
19. Tailwater Recovery and Use System; and
20. Nursery Production Systems.

For the BMPs listed above, water savings (yield) and costs to implement these strategies reported in TWDB guidance documents are summarized in Table 2.2-1. The TWDB describes how the BMPs reduce irrigation water use, however information regarding specific water savings and costs to install irrigation water saving systems is generally unavailable.

The Brazos G RWPG does not recommend specific conservation BMPs for irrigation entities, as each entity should choose those conservation strategies that best fit their individual situation.

Water savings and costs for three irrigation water conservation BMPs are presented: 1) furrow dikes; 2) low-pressure sprinklers (LESA); and 3) low-energy precision application systems (LEPA). These major irrigation water conservation techniques applicable in the Brazos G are described briefly below and used to estimate costs to implement irrigation water conservation programs to achieve target savings.

Furrow Dikes

Furrow dikes are small mounds of soil mechanically installed a few feet apart in the furrow. These mounds of soil create small reservoirs that capture precipitation and hold it until it soaks into the soil instead of running down the furrow and out the end of the field. This practice can conserve (capture) as much as 100 percent of rainfall runoff, and furrow dikes are used to prevent irrigation runoff under sprinkler systems. This maintains high irrigation uniformity and increases irrigation application efficiencies. Capturing and holding precipitation that would have drained from the fields replaces required irrigation water on irrigated fields; and furrow dikes have been demonstrated to be useful management tools on both irrigated and non-irrigated cropland.

Use of furrow dikes can have water savings up to 12 percent gross quantity of water applied using sprinkler irrigation. Furrow dikes require special equipment and costs $5 to $30 per acre to install.

Table 2.2-1. Cost and Savings of Possible Irrigation Water Conservation Techniques (BMPs)

Best Management Practices	Water Savings Estimates				Cost Estimates				Assumptions/Notes
	Min	Max	Avg	Savings Metric	Min	Max	Avg	Cost Metric	
Irrigation Scheduling	0.3	0.5	0.4	acft/ac/yr	-	-	-	-	Verification of estimated savings attempted by Pacific NW Lab (1994), results inconclusive.
Volumetric Measurement of Irrigation Water Use	0.0	0.0	0.0	-	-	-	-	-	Helps inform conservation efforts, but does not directly lead to conservation savings. Cost varies.
Crop Residue Management and Conservation Tillage	0.3	1.0	0.6	acft/ac/yr	-	-	-	-	Cost varies, some conservation tillage programs are less expensive than conventional tillage.
On-farm Irrigation audit	-	-	-	-	-	-	-	-	No quantifiable savings or costs. Site and crop use specific.
Furrow Dikes	-	-	0.3	acft/ac/yr	5	30	18	per acre/yr	
Land Leveling	-	-	0.3	acft/ac/yr	150	500	325	per acre	Savings based on leveled rice fields near the Texas Gulf Coast. Costs reflect initial costs (touch-up costs are much less)
Contour Farming	-	-	-	-	5	10	8	per acre	
Conservation of Supplemental Irrigated Farmland to Dry-Land	-	-	-	-	-	-	-	-	
Brush Control/Management	0.3	0.6	0.5	acft/ac/yr	36	203	119	acre/10 yrs	Cost estimates are per a Texas A&M study; county average costs range from $150 to $200
Lining of On-Farm Irrigation ditches	-	-	-	-	3	4	3	per sq ft	Concrete lining saves about 80% (conservative estimate) of original seepage. Cost is for concrete lining.
Replacement of On-/farm Irrigation Ditches with Pipelines	-	-	-	-	-	-	-	-	
Low Pressure Center Pivot Sprinkler Irrigation Systems	0.3	0.7	0.5	acft/yr	300	500	400	per acre	Savings based on fraction. "Min" water savings estimate based on fair conditions.
Drip/Micro-Irrigation System	-	-	-	-	800	1,200	1,000	per acre	Costs reflect installation costs only (no O&M)
Gated and Flexible Pipe for Field Water Distribution Systems	-	-	-	-	20	25	23	per acft/yr	*Assuming that 0.25 acft/ac/yr of water is saved
Surge Flow Irrigation for Field Water Distribution Systems	0.1	0.4	0.3	acft/yr	20	25	23	per acft/yr	Savings based on a percentage. Cost estimates assume that 0.25 acft/ac/yr of water is saved by using a surge valve
Linear Move Sprinkler Irrigation Systems	0.3	0.7	0.5	acft/yr	300	700	500	per acre	Savings based on fraction. "Min" water savings estimate based on fair conditions.
Lining of District Irrigation Canals	-	-	-	-	3	4	3	per sq ft	Cost of concrete lining
Replacement of District Irrigation canals and Lateral canals with Pipelines	-	-	-	-	-	-	-	-	
Tailwater Recovery and Use System	0.5	1.5	1.0	acft/ac/yr	-	-	-	-	Cost Varies widely
Nursery Production Systems	-	-	-	-	-	-	-	-	

