

CHAPTER 5 WATER CONSERVATION

5.1 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 acftac-ft/year (non-irrigation).
 - » Greater than 10,000 acftac-ft/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 1](#), 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 [2021-2026](#) 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 Legislature², 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 **2021-2026** Regional Water Plans. These resources were considered during development of the **2021-2026** 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)

Commented [MP1]: Data to be updated.

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.

Commented [MP2]: Data to be updated.

Commented [MP3]: Data to be updated.

5.1.1 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 the 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 5.1.

Table 5.1 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 5.2. 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 5.2 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	

5.1.2 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 gpcd⁴, 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, [u](#)

³“Water Conservation Impacts on Per Capita Water Use,” Water Planning Information, Texas Water Development Board, Austin, Texas, 1992.

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

Unless an entity requests to opt out, 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 TWDB⁵:

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 Reuse⁶,
18. Public Information,
19. Rainwater Harvesting and Condensate Reuse⁶,
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)

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.

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 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).
- System water audit and water loss control (33 out of 49 Brazos G respondents).

Commented [MP4]: Data to be updated.

5.1.3 Available Supply

Per capita water use from the 2017-2021 State Water Plan was provided by the TWDB for 2021-2026 Regional Water Planning purposes for each municipal WUG based on TWDB-approved population and water demand estimates for each decade from 2020-2030 to 2070-2080 (summarized in Volume 1 Chapter 2, Table 5-5XXXXX). The historical per capita water use in 2011 was used as a basis for projected per capita water use in decades from 2020-2030 to 2070-2080 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.

Table 5.3 shows a comparison of TWDB baseline per capita rates for the 2021-2026 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 5.4 lists the additional water savings attributable to the Brazos G RWPG conservation recommendations. The projected savings attributed to advanced conservation in Brazos G is 24,971,29,755 ac-ft/yr in 2020-2030 and increases to 111,339,189,882 ac-ft/yr by 2070-2080, shown by WUG in Table 5.4. 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.

Table 5.3 Comparison of TWDB Baseline Per Capita Rates for the 2021-2026 Brazos G Plan and Per Capita Rates With Advanced Conservation

WUG	COUNTY	GPCD Board Projections without Advanced Conservation							GPCD Goal with Advanced Conservation					
		Base GPCD	Projected GPCD						Projected GPCD					
		2011	2030	2040	2050	2060	2070	2080	2030	2040	2050	2060	2070	2080
439 WSC	Bell	172	168	167	167	167	167	167	155	140	140	140	140	140
Abilene	Taylor	183	178	178	178	178	178	178	165	146	140	140	140	140
Acton MUD	Hood	185	180	180	180	180	180	180	167	148	140	140	140	140
Acton MUD	Johnson	185	176	181	172	175	175	174	167	148	140	140	140	140
Albany	Shackelford	276	271	271	271	270	271	271	248	221	193	166	140	140
Armstrong WSC	Bell	159	155	154	154	154	154	154	140	140	140	140	140	140
Aspermont	Stonewall	331	326	325	325	326	326	324	298	265	232	199	166	140
Axtell WSC	McLennan	157	152	152	152	152	152	152	140	140	140	140	140	140

WUG	COUNTY	GPCD Board Projections without Advanced Conservation							GPCD Goal with Advanced Conservation					
		Base GPCD 2011	Projected GPCD						Projected GPCD					
		2011	2030	2040	2050	2060	2070	2080	2030	2040	2050	2060	2070	2080
Baird	Callahan	196	191	191	191	191	191	191	176	157	140	140	140	140
Bartlett	Bell	183	179	177	178	177	177	177	165	146	128	120	120	120
Bartlett	Williamson	183	179	178	177	178	178	178	165	146	128	120	120	120
Bell County WCID 1	Bell	338	331	331	331	331	331	331	304	270	237	203	169	140
Bell County WCID 2	Bell	175	170	170	170	170	170	170	158	140	140	140	140	140
Bell County WCID 3	Bell	161	157	156	156	156	156	156	145	140	140	140	140	140
Bell Milam Falls WSC	Bell	162	157	157	157	157	157	157	146	140	140	140	140	140
Bell Milam Falls WSC	Falls	162	157	157	157	157	157	157	146	140	140	140	140	140
Bell Milam Falls WSC	Milam	162	157	157	157	157	157	157	146	140	140	140	140	140
Bell Milam Falls WSC	Williamson	162	157	157	157	157	157	157	146	140	140	140	140	140
Belton	Bell	157	153	152	152	152	152	152	140	140	140	140	140	140
Benjamin	Knox	277	274	273	269	273	272	271	249	222	194	166	140	140
Bethesda WSC	Tarrant	188	184	183	184	182	184	184	169	150	140	140	140	140
Bethesda WSC	Johnson	188	184	183	183	183	183	183	169	150	140	140	140	140
Bistone Municipal Water Supply District	Limestone	419	416	414	414	415	415	415	377	335	293	251	210	168
Brandon Irene WSC	Navarro	249	247	248	241	241	241	245	224	199	174	149	140	140
Brandon Irene WSC	Hill	249	244	243	244	243	243	244	224	199	174	149	140	140
Brandon Irene WSC	Hill	249	243	243	243	244	244	243	224	199	174	149	140	140
Breckenridge	Stephens	161	156	156	156	156	156	156	145	140	140	140	140	140
Bremond	Robertson	183	178	178	178	178	177	178	165	146	140	140	140	140
Brenham	Washington	230	225	224	224	224	224	224	207	184	161	140	140	140
Bruceville Eddy	Falls	245	240	240	240	240	239	240	221	196	172	147	140	140
Bruceville Eddy	McLennan	245	240	240	240	240	240	240	221	196	172	147	140	140
Brushy Creek MUD	Williamson	185	180	180	180	180	180	180	167	148	130	120	120	120
Brushy Creek MUD	Williamson	185	180	180	180	179	179	179	167	148	130	120	120	120
Bryan	Brazos	169	164	164	164	164	164	164	152	140	140	140	140	140
Burleson	Tarrant	143	139	138	138	138	138	138	140	140	140	140	140	140
Burleson	Johnson	143	139	138	138	138	138	138	140	140	140	140	140	140
Cade Lakes WSC	Burleson	230	225	226	225	224	224	224	207	184	161	140	140	140