Source: TWDB Best Management Practices for Agricultural Water Users. https://www.twdb.texas.gov/conservation/BMPs/Ag/index.asp

Low Elevation Spray Application (LESA) and Low Energy Precision Application (LEPA)

Low Elevation Spray Application (LESA) with 75 to 90 percent application efficiency improve irrigation application efficiency in comparison to conventional furrow irrigation by reducing water requirements per acre by 15 percent. Low Energy Precision Application (LEPA) systems involve a sprinkler system that has been modified to discharge water directly into furrows at low pressure, thus reducing evaporation losses. When used in conjunction with furrow dikes, which hold both precipitation and sprinkler applied water behind small mounds of earth within the furrows, LEPA systems can accomplish the irrigation objective with less water than is required for the furrow irrigation and pressurized sprinkler methods.

If LEPA is used with furrow dike systems an expected efficiency of 80 to 95 percent is expected. Use of LEPA and furrow dikes allows irrigation farmers to produce equivalent yields per acre at lower energy and labor costs of irrigation. It has been demonstrated that LEPA systems improve production and profitability of irrigation farming. The barriers to installation are high capital costs; with no assurance (at the present time) that the water saved would be available to the irrigation farmer who incurred the costs.

To determine the potential water savings (acft/acre) and cost per acft saved, a five year average of the irrigated acres and water use from 2013-2017 was calculated for each county based on information provided by the USDA National Agricultural Statistics Service. Based on information shown in Table 2.2-2 for low pressure center pivot sprinkler irrigation systems and linear move sprinkler irrigation systems, an average cost of $450 per acre to implement LESA/LEPA technologies was assumed. As a conservative estimate, the amount of water saved (acft/acre) assumed 80 percent application efficiency achieved by LESA or LEPA as compared to traditional non-BMP system with 60% efficiency. As shown in Table 2.2-2, this conversion to higher efficiency BMP is expected to save between 0.21 to 0.66 acft/acre at a cost of $680 to $2,118 per acft of water saved.

A 15 percent reduction in irrigation water demand by 2070 for irrigation counties with needs results in a water savings of up to 19,138 acft/yr in 2070 for the region as seen in Table 2.2-3.

Table 2.2-2. Costs and Savings by Implementing LESA/LEPA Water Conservation Techniques (BMPs)

Water User Group	Irrigated Acreage (5 yr avg 2013-2017), acres	Irrigation Water Use (5 yr avg 2013-2017), ac-ft	Cost per acre ($)	Water Saved (acft/acre)*	$ per acft
BELL COUNTY-IRRIGATION	2,008	2,732	$450	0.34	$1,323
BOSQUE COUNTY-IRRIGATION	1,406	2,610	$450	0.46	$970
BURLESON COUNTY-IRRIGATION	16,909	19,307	$450	0.29	$1,576
COMANCHE COUNTY-IRRIGATION	20,428	26,607	$450	0.33	$1,382
GRIMES COUNTY-IRRIGATION	358	468	$450	0.33	$1,376
HASKELL COUNTY-IRRIGATION	41,460	46,810	$450	0.28	$1,594
HILL COUNTY-IRRIGATION	548	1,450	$450	0.66	$680
JOHNSON COUNTY-IRRIGATION	398	577	$450	0.36	$1,241
JONES COUNTY-IRRIGATION	1,944	2,484	$450	0.32	$1,409
KNOX COUNTY-IRRIGATION	30,756	33,302	$450	0.27	$1,662
LAMPASAS COUNTY-IRRIGATION	348	488	$450	0.35	$1,285
MILAM COUNTY-IRRIGATION	4,850	5,660	$450	0.29	$1,542
NOLAN COUNTY-IRRIGATION	10,334	12,452	$450	0.30	$1,494
PALO PINTO COUNTY-IRRIGATION	958	1,649	$450	0.43	$1,045
ROBERTSON COUNTY-IRRIGATION	32,424	68,119	$450	0.53	$857
STEPHENS COUNTY-IRRIGATION	110	133	$450	0.30	$1,489
TAYLOR COUNTY-IRRIGATION	1,610	1,506	$450	0.23	$1,924
THROCKMORTON COUNTY-IRRIGATION	60	51	$450	0.21	$2,118
WILLIAMSON COUNTY-IRRIGATION	288	369	$450	0.32	$1,404
YOUNG COUNTY-IRRIGATION	343	641	$450	0.47	$963
Total Region G:	**167,540**	**227,416**			

TWDB BMPs for Ag Water Users. Low Pressure Center Pivot Sprinkler Irrigation Systems ($300-500 per acre) and Linear Move Sprinkler Irrigation Systems ($300-700 per acre). Avg is $400 and $500. Use $450 per acre.
*Assumes application of non-BMP system is 60% efficient. LESA/LEPA system gains 80% efficiency, as a conservative estimate.

Table 2.2-3. Projected Irrigation Water Savings (acft/yr) with Conservation

Water User Group	Projected Water Savings (acft/yr) with Voluntary Reduction in Demand of 3% by 2020; 5% by 2030; and 7% 2040-2070					
	2020	2030	2040	2050	2060	2070
BELL COUNTY-IRRIGATION	85	142	199	199	199	199
BOSQUE COUNTY-IRRIGATION	107	179	250	250	250	250
BURLESON COUNTY-IRRIGATION	804	1,340	1,876	1,876	1,876	1,876
COMANCHE COUNTY-IRRIGATION	964	1,606	2,248	2,248	2,248	2,248
GRIMES COUNTY-IRRIGATION	20	33	47	47	47	47
HASKELL COUNTY-IRRIGATION	1,747	2,912	3,922	3,933	4,010	4,010
HILL COUNTY-IRRIGATION	53	88	123	123	123	123
JOHNSON COUNTY-IRRIGATION	17	28	40	40	40	40
JONES COUNTY-IRRIGATION	85	141	198	198	198	198
KNOX COUNTY-IRRIGATION	1,319	2,199	2,791	2,665	2,829	2,829
LAMPASAS COUNTY-IRRIGATION	16	27	38	38	38	38
MILAM COUNTY-IRRIGATION	195	325	455	455	455	455
NOLAN COUNTY-IRRIGATION	347	578	809	809	809	809
PALO PINTO COUNTY-IRRIGATION	90	151	211	211	211	211
ROBERTSON COUNTY-IRRIGATION	2,375	3,959	5,579	5,612	5,612	5,612
STEPHENS COUNTY-IRRIGATION	5	8	11	11	11	11
TAYLOR COUNTY-IRRIGATION	49	82	114	114	114	114
THROCKMORTON COUNTY-IRRIGATION	5	8	11	11	11	11
WILLIAMSON COUNTY-IRRIGATION	10	17	23	23	23	23
YOUNG COUNTY-IRRIGATION	15	25	35	35	35	35
Total Region G:	**8,308**	**13,847**	**18,980**	**18,898**	**19,138**	**19,138**

2.2.3 Environmental Issues

The irrigation water conservation methods described above have been developed and tested through public and private sector research, and have been adopted and applied within the region. Hundreds of LEPA systems have been installed and are in operation today, and experience has revealed no significant environmental issues associated with this water management strategy. This method improves water use efficiency without making significant changes to wildlife habitat. This method of application, when coupled with furrow dikes, reduces runoff of both applied irrigation water and rainfall. These actions result in the reduced transport of sediment, fertilizers, pesticides and other chemicals that have been applied to the crops. Thus, the proposed conservation practices are not anticipated to have significant potential adverse environmental effects and may have potentially beneficial environmental effects.