WUG	COUNTY	GPCD Board Projections without Advanced Conservation							GPCD Goal with Advanced Conservation					
		Base GPCD 2011	Projected GPCD						Projected GPCD					
		2011	2030	2040	2050	2060	2070	2080	2030	2040	2050	2060	2070	2080
Caldwell	Burleson	196	191	190	191	191	190	191	176	157	140	140	140	140
Calvert	Robertson	235	230	229	230	229	229	229	212	188	165	140	140	140
Cameron	Milam	217	212	212	212	212	212	212	195	174	152	140	140	140
Cedar Park	Williamson	191	187	186	186	186	186	186	172	153	134	120	120	120
Cedar Park	Williamson	191	187	186	186	186	186	186	172	153	134	120	120	120
Cedar Park	Travis	191	187	186	186	186	186	186	172	153	134	120	120	120
Cego-Durango WSC	Falls	159	154	154	154	154	154	154	140	140	140	140	140	140
Central Bosque WSC	McLennan	161	156	156	155	155	156	155	145	140	140	140	140	140
Central Texas College District	Bell	283	280	279	279	279	279	279	255	226	198	170	140	140
Central Texas College District	Coryell	283	281	278	278	278	278	278	255	226	198	170	140	140
Chalk Bluff WSC	McLennan	147	143	142	142	142	142	142	140	140	140	140	140	140
Chappell Hill WSC	Washington	198	194	193	193	193	193	193	178	158	140	140	140	140
Chatt WSC	Hill	162	157	156	156	155	155	156	146	140	140	140	140	140
Chatt WSC	Hill	162	157	157	155	156	157	157	146	140	140	140	140	140
Childress Creek WSC	Bosque	230	226	225	225	225	225	225	207	184	161	140	140	140
Childress Creek WSC	McLennan	230	228	219	220	223	223	223	207	184	161	140	140	140
Cisco	Eastland	170	165	164	165	165	164	164	153	140	140	140	140	140
Cleburne	Johnson	192	187	187	187	187	187	187	173	154	140	140	140	140
Clifton	Bosque	201	196	196	196	196	196	196	181	161	140	140	140	140
College Station	Brazos	177	172	172	172	172	172	172	159	140	140	140	140	140
Coolidge	Limestone	174	169	169	169	170	169	168	157	140	140	140	140	140
Coolidge	Limestone	174	171	169	170	169	170	171	157	140	140	140	140	140
Corix Utilities Texas Inc	Mitchell	170	165	165	165	165	165	165	153	140	140	140	140	140
Corix Utilities Texas Inc	Lampasas	170	165	165	165	165	165	165	153	140	140	140	140	140
Corix Utilities Texas Inc	Lampasas	170	165	165	165	165	165	165	153	140	140	140	140	140
Corix Utilities Texas Inc	Washington	170	165	165	165	165	165	165	153	140	140	140	140	140
Corix Utilities Texas Inc	Blanco	170	165	165	165	165	165	165	153	140	140	140	140	140

WUG	COUNTY	GPCD Board Projections without Advanced Conservation							GPCD Goal with Advanced Conservation					
		Base GPCD 2011	Projected GPCD						Projected GPCD					
		2011	2030	2040	2050	2060	2070	2080	2030	2040	2050	2060	2070	2080
Corix Utilities Texas Inc	Burnet	170	165	161	170	166	160	163	153	140	140	140	140	140
Corix Utilities Texas Inc	Burnet	170	165	165	165	165	165	165	153	140	140	140	140	140
Corix Utilities Texas Inc	Colorado	170	164	165	163	164	163	167	153	140	140	140	140	140
Corix Utilities Texas Inc	Llano	170	165	165	165	165	165	165	153	140	140	140	140	140
Corix Utilities Texas Inc	Matagorda	170	164	164	165	163	164	163	153	140	140	140	140	140
Corix Utilities Texas Inc	Matagorda	170	223	223	298	298	298	298	153	140	140	140	140	140
Corix Utilities Texas Inc	Mills	170	165	165	165	166	165	164	153	140	140	140	140	140
Corix Utilities Texas Inc	San Saba	170	163	167	168	162	171	172	153	140	140	140	140	140
Coryell City Water Supply District	Coryell	163	159	159	159	159	159	159	147	140	140	140	140	140
Coryell City Water Supply District	Hamilton	163	160	160	157	157	157	157	147	140	140	140	140	140
Coryell City Water Supply District	McLennan	163	159	158	159	159	159	158	147	140	140	140	140	140
County-Other, Bell	Bell	151	147	146	147	147	147	146	140	140	140	140	140	140
Crawford	McLennan	212	207	207	207	207	207	207	191	170	148	140	140	140
Cross Country WSC	Bosque	178	175	173	172	172	173	174	160	140	140	140	140	140
Cross Country WSC	McLennan	178	173	173	173	173	173	173	160	140	140	140	140	140
Cross Plains	Callahan	210	205	204	204	205	204	205	189	168	147	140	140	140
Deanville WSC	Burleson	175	170	169	169	169	169	169	158	140	140	140	140	140
Dog Ridge WSC	Bell	172	168	167	167	167	167	167	155	140	140	140	140	140
Double Diamond Utilities	Hill	1023	1020	1019	1019	1019	1019	1019	921	818	716	614	512	409
Double Diamond Utilities	Johnson	1023	1019	1019	1019	1019	1019	1019	921	818	716	614	512	409
Double Diamond Utilities	Palo Pinto	1023	1019	1019	1019	1019	1019	1019	921	818	716	614	512	409
East Bell WSC	Bell	155	150	150	150	150	150	150	140	140	140	140	140	140
East Bell WSC	Falls	155	153	150	146	150	149	150	140	140	140	140	140	140