2.2.4 Engineering and Costing

The Brazos G RWPG recommended irrigation water conservation as a water management strategy for irrigation needs, resulting in a total water savings of 8,308 acft/yr beginning in 2020, 18,980 acft/yr in 2040 and 19,138 acft/yr in 2070 as shown in Table 2.2-3. Brazos G recommends the use of furrow, LESA, and LEPA systems described above but supports flexibility for each WUG to voluntarily decide which of these or other options might serve them best. An average cost of implementing furrow dikes, LESA, and LEPA programs of

$450 per acre and water savings rate shown in Table 2.2-1 were used to calculate a cost per acft of water saved. This was then used to calculate a total estimated cost based on water saved in Table 2.2-3. The total cost of implementing these three BMPs for Brazos G entities is estimated to cost $25,224,527 in 2040 and $25,455,400 in 2070 as shown in Table 2.2-4.

Each of the three irrigation water conservation strategies described (furrow dikes, LESA, and LEPA) have the potential to increase water savings beyond the minimum recommended by the Brazos G RWPG; however, none of the strategies can accomplish water savings sufficient to meet all of the projected needs. Further studies are needed to consider other irrigation water conservation BMPs that can be applied to surface applications to increase their application efficiencies.

Table 2.2-4. Brazos G Irrigation Water Savings and Estimated Costs

Brazos G Water User Group	Projected Water Savings (acft/yr) with Voluntary Reduction in Demand of 3% by 2020; 5% by 2030; and 7% 2040-2070						$ per acft water saved	Costs of Water Savings ($)					
	2020	**2030**	**2040**	**2050**	**2060**	**2070**		**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
BELL COUNTY-IRRIGATION	85	142	199	199	199	199	$1,323	$112,854	$188,090	$263,326	$263,326	$263,326	$263,326
BOSQUE COUNTY-IRRIGATION	107	179	250	250	250	250	$970	$104,070	$173,449	$242,829	$242,829	$242,829	$242,829
BURLESON COUNTY-IRRIGATION	804	1,340	1,876	1,876	1,876	1,876	$1,576	$1,267,630	$2,112,717	$2,957,804	$2,957,804	$2,957,804	$2,957,804
COMANCHE COUNTY-IRRIGATION	964	1,606	2,248	2,248	2,248	2,248	$1,382	$1,331,534	$2,219,223	$3,106,912	$3,106,912	$3,106,912	$3,106,912
GRIMES COUNTY-IRRIGATION	20	33	47	47	47	47	$1,376	$27,582	$45,970	$64,357	$64,357	$64,357	$64,357
HASKELL COUNTY-IRRIGATION	1,747	2,912	3,922	3,933	4,010	4,010	$1,594	$2,785,457	$4,642,428	$6,251,985	$6,270,511	$6,392,488	$6,392,488
HILL COUNTY-IRRIGATION	53	88	123	123	123	123	$680	$35,714	$59,524	$83,334	$83,334	$83,334	$83,334
JOHNSON COUNTY-IRRIGATION	17	28	40	40	40	40	$1,241	$21,075	$35,125	$49,175	$49,175	$49,175	$49,175
JONES COUNTY-IRRIGATION	85	141	198	198	198	198	$1,409	$119,575	$199,292	$279,009	$279,009	$279,009	$279,009
KNOX COUNTY-IRRIGATION	1,319	2,199	2,791	2,665	2,829	2,829	$1,662	$2,193,453	$3,655,754	$4,640,020	$4,431,025	$4,702,742	$4,702,742
LAMPASAS COUNTY-IRRIGATION	16	27	38	38	38	38	$1,285	$20,734	$34,557	$48,380	$48,380	$48,380	$48,380
MILAM COUNTY-IRRIGATION	195	325	455	455	455	455	$1,542	$300,861	$501,435	$702,009	$702,009	$702,009	$702,009
NOLAN COUNTY-IRRIGATION	347	578	809	809	809	809	$1,494	$518,232	$863,720	$1,209,208	$1,209,208	$1,209,208	$1,209,208
PALO PINTO COUNTY-IRRIGATION	90	151	211	211	211	211	$1,045	$94,437	$157,396	$220,354	$220,354	$220,354	$220,354
ROBERTSON COUNTY-IRRIGATION	2,375	3,959	5,579	5,612	5,612	5,612	$857	$2,035,254	$3,392,090	$4,780,352	$4,807,941	$4,808,000	$4,808,000
STEPHENS COUNTY-IRRIGATION	5	8	11	11	11	11	$1,489	$6,789	$11,314	$15,840	$15,840	$15,840	$15,840
TAYLOR COUNTY-IRRIGATION	49	82	114	114	114	114	$1,924	$94,375	$157,291	$220,207	$220,207	$220,207	$220,207
THROCKMORTON COUNTY-IRRIGATION	5	8	11	11	11	11	$2,118	$9,974	$16,624	$23,273	$23,273	$23,273	$23,273
WILLIAMSON COUNTY-IRRIGATION	10	17	23	23	23	23	$1,404	$14,027	$23,379	$32,730	$32,730	$32,730	$32,730
YOUNG COUNTY-IRRIGATION	15	25	35	35	35	35	$963	$14,323	$23,872	$33,421	$33,421	$33,421	$33,421
Total Region G:	**8,308**	**13,847**	**18,980**	**18,898**	**19,138**	**19,138**		**$11,107,950**	**$18,513,250**	**$25,224,527**	**$25,061,645**	**$25,455,400**	**$25,455,400**

2.2.5 Implementation Issues

Irrigation demand reduction through water conservation is being implemented throughout the Brazos G Area and the State of Texas. The rate of adoption of efficient water-use practices is dependent upon public knowledge of the benefits, information about how to implement water conservation measures, and financing.

There is widespread public support for irrigation water conservation and it is being implemented at a steady pace, and as water markets for conserved water expand, this practice will likely reach its maximum potential. A major barrier to implementation of water conservation is financing. The TWDB has irrigation conservation programs that may provide funding to irrigators to implement irrigation BMPs that increase water use efficiency. Future planning efforts should consider the use of detailed studies to fully determine the maximum potential benefits of additional irrigation conservation.

This option is compared to the plan development criteria in Table 2.2-5 and meets most criteria.

Table 2.2-5. Comparison of Irrigation Conservation to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Firm Yield: Variable according to BMP selected.
2. Reliability	2. High reliability
3. Cost	3. High for internal use (based on BMP selected)
B. Environmental factors	
1. Environmental Water Needs	1. None or low impact
2. Habitat	2. None or low impact
3. Cultural Resources	3. No apparent negative impact
4. Bays and Estuaries	4. None
5. Threatened and Endangered Species	5. None
6. Wetlands	6. No cultural resources affected
C. Impact on Other State Water Resources	• No apparent negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	• None
E. Equitable Comparison of Feasible Strategies	• Standard analyses and methods used
F. Requirements for Interbasin Transfers	• None
Third Party Social and Economic Impacts from Voluntary Redistribution	• None

2.3 Industrial Water Conservation

2.3.1 Description of Strategy

Water uses for industrial purposes (manufacturing, steam-electric power generation, and mining) are primarily associated with manufacturing products, cleaning and waste removal, waste heat removal, dust control, landscaping, and mine dewatering.

Manufacturing is an important part of the Brazos G Area's economy, and industries use water as a component of the final product, for cooling, and cleaning/wash-down of parts and/or products. Regional industries that are major water users include food and kindred products, apparel, fabricated metal, machinery, and stone and concrete production. There are ten (10) counties in the Brazos G Area with projected manufacturing needs: Bell, Burleson, Erath, Knox, Lampasas, Limestone, McLennan, Nolan, Stonewall, and Washington. In 2070, the estimated water needs are 1,891 acft/yr, which is 12% of the manufacturing water demand for the Brazos G Area.