WUG	COUNTY	GPCD Board Projections without Advanced Conservation							GPCD Goal with Advanced Conservation					
		Base GPCD 2011	Projected GPCD						Projected GPCD					
		2011	2030	2040	2050	2060	2070	2080	2030	2040	2050	2060	2070	2080
East Crawford WSC	McLennan	304	300	299	299	299	299	299	274	243	213	182	152	140
Eastland	Eastland	160	155	154	154	154	154	154	140	140	140	140	140	140
Elm Creek WSC	Bell	143	139	138	138	138	138	138	140	140	140	140	140	140
Elm Creek WSC	Coryell	143	139	138	138	138	138	137	140	140	140	140	140	140
Elm Creek WSC	McLennan	143	139	138	138	138	138	138	140	140	140	140	140	140
Fern Bluff MUD	Williamson	194	190	189	189	189	189	189	175	155	136	120	120	120
Fern Bluff MUD	Williamson	194	188	192	189	186	190	187	175	155	136	120	120	120
Files Valley WSC	Ellis	179	175	174	174	175	174	175	161	140	140	140	140	140
Files Valley WSC	Hill	179	175	175	175	175	175	174	161	140	140	140	140	140
Files Valley WSC	Hill	179	175	175	174	174	174	174	161	140	140	140	140	140
Flat WSC	Coryell	258	254	253	254	254	253	253	232	206	181	155	140	140
Fort Gates WSC	Coryell	187	182	182	182	182	182	182	168	150	140	140	140	140
Fort Griffin SUD	Shackelford	171	167	165	166	166	166	166	154	140	140	140	140	140
Fort Griffin SUD	Stephens	171	166	166	165	165	166	166	154	140	140	140	140	140
Fort Griffin SUD	Throckmorton	171	168	163	164	169	168	166	154	140	140	140	140	140
Fort Hood	Bell	215	210	210	210	210	210	210	194	172	151	140	140	140
Fort Hood	Coryell	215	210	210	210	210	210	210	194	172	151	140	140	140
Gatesville	Coryell	246	241	241	241	241	241	241	221	197	172	148	140	140
Georgetown	Bell	173	169	168	168	168	168	168	156	138	120	120	120	120
Georgetown	Williamson	173	169	168	168	168	168	168	156	138	120	120	120	120
Georgetown	Burnet	173	169	168	168	168	168	169	156	138	120	120	120	120
Giddings	Lee	188	183	183	183	182	183	183	169	150	140	140	140	140
Giddings	Lee	188	183	183	182	183	183	183	169	150	140	140	140	140
Glen Rose	Somervell	199	194	194	193	193	193	193	179	159	140	140	140	140
Gordon	Erath	230	298	298	298	298	298	298	207	184	161	138	115	140
Gordon	Palo Pinto	230	224	224	224	225	225	224	207	184	161	138	115	140
Graham	Young	302	297	296	297	297	297	296	272	242	211	181	151	140
Granbury	Hood	175	170	169	169	169	169	169	158	140	140	140	140	140
Grandview	Johnson	153	148	148	148	148	148	148	140	140	140	140	140	140
Granger	Williamson	145	140	140	140	140	139	140	131	120	120	120	120	120
Groesbeck	Limestone	167	162	161	161	161	161	161	150	140	140	140	140	140
Hamilton	Hamilton	179	174	173	173	174	173	174	161	140	140	140	140	140
Hamlin	Jones	187	182	182	182	181	181	181	168	150	140	140	140	140
Harker Heights	Bell	178	174	173	173	173	173	173	160	140	140	140	140	140
Haskell	Haskell	174	169	169	168	169	168	169	157	140	140	140	140	140

WUG	COUNTY	GPCD Board Projections without Advanced Conservation							GPCD Goal with Advanced Conservation					
		Base GPCD 2011	Projected GPCD						Projected GPCD					
		2011	2030	2040	2050	2060	2070	2080	2030	2040	2050	2060	2070	2080
Hearne	Robertson	152	147	147	147	147	147	147	140	140	140	140	140	140
Hewitt	McLennan	176	171	171	171	171	171	171	158	140	140	140	140	140
Highland Park WSC	Bosque	264	259	258	260	258	258	259	238	211	185	158	140	140
Highland Park WSC	McLennan	264	260	259	260	257	259	261	238	211	185	158	140	140
Hilco United Services	Ellis	187	183	182	182	181	182	182	168	150	140	140	140	140
Hilco United Services	Bosque	187	182	182	182	182	182	182	168	150	140	140	140	140
Hilco United Services	Hill	187	182	182	182	182	182	182	168	150	140	140	140	140
Hillsboro	Hill	211	206	206	206	206	206	206	190	169	148	140	140	140
Hilltop WSC	McLennan	143	138	138	138	137	137	138	140	140	140	140	140	140
Hog Creek WSC	Bosque	962	954	956	957	960	949	951	866	770	673	577	481	385
Hog Creek WSC	McLennan	962	956	955	955	955	955	956	866	770	673	577	481	385
Jayton	Kent	180	176	174	175	175	175	174	162	140	140	140	140	140
Jonah Water SUD	Williamson	188	184	184	184	184	184	184	169	150	132	120	120	120
Kempner WSC	Bell	176	171	171	171	171	171	171	158	140	140	140	140	140
Kempner WSC	Coryell	176	172	171	171	171	171	171	158	140	140	140	140	140
Kempner WSC	Lampasas	176	172	171	171	171	171	171	158	140	140	140	140	140
Kempner WSC	Burnet	176	172	171	171	170	172	171	158	140	140	140	140	140
Knox City	Knox	224	219	219	219	219	218	219	202	179	157	140	140	140
Lampasas	Lampasas	167	162	162	162	162	162	162	150	140	140	140	140	140
Lawn	Taylor	178	173	171	174	175	172	170	160	140	140	140	140	140
Levi WSC	Falls	238	234	232	233	233	233	233	214	190	167	140	140	140
Levi WSC	McLennan	238	234	233	233	233	233	233	214	190	167	140	140	140
Lexington	Lee	177	172	172	172	172	171	172	159	140	140	140	140	140
Lipan	Hood	143	139	138	138	138	138	138	140	140	140	140	140	140
Little Elm Valley WSC	Bell	171	167	167	166	166	166	166	154	140	140	140	140	140
Little Elm Valley WSC	Falls	171	175	166	169	168	169	165	154	140	140	140	140	140
Lorena	McLennan	171	167	166	166	166	166	166	154	140	140	140	140	140
Marlin	Falls	267	262	262	262	262	262	262	240	214	187	160	140	140
Mart	McLennan	233	228	228	227	227	228	227	210	186	163	140	140	140
McGregor	McLennan	238	233	233	233	233	233	233	214	190	167	140	140	140
McLennan County WCID 2	McLennan	172	167	166	166	166	167	167	155	140	140	140	140	140