In the Brazos G Area, the trends for steam-electric water demands are projected to be 232,894 acft/yr from 2030 through 2070. Grimes, Limestone, Milam, Robertson, and Somervell Counties comprise over 80 percent of the projected regional steam-electric water use in 2070. The Brazos G Area steam-electric users are projected to receive around 90% of their water supplies from surface water sources in 2070. There are seven (7) counties in the Brazos G Area with projected steam-electric needs: Brazos, Grimes, Hill, Johnson, Limestone, Milam, and Somervell. In 2070, the estimated water needs are 74,477 acft/yr, which is 32% of the steam-electric water demand for the Brazos G Area.

In the Brazos G Area, the mining water demands increase from 59,340 acft/yr in 2040 to 60,838 acft/yr in 2070. In 2070, the Brazos G Area mining users are projected to receive over 90% of their water supplies from groundwater sources. Thirty-one (31) of the thirty-seven counties in the Brazos G Area have projected mining needs over the planning period. In 2070, the estimated water needs are 28,236 acft, which is about 46% of the mining water demand for the Brazos G Area.

2.3.2 Available Yield

All mining entities in the Brazos G Region are encouraged to conserve water.

The Brazos G RWPG recommends that counties with projected needs (shortages) for industrial users (manufacturing or mining) reduce those water demands by 3 percent by 2020, 5 percent by 2030, and 7 percent from 2040 to 2070 by using BMPs identified by the TWDB.

The Brazos G RWPG considered water conservation as a water management strategy for steam-electric users, but opted not to recommend water conservation due to variability in processes and water use practices.

The TWDB lists the following industrial BMPs that may be used to achieve the recommended water savings[10]:

1. Industrial Water Audit

[10] TWDB website: https://www.twdb.texas.gov/conservation/BMPs/Ind/index.asp

2. Industrial Water Waste Reduction
3. Industrial Submetering
4. Cooling Towers
5. Cooling Systems (other than Cooling Towers)
6. Industrial Alternative Sources and Reuse and Recirculation of Process Water
7. Rinsing/Cleaning
8. Water Treatment
9. Boiler and Steam Systems
10. Refrigeration (including Chilled Water)
11. Once-Through Cooling
12. Management and Employee Programs
13. Industrial Facility Landscaping
14. Industrial Site-Specific Conservation

For the BMPs listed above, water savings (yield) and costs to implement these strategies reported in TWDB guidance documents are summarized in Table 2.3-1. The TWDB describes how the BMPs reduce water use, however information regarding specific water savings and costs to implement conservation programs is generally unavailable. Conservation savings and costs are facility and process specific. Since mining entities are presented on a county-wide basis and are not individually identified, identification and quantifying of savings of specific water management strategies are not reasonable expectations.

For the 10 manufacturing users with projected needs, the total water savings after 7 percent water demand reduction in 2070 is 708 acft/yr as shown in Table 2.3-2, which amounts to a 37% reduction in total regional manufacturing shortages.

For the thirty one (31) mining users with projected needs, the total water savings after 7 percent water demand reduction in 2070 is 3,317 acft/yr as also shown in Table 2.3-2, which amounts to a 20% reduction in total regional mining shortages.

Table 2.3-1. Cost and Savings of Possible Industrial Water Conservation Techniques (BMPs)