WUG	COUNTY	GPCD Board Projections without Advanced Conservation							GPCD Goal with Advanced Conservation					
		Base GPCD 2011	Projected GPCD						Projected GPCD					
		2011	2030	2040	2050	2060	2070	2080	2030	2040	2050	2060	2070	2080
Meridian	Bosque	145	140	140	139	139	140	140	140	140	140	140	140	140
Milano WSC	Burleson	167	162	162	162	162	162	162	150	140	140	140	140	140
Milano WSC	Milam	167	162	162	162	162	162	162	150	140	140	140	140	140
Mineral Wells	Parker	180	175	175	175	174	174	174	162	140	140	140	140	140
Mineral Wells	Palo Pinto	180	175	175	175	175	175	175	162	140	140	140	140	140
Moffat WSC	Bell	167	162	162	162	162	161	162	150	140	140	140	140	140
Mountain WSC	Coryell	157	153	152	152	152	152	152	140	140	140	140	140	140
Munday	Knox	180	175	175	175	175	174	175	162	144	140	140	140	140
Mustang Valley WSC	Bosque	215	211	210	210	210	210	210	194	172	151	140	140	140
Mustang Valley WSC	Coryell	215	198	198	223	198	223	206	194	172	151	140	140	140
Navasota	Grimes	183	178	178	178	178	178	178	165	146	140	140	140	140
Noack WSC	Williamson	189	184	184	184	184	184	184	170	151	132	120	120	120
North Bosque WSC	McLennan	279	274	274	274	274	274	274	251	223	195	167	140	140
North Milam WSC	Falls	173	198	128	149	179	223	298	156	140	140	140	140	140
North Milam WSC	Milam	173	168	168	167	167	168	168	156	140	140	140	140	140
Parker WSC	Hill	147	142	142	144	141	141	142	140	140	140	140	140	140
Parker WSC	Hill	147	137	134	131	152	149	145	140	140	140	140	140	140
Parker WSC	Johnson	147	142	142	142	142	142	141	140	140	140	140	140	140
Parker WSC	Johnson	147	144	142	140	143	143	143	140	140	140	140	140	140
Pendleton WSC	Bell	169	165	164	164	164	164	164	152	140	140	140	140	140
Possum Kingdom WSC	Palo Pinto	384	379	378	378	378	378	378	346	307	269	230	192	154
Possum Kingdom WSC	Stephens	384	372	446	298	446	0	0	346	307	269	230	192	154
Post Oak SUD	Navarro	205	200	200	201	199	199	201	185	164	144	140	140	140
Post Oak SUD	Hill	205	201	196	200	197	199	203	185	164	144	140	140	140
Post Oak SUD	Hill	205	200	200	200	200	200	199	185	164	144	140	140	140
Post Oak SUD	Limestone	205	210	189	195	208	185	191	185	164	144	140	140	140
Post Oak SUD	Limestone	205	197	206	203	200	201	209	185	164	144	140	140	140
Prairie Hill WSC	Limestone	183	179	179	178	179	177	179	165	146	140	140	140	140
Prairie Hill WSC	McLennan	183	179	178	178	178	178	178	165	146	140	140	140	140
Ranger	Eastland	166	161	160	160	160	160	160	149	140	140	140	140	140
Rio Vista	Hill	159	179	179	179	149	149	149	143	127	140	140	140	140
Rio Vista	Johnson	159	154	154	154	154	154	154	143	127	140	140	140	140
Rising Star	Eastland	171	166	165	165	165	165	165	154	140	140	140	140	140

WUG	COUNTY	GPCD Board Projections without Advanced Conservation							GPCD Goal with Advanced Conservation					
		Base GPCD 2011	Projected GPCD						Projected GPCD					
		2011	2030	2040	2050	2060	2070	2080	2030	2040	2050	2060	2070	2080
Robertson County WSC	Robertson	143	138	137	137	137	137	138	140	140	140	140	140	140
Robinson	McLennan	200	195	195	195	195	195	195	180	160	140	140	140	140
Roby	Fisher	207	203	201	201	202	201	201	186	166	145	140	140	140
Rockdale	Milam	198	193	193	193	193	193	193	178	158	140	140	140	140
Rogers	Bell	164	159	158	158	159	158	158	148	140	140	140	140	140
Roscoe	Nolan	186	181	180	180	180	180	180	167	149	140	140	140	140
Rotan	Fisher	165	160	160	160	160	160	160	149	140	140	140	140	140
Salado WSC	Bell	296	292	291	291	291	291	291	266	237	207	178	148	140
Salem Elm Ridge WSC	Milam	175	171	170	170	170	170	171	158	140	140	140	140	140
Snook	Burleson	318	313	312	312	312	312	312	286	254	223	191	159	140
Somervell County Water District	Somervell	240	236	235	235	235	235	235	216	192	168	144	140	140
Somerville	Burleson	187	182	181	181	182	181	181	168	150	140	140	140	140
Southwest Milam WSC	Burleson	190	186	184	185	185	185	185	171	152	140	140	140	140
Southwest Milam WSC	Lee	190	185	185	185	185	185	185	171	152	140	140	140	140
Southwest Milam WSC	Milam	190	185	185	185	185	185	185	171	152	140	140	140	140
Southwest Milam WSC	Williamson	190	186	185	185	185	185	185	171	152	140	140	140	140
Sportsmans World MUD	Palo Pinto	890	881	881	881	881	881	881	801	712	623	534	445	356
Spring Valley WSC	McLennan	160	155	155	155	155	155	155	140	140	140	140	140	140
Staff WSC	Eastland	143	139	138	138	138	138	139	140	140	140	140	140	140
Staff WSC	Stephens	143	141	136	139	139	140	137	140	140	140	140	140	140
Stamford	Jones	233	228	228	228	228	228	228	210	186	163	140	140	140
Stephens Regional SUD	Stephens	178	173	173	173	173	172	173	160	140	140	140	140	140
Stephens Regional SUD	Throckmorton	178	175	174	173	171	172	175	160	140	140	140	140	140
Strawn	Palo Pinto	207	202	202	201	202	202	201	186	166	145	140	140	140
Sweetwater	Nolan	144	139	139	139	139	139	139	140	140	140	140	140	140
TDCJ Luther Units	Grimes	247	243	243	243	243	243	243	222	198	173	148	140	140
TDCJ W Pack Unit	Grimes	245	240	239	239	239	239	239	221	196	172	147	140	140
Temple	Bell	227	222	222	222	222	222	222	204	182	159	140	140	140