Best Management Practices	Water Savings Estimates				Cost Estimates				Assumptions/Notes
	Min	Max	Avg	Savings Metric	Min	Max	Avg	Cost Metric	
Industrial Water Audit	10.0	35.0	22.5	%	-	-	-	-	-
Industrial Water Waste Reduction	-	-	-	-	-	-	-	-	-
Industrial Sub-metering	-	-	-	-	-	-	-	-	-
Cooling Towers	-	-	-	-	-	-	-	-	Highly variable. Savings due to increased concentration ratio and implemented changes in operating procedures. TWDB guidance available for calculating water savings.
Cooling Systems (other than Cooling Towers)	-	90.0	-	%	-	-	-	-	Estimated that retrofitting of single-pass cooling equipment such as x-rays to recirculating water systems can cut water use by up to 90%.
Industrial Alternative Sources and Reuse and Recirculation of Process Water	-	-	-	-	-	-	-	-	-
Rinsing/Cleaning	-	-	-	-	-	-	-	-	-
Water Treatment	10.0	85.0	47.5	%	-	-	-	-	Water savings range widely based on specific updates - from process adjustments to reclaim systems.
Boiler and Steam Systems	-	-	-	-	-	-	-	-	Highly variable. Savings due to increased condensate return and increased concentration ratios. TWDB guidance available for calculating water savings.
Refrigeration (including Chilled Water)	-	-	-	-	-	-	-	-	-
Once-Through Cooling	-	-	-	-	-	-	-	-	-
Management and Employee Programs	-	-	-	-	-	-	-	-	-
Industrial Facility Landscaping	-	-	15.0	%	-	-	-	-	-
Industrial Site Specific Conservation	10.0	95.0	52.5	%	-	-	-	-	Savings vary widely - from water audits to changing from potable to recycled water.

Source: TWDB Best management Practices for Industrial Water Users, February 2013.
https://www.twdb.texas.gov/conservation/BMPs/Ind/index.asp

Table 2.3-2. Projected Water Savings for Manufacturing and Mining Water User Groups Considering up to a 7 Percent Demand Reduction by 2040

Water Savings (acft/yr) with Voluntary Reduction in Demand of 3% by 2020; 5% by 2030; and 7% from 2040-2070						
	2020 (3%)	*2030 (5%)*	*2040 (7%)*	*2050 (7%)*	*2060 (7%)*	*2070 (7%)*
Manufacturing						
BELL COUNTY-MANUFACTURING	19	34	48	48	48	48
BURLESON COUNTY-MANUFACTURING	4	6	8	8	8	8
ERATH COUNTY-MANUFACTURING	2	4	6	6	6	6
KNOX COUNTY-MANUFACTURING	0	0	0	0	0	0
LAMPASAS COUNTY-MANUFACTURING	6	11	15	15	15	15
LIMESTONE COUNTY-MANUFACTURING	10	19	26	26	26	26
MCLENNAN COUNTY-MANUFACTURING	144	373	522	522	522	522
NOLAN COUNTY-MANUFACTURING	13	26	37	37	37	37
STONEWALL COUNTY-MANUFACTURING	2	3	4	4	4	4
WASHINGTON COUNTY-MANUFACTURING	17	29	41	41	41	41
Total Brazos G water savings for Manufacturing WUGs with needs (acft/yr)	**217**	**506**	**708**	**708**	**708**	**708**
Mining						
BELL COUNTY-MINING	97	199	322	374	427	488
BOSQUE COUNTY-MINING	59	104	132	131	128	127
CALLAHAN COUNTY-MINING	7	11	15	14	13	13
COMANCHE COUNTY-MINING	13	26	25	19	13	9
CORYELL COUNTY-MINING	45	54	34	25	28	31
EASTLAND COUNTY-MINING	35	59	65	50	36	30
FALLS COUNTY-MINING	7	12	18	20	21	23
FISHER COUNTY-MINING	12	20	25	22	19	17

Table 2.3-2. Projected Water Savings for Manufacturing and Mining Water User Groups Considering up to a 7 Percent Demand Reduction by 2040

Water Savings (acft/yr) with Voluntary Reduction in Demand of 3% by 2020; 5% by 2030; and 7% from 2040-2070						
	2020 (3%)	*2030 (5%)*	*2040 (7%)*	*2050 (7%)*	*2060 (7%)*	*2070 (7%)*
GRIMES COUNTY-MINING	10	30	33	24	15	9
HAMILTON COUNTY-MINING	12	12	7	0	0	0
HASKELL COUNTY-MINING	3	5	6	5	5	4
HILL COUNTY-MINING	49	60	54	28	31	33
HOOD COUNTY-MINING	62	122	156	149	143	144
JOHNSON COUNTY-MINING	124	139	106	71	81	94
JONES COUNTY-MINING	7	12	15	14	13	12
KNOX COUNTY-MINING	0	1	1	1	1	1
LAMPASAS COUNTY-MINING	6	11	17	18	20	22
LEE COUNTY-MINING	95	159	0	0	0	0
LIMESTONE COUNTY-MINING	310	496	691	724	756	800
MCLENNAN COUNTY-MINING	76	150	214	246	268	295
NOLAN COUNTY-MINING	7	11	14	12	11	10
PALO PINTO COUNTY-MINING	20	42	44	34	24	16
SHACKELFORD COUNTY-MINING	17	37	39	31	23	17
SOMERVELL COUNTY-MINING	33	64	80	74	70	68
STEPHENS COUNTY-MINING	152	257	312	268	228	194
STONEWALL COUNTY-MINING	18	29	36	31	27	24
TAYLOR COUNTY-MINING	12	20	26	24	23	22
THROCKMORTON COUNTY-MINING	6	10	12	11	9	8
WASHINGTON COUNTY-MINING	17	43	49	38	26	18
WILLIAMSON COUNTY-MINING	155	313	516	599	685	783
YOUNG COUNTY-MINING	6	14	14	11	7	5
Total Brazos G water savings for Mining WUGs with needs (acft/yr)	**1,471**	**2,520**	**3,078**	**3,068**	**3,153**	**3,317**

2.3.3 Environmental Issues

The Task Force BMPs have been developed and tested through public and private sector research, and have been applied within the region. Such programs have been installed, and are in operation today, and are not expected to have significant environmental issues associated with implementation. For example, most BMPs improve water use efficiency without making significant changes to wildlife habitat. Thus, the proposed conservation practices are not anticipated to have significant potential adverse environmental effects, and may have potentially beneficial environmental effects.

2.3.4 Engineering and Costing

Costs to implement BMPs vary from site to site and the Brazos G RWPG recognizes that industries will pursue conservation strategies that are economically feasible with water savings benefits. For this reason, it is impractical to evaluate the costs of implementing industrial water conservation strategies.

2.3.5 Implementation Issues

Demand reduction through water conservation is being implemented throughout the Brazos G Area. The rate of adoption of efficient water-using practices is dependent upon public knowledge of the benefits, information about how to implement water conservation measures, and financing.

There is public support for industrial water conservation; and, it is being implemented at a steady pace, and as water markets for conserved water expand, this practice will likely reach greater potentials. The TWDB has industrial water conservation programs including presentations and workshops for utilities who wish to train staff to develop local programs including water use site surveys, publications on industrial water reuse potential, and information on tax incentives for industries that conserve or reuse water. Future planning efforts should consider the use of detailed studies to fully determine the maximum potential benefits of mining conservation.

This option is compared to the plan development criteria in Table 2.3-3 and the option meets each criterion.

Table 2.3-3. Comparison of Industrial Conservation to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1 Quantity	1. Manufacturing Firm Yield: up to 1,688 acft/yr (2070) Steam-Electric Firm Yield: up to 14,307 acft/yr (2070) Mining Firm Yield: up to 5,680 acft/yr (2070)
2. Reliability and Cost	2. Good reliability.
3. Cost	3. Cost: Highly variable based on BMP selected and facility specifics.
B. Environmental factors	
1. Instream flows	1. None or low impact.
2. Bay and Estuary Inflows	2. None or low impact.
3. Wildlife Habitat	3. None or low impact.
4. Wetlands	4. None or low impact.
5. Threatened and Endangered Species	5. None.
6. Cultural Resources	6. No cultural resources affected.
7. Water Quality	7. None or low impact.
C. Impacts to State water resources	• No apparent negative impacts on water resources
D. Threats to agriculture and natural resources in region	• None
E. Recreational impacts	• None
F. Equitable Comparison of Strategies	• Standard analyses and methods used
G. Interbasin transfers	• None
H. Third party social and economic impacts from voluntary redistribution of water	• None
I. Efficient use of existing water supplies and regional opportunities	• Improvement over current conditions by reducing the rate of decline of local groundwater levels.
J. Effect on navigation	• None
K. Consideration of water pipelines and other facilities used for water conveyance	• None

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