WUG	COUNTY	GPCD Board Projections without Advanced Conservation							GPCD Goal with Advanced Conservation					
		Base GPCD 2011	Projected GPCD						Projected GPCD					
		2011	2030	2040	2050	2060	2070	2080	2030	2040	2050	2060	2070	2080
Texas A&M University	Brazos	477	472	472	472	472	472	472	429	382	334	286	239	191
Texas State Technical College	McLennan	1804	1800	1799	1799	1799	1799	1799	1624	1443	1263	1082	902	722
Throckmorton	Throckmorton	216	211	210	211	210	211	210	194	173	151	140	140	140
Tolar	Hood	148	144	143	144	143	144	143	140	140	140	140	140	140
Twin Creek WSC	Robertson	223	218	217	218	218	218	218	201	178	156	140	140	140
Tye	Taylor	143	138	136	137	137	136	138	140	140	140	140	140	140
Valley Mills	Bosque	179	174	174	173	174	174	173	161	140	140	140	140	140
Valley Mills	McLennan	179	179	167	206	179	223	149	161	140	140	140	140	140
Venus	Johnson	168	163	162	162	162	162	163	151	140	140	140	140	140
View Caps WSC	Taylor	150	145	144	144	144	145	144	140	140	140	140	140	140
Waco	McLennan	222	217	216	216	216	217	217	200	178	155	140	140	140
Wellborn SUD	Brazos	188	184	184	184	184	184	184	169	150	140	140	140	140
Wellborn SUD	Robertson	188	184	184	184	184	184	184	169	150	140	140	140	140
West	McLennan	165	160	160	160	159	159	160	149	140	140	140	140	140
West Bell County WSC	Bell	166	161	161	161	161	161	161	149	140	140	140	140	140
West Brazos WSC	Falls	159	154	155	154	154	155	154	140	140	140	140	140	140
West Brazos WSC	McLennan	159	154	154	154	154	154	154	140	140	140	140	140	140
Whitney	Hill	172	167	167	167	166	167	167	155	140	140	140	140	140
Williamson County WSID 3	Williamson	184	179	178	179	179	178	178	166	147	129	120	120	120
Williamson County WSID 3	Williamson	184	180	179	178	178	179	178	166	147	129	120	120	120
Williamson County WSID 3	Travis	184	180	178	177	179	179	180	166	147	129	120	120	120
Williamson Travis Counties MUD 1	Williamson	141	136	136	135	136	136	135	127	120	120	120	120	120
Williamson Travis Counties MUD 1	Williamson	141	136	136	136	136	136	136	127	120	120	120	120	120
Williamson Travis Counties MUD 1	Travis	141	136	136	136	136	136	136	127	120	120	120	120	120
Windsor Water	McLennan	148	144	143	142	143	143	143	140	140	140	140	140	140
Woodrow Osceola WSC	Hill	176	172	171	171	171	171	171	158	140	140	140	140	140
Woodway	McLennan	351	346	346	346	346	346	346	316	281	246	211	176	140

Table 5.4 Estimated Annual Water Savings for WUGs with Recommended Conservation

WUG	COUNTY	Additional Water Saved with Advanced Conservation					
		2030	2040	2050	2060	2070	2080
439 WSC	Bell	113	286	324	356	381	393
Abilene	Taylor	1,995	5,139	6,489	6,866	7,285	7,756
Acton MUD	Hood	169	441	601	653	709	769
Acton MUD	Johnson	1	2	2	2	2	2
Albany	Shackelford	47	89	124	152	170	145
Armstrong WSC	Bell	52	57	62	65	69	73
Aspermont	Stonewall	21	42	60	77	90	97
Axtell WSC	McLennan	25	27	30	34	38	41
Baird	Callahan	26	58	86	86	84	83
Bartlett	Bell	10	22	34	38	36	34
Bartlett	Williamson	15	35	55	66	67	69
Bell County WCID 1	Bell	8	18	28	38	48	57
Bell County WCID 2	Bell	25	64	67	68	70	72
Bell County WCID 3	Bell	122	208	268	328	342	357
Bell Milam Falls WSC	Bell	29	45	47	49	50	51
Bell Milam Falls WSC	Falls	16	22	21	19	17	15
Bell Milam Falls WSC	Milam	18	26	25	25	24	23
Bell Milam Falls WSC	Williamson	4	9	10	13	16	19
Belton	Bell	402	466	546	619	680	722
Benjamin	Knox	5	10	14	19	21	18
Bethesda WSC	Tarrant	6	14	21	21	23	24
Bethesda WSC	Johnson	586	1,519	2,244	2,489	2,761	3,068
Bistone Municipal Water Supply District	Limestone	23	45	66	86	102	117
Brandon Irene WSC	Navarro	2	5	8	11	14	16
Brandon Irene WSC	Hill	23	51	83	114	127	131
Brandon Irene WSC	Hill	20	48	76	106	119	121
Breckenridge	Stephens	69	91	83	79	74	66
Bremond	Robertson	12	27	31	30	29	28
Brenham	Washington	342	778	1,217	1,622	1,624	1,626
Bruceville Eddy	Falls	27	81	134	196	224	254
Bruceville Eddy	McLennan	115	263	436	637	732	767
Brushy Creek MUD	Williamson	294	693	1,085	1,302	1,302	1,302
Brushy Creek MUD	Williamson	4	11	16	19	19	19
Bryan	Brazos	1,410	3,253	3,853	4,568	5,753	7,243
Burleson	Tarrant	0	0	0	0	0	0
Burleson	Johnson	0	0	0	0	0	0

WUG	COUNTY	Additional Water Saved with Advanced Conservation					
		2030	2040	2050	2060	2070	2080
Cade Lakes WSC	Burleson	9	21	31	41	41	40
Caldwell	Burleson	73	162	244	243	241	239
Calvert	Robertson	22	47	71	94	90	86
Cameron	Milam	103	221	338	393	380	365
Cedar Park	Williamson	1,475	3,322	5,228	6,632	6,632	6,632
Cedar Park	Williamson	41	93	146	185	185	185
Cedar Park	Travis	174	444	732	928	928	928
Cego-Durango WSC	Falls	19	21	24	26	29	34
Central Bosque WSC	McLennan	10	15	15	15	17	17
Central Texas College District	Bell	15	32	49	67	85	85
Central Texas College District	Coryell	10	20	31	42	53	53
Chalk Bluff WSC	McLennan	10	9	9	11	12	13
Chappell Hill WSC	Washington	9	19	30	29	28	28
Chatt WSC	Hill	13	19	20	20	20	21
Chatt WSC	Hill	2	4	3	4	4	4
Childress Creek WSC	Bosque	27	58	87	111	106	102
Childress Creek WSC	McLennan	1	2	5	8	9	11
Cisco	Eastland	54	110	114	115	115	117
Cleburne	Johnson	572	1,483	2,360	2,574	2,815	3,084
Clifton	Bosque	60	146	253	272	292	315
College Station	Brazos	1,837	4,993	5,873	6,904	6,781	6,673
Coolidge	Limestone	6	14	14	14	13	12
Coolidge	Limestone	4	9	9	8	8	8
Corix Utilities Texas Inc	Mitchell	38	78	84	84	84	85
Corix Utilities Texas Inc	Lampasas	49	101	102	100	100	98
Corix Utilities Texas Inc	Lampasas	28	59	58	58	57	56
Corix Utilities Texas Inc	Washington	46	97	99	103	106	109
Corix Utilities Texas Inc	Blanco	3	6	6	6	6	6
Corix Utilities Texas Inc	Burnet	1	2	3	3	2	3
Corix Utilities Texas Inc	Burnet	60	136	148	162	178	196
Corix Utilities Texas Inc	Colorado	4	8	7	6	6	6
Corix Utilities Texas Inc	Llano	36	75	76	77	80	82
Corix Utilities Texas Inc	Matagorda	5	11	10	9	9	8
Corix Utilities Texas Inc	Matagorda	0	0	1	1	1	1
Corix Utilities Texas Inc	Mills	7	14	14	13	12	10
Corix Utilities Texas Inc	San Saba	1	3	3	2	2	2
Coryell City Water Supply District	Coryell	67	106	107	106	107	105

WUG	COUNTY	Additional Water Saved with Advanced Conservation					
		2030	2040	2050	2060	2070	2080
Coryell City Water Supply District	Hamilton	4	6	5	5	5	5
Coryell City Water Supply District	McLennan	14	23	24	24	25	25
County-Other, Bell	Bell	37	38	40	37	32	24
Crawford	McLennan	16	41	72	91	100	111
Cross Country WSC	Bosque	5	10	10	9	9	9
Cross Country WSC	McLennan	45	127	141	156	173	192
Cross Plains	Callahan	16	37	58	65	64	63
Deanville WSC	Burleson	26	64	64	63	62	62
Dog Ridge WSC	Bell	71	172	187	197	209	221
Double Diamond Utilities	Hill	149	311	478	651	831	1,023
Double Diamond Utilities	Johnson	61	166	314	500	739	1,041
Double Diamond Utilities	Palo Pinto	104	213	318	423	526	629
East Bell WSC	Bell	27	24	22	21	20	19
East Bell WSC	Falls	2	1	1	1	1	2
East Crawford WSC	McLennan	29	65	104	147	194	219
Eastland	Eastland	59	50	46	42	40	37
Elm Creek WSC	Bell	0	0	0	0	0	0
Elm Creek WSC	Coryell	0	0	0	0	0	0
Elm Creek WSC	McLennan	0	0	0	0	0	0
Fern Bluff MUD	Williamson	88	215	349	454	454	454
Fern Bluff MUD	Williamson	2	5	7	9	10	10
Files Valley WSC	Ellis	13	39	47	55	62	72
Files Valley WSC	Hill	17	44	45	45	46	47
Files Valley WSC	Hill	39	100	101	103	106	108
Flat WSC	Coryell	17	37	58	77	88	88
Fort Gates WSC	Coryell	38	85	114	113	112	111
Fort Griffin SUD	Shackelford	6	13	13	14	13	13
Fort Griffin SUD	Stephens	7	16	17	18	16	16
Fort Griffin SUD	Throckmorton	3	4	4	5	4	4
Fort Hood	Bell	377	903	1,462	1,801	1,866	1,930
Fort Hood	Coryell	284	682	1,103	1,360	1,408	1,456
Gatesville	Coryell	354	780	1,247	1,686	1,836	1,844
Georgetown	Bell	62	202	353	354	359	354
Georgetown	Williamson	3,522	14,682	32,179	39,700	48,473	56,324
Georgetown	Burnet	8	27	49	52	56	59
Giddings	Lee	43	100	129	126	123	120
Giddings	Lee	45	104	133	132	129	125

WUG	COUNTY	Additional Water Saved with Advanced Conservation					
		2030	2040	2050	2060	2070	2080
Glen Rose	Somervell	46	111	173	173	172	171
Gordon	Erath	1	1	1	1	1	1
Gordon	Palo Pinto	13	29	45	62	79	59
Graham	Young	209	449	674	905	1,130	1,202
Granbury	Hood	225	626	703	787	880	986
Grandview	Johnson	16	17	19	21	24	25
Granger	Williamson	13	29	32	34	36	39
Groesbeck	Limestone	43	75	73	71	69	66
Hamilton	Hamilton	40	101	101	100	98	96
Hamlin	Jones	24	48	56	48	43	39
Harker Heights	Bell	563	1,577	1,786	1,852	1,852	1,852
Haskell	Haskell	43	100	97	97	96	95
Hearne	Robertson	43	39	37	36	35	32
Hewitt	McLennan	258	592	592	592	592	592
Highland Park WSC	Bosque	8	18	28	36	40	39
Highland Park WSC	McLennan	4	9	14	19	23	24
Hilco United Services	Ellis	10	24	33	35	37	40
Hilco United Services	Bosque	21	50	71	76	82	88
Hilco United Services	Hill	75	171	229	233	238	244
Hillsboro	Hill	273	635	1,016	1,180	1,204	1,233
Hilltop WSC	McLennan	0	0	0	0	0	0
Hog Creek WSC	Bosque	7	15	22	28	33	39
Hog Creek WSC	McLennan	30	62	96	127	159	190
Jayton	Kent	8	19	20	21	21	21
Jonah Water SUD	Williamson	511	1,625	3,370	5,331	6,658	8,150
Kempner WSC	Bell	33	85	90	94	99	103
Kempner WSC	Coryell	66	152	150	146	142	137
Kempner WSC	Lampasas	160	378	379	375	370	365
Kempner WSC	Burnet	9	19	19	17	17	16
Knox City	Knox	19	45	69	88	86	87
Lampasas	Lampasas	117	230	252	270	278	273
Lawn	Taylor	4	7	7	6	5	4
Levi WSC	Falls	9	24	47	74	83	92
Levi WSC	McLennan	40	90	145	211	218	228
Lexington	Lee	29	71	69	68	66	65
Lipan	Hood	0	0	0	0	0	0
Little Elm Valley WSC	Bell	26	60	63	66	70	73

WUG	COUNTY	Additional Water Saved with Advanced Conservation					
		2030	2040	2050	2060	2070	2080
Little Elm Valley WSC	Falls	1	2	3	4	5	5
Lorena	McLennan	40	86	90	93	97	101
Marlin	Falls	114	231	344	448	524	531
Mart	McLennan	37	79	116	143	128	111
McGregor	McLennan	214	502	808	1,188	1,243	1,304
McLennan County WCID 2	McLennan	16	32	30	27	23	19
Meridian	Bosque	0	0	0	0	0	0
Milano WSC	Burleson	18	32	33	34	34	34
Milano WSC	Milam	20	36	34	33	32	31
Mineral Wells	Parker	26	74	78	81	81	81
Mineral Wells	Palo Pinto	250	692	728	765	765	765
Moffat WSC	Bell	29	45	40	36	31	29
Mountain WSC	Coryell	27	27	28	28	27	27
Munday	Knox	17	41	47	47	48	50
Mustang Valley WSC	Bosque	34	76	114	131	124	119
Mustang Valley WSC	Coryell	0	1	2	2	3	2
Navasota	Grimes	118	294	360	369	380	390
Noack WSC	Williamson	11	28	45	58	59	61
North Bosque WSC	McLennan	55	133	231	351	492	552
North Milam WSC	Falls	0	0	0	0	0	1
North Milam WSC	Milam	13	30	28	27	26	25
Parker WSC	Hill	0	0	1	0	0	1
Parker WSC	Hill	0	0	0	1	0	0
Parker WSC	Johnson	3	3	3	2	3	2
Parker WSC	Johnson	1	0	0	1	1	1
Pendleton WSC	Bell	31	66	69	70	73	76
Possum Kingdom WSC	Palo Pinto	51	112	169	228	286	342
Possum Kingdom WSC	Stephens	0	1	0	0	0	0
Post Oak SUD	Navarro	8	19	28	27	24	22
Post Oak SUD	Hill	2	4	7	7	8	9
Post Oak SUD	Hill	13	32	50	55	56	57
Post Oak SUD	Limestone	1	1	2	2	1	2
Post Oak SUD	Limestone	1	4	6	6	5	6
Prairie Hill WSC	Limestone	10	24	27	27	25	24
Prairie Hill WSC	McLennan	11	29	38	44	49	54
Ranger	Eastland	31	48	46	45	43	43
Rio Vista	Hill	0	0	0	0	0	0

WUG	COUNTY	Additional Water Saved with Advanced Conservation					
		2030	2040	2050	2060	2070	2080
Rio Vista	Johnson	14	37	21	24	28	31
Rising Star	Eastland	10	19	18	17	17	16
Robertson County WSC	Robertson	0	0	0	0	0	0
Robinson	McLennan	234	605	1,086	1,238	1,413	1,614
Roby	Fisher	10	20	31	34	33	33
Rockdale	Milam	128	292	446	449	452	456
Rogers	Bell	12	18	18	17	16	16
Roscoe	Nolan	18	37	46	45	45	44
Rotan	Fisher	18	31	30	30	29	28
Salado WSC	Bell	216	512	892	1,344	1,906	2,257
Salem Elm Ridge WSC	Milam	13	29	28	27	26	25
Snook	Burleson	35	77	117	158	198	221
Somervell County Water District	Somervell	125	282	444	598	619	614
Somerville	Burleson	20	47	60	61	60	60
Southwest Milam WSC	Burleson	13	30	44	46	49	51
Southwest Milam WSC	Lee	8	20	29	30	32	34
Southwest Milam WSC	Milam	91	202	266	257	247	238
Southwest Milam WSC	Williamson	28	79	136	166	199	237
Sportsmans World MUD	Palo Pinto	7	14	22	29	36	43
Spring Valley WSC	McLennan	43	49	53	59	66	72
Staff WSC	Eastland	0	0	0	0	0	0
Staff WSC	Stephens	0	0	0	0	0	0
Stamford	Jones	59	123	173	210	181	146
Stephens Regional SUD	Stephens	38	97	99	102	107	114
Stephens Regional SUD	Throckmorton	4	9	8	7	7	7
Strawn	Palo Pinto	10	22	34	37	37	37
Sweetwater	Nolan	0	0	0	0	0	0
TDCJ Luther Units	Grimes	28	59	91	124	135	135
TDCJ W Pack Unit	Grimes	36	81	126	173	186	186
Temple	Bell	2,375	5,762	9,836	13,473	14,215	15,045
Texas A&M University	Brazos	957	1,979	3,037	4,095	5,131	6,189
Texas State Technical College	McLennan	197	399	600	803	1,005	1,206
Throckmorton	Throckmorton	12	24	36	39	38	35
Tolar	Hood	5	5	6	6	8	8
Twin Creek WSC	Robertson	17	40	60	73	69	66
Tye	Taylor	0	0	0	0	0	0
Valley Mills	Bosque	18	48	48	50	51	51

WUG	COUNTY	Additional Water Saved with Advanced Conservation					
		2030	2040	2050	2060	2070	2080
Valley Mills	McLennan	0	0	1	0	1	0
Venus	Johnson	33	57	53	50	46	43
View Caps WSC	Taylor	11	10	11	12	13	13
Waco	McLennan	3,008	7,396	12,685	16,949	18,261	19,732
Wellborn SUD	Brazos	473	1,198	1,836	2,188	2,582	3,025
Wellborn SUD	Robertson	31	66	83	80	77	73
West	McLennan	36	64	66	68	70	73
West Bell County WSC	Bell	59	108	113	117	120	125
West Brazos WSC	Falls	12	12	11	11	11	11
West Brazos WSC	McLennan	25	27	28	31	34	37
Whitney	Hill	33	75	76	77	79	80
Williamson County WSID 3	Williamson	56	178	360	529	643	775
Williamson County WSID 3	Williamson	11	34	68	100	123	147
Williamson County WSID 3	Travis	7	13	16	17	13	11
Williamson Travis Counties MUD 1	Williamson	18	30	30	31	30	30
Williamson Travis Counties MUD 1	Williamson	21	37	38	38	38	39
Williamson Travis Counties MUD 1	Travis	12	21	21	21	21	21
Windsor Water	McLennan	3	2	2	2	2	3
Woodrow Osceola WSC	Hill	43	102	104	106	108	111
Woodway	McLennan	348	744	1,145	1,547	1,948	2,361

5.1.4 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 5.5.

Table 5.5 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

Issue	Description
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

5.1.5 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 2.1.2XXXX, water savings (yield) and costs to implement these strategies reported in TWDB guidance documents are summarized in Table 5.6. Costs and savings presented are general and often sparse, based on a range of variables affecting implementation and level of success.

Table 5.6 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 Uniform Costing Model](#) 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](#). [Large/Small meter replacement](#).
- [Bathroom Retrofit](#). [Leak Detection and Repair](#).
- [Showerhead and Aerator Kit](#). [Advanced Pressure Management](#).
- [Clothes Washer Rebate](#). [Public and School Education](#).

- Home Water Reports Water Audits.
- Irrigation Audits– High Users.
- High Efficiency Sprinkler Nozzle Rebate.
- Smart Irrigation Controller Rebate.
- WaterWise Landscape Rebate.
- Rainwater Harvesting Rebate.
- Rain Barrel/Other category for user defined savings and cost BMPs.

The costs to implement these BMPs ranges from \$271-153 to \$1,358-940 per ac-ft 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 also has a simple costing method consisting of three WUG density classifications, three Brazos G water user groups were selected to represent a range of Small Rural, Medium Suburban and Large Urban utilities for costing purposes.

As an example The City of Hico records in the TWDB tool were considered representative of "Small Rural" Brazos G municipal water users; the City of Taylor was considered representative of "Medium Suburban" Brazos G municipal water users; and the City of Waco was considered representative of "Large Urban." 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 simplified costs to implement conservation these BMPs were \$560-888 per ac-ft per year of water saved for Rural WUGs, \$785 per ac-ft per year for Suburban WUGs, and did not vary much amongst small, medium, and large users \$692 per ac-ft per year for Urban WUGs.

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 5.7. 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 5.7.

Commented [MP5]: Data to be updated.

Table 5.7 Estimated Cost of Conservation to Achieve Water Savings Identified in Table 5.4

Commented [MP6]: Data to be updated.

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

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

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

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

5.1.6 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 5.8, and the option meets each criterion.

Table 5.8 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	<ul style="list-style-type: none"> No apparent negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	<ul style="list-style-type: none"> None
E. Equitable Comparison of Strategies Deemed Feasible	<ul style="list-style-type: none"> Option is considered to meet municipal shortages
F. Requirements for Interbasin Transfers	<ul style="list-style-type: none"> Not applicable
G. Third Party Social and Economic Impacts from Voluntary Redistribution	<ul style="list-style-type: none"> Not applicable

5.1.7 Water Loss Reduction

The TWDB provided results of their 2010-2022 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 2026 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.

Commented [MP7]: Data to be updated.

Commented [MP8]: Data to be updated.

The Brazos G In previous planning efforts the Brazos G RWPG has 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 ~~ac-ft~~ 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. For the 2026 Brazos G Plan the RWPG is once again evaluating potential water supply savings and cost of water loss reduction WMSs.

5.2 Irrigation Water Conservation

5.2.1 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.

5.2.2 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 ~~2020-2030~~ to ~~2070-2080~~. A voluntary target is recommended for these irrigation entities with needs to reduce water demands by 3% by ~~2020-2030~~, 5% by ~~2030-2040~~, and 7% from ~~2040-2050-2070-2080~~. In the Brazos G Area, eighteen counties are projected to have irrigation needs (shortages) during the ~~2020-2030~~ to ~~2070-2080~~ planning period.

This conservation can be achieved in a variety of ways, including using BMPs identified by the TWDB⁷, such as:

1. Irrigation Scheduling;
2. Volumetric Measurement of Irrigation Water Use;
3. Crop Residue Management and Conservation Tillage;
4. On-farm Irrigation audit;

⁷ TWDB website: <https://www.twdb.texas.gov/conservation/BMPs/Ag/index.asp>

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;
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 5.9. 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.

5.2.2.1 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 5.9. 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>

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

Low Elevation Spray Application (LESA) with 75 to 90 percent application efficiency ~~improve~~ improves 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 (ac-ft/acre) and cost per ac-ft 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 5.10 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 (ac-ft/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 5.10, this conversion to higher efficiency BMP is expected to save between 0.21 to 0.66 ac-ft/acre at a cost of \$680 to \$2,118 per ac-ft of water saved.

A 15.7 percent reduction in irrigation water demand by 2070-2080 for irrigation counties with needs results in a water savings of up to 19,138,152,227 ac-ft/yr in 2070-2080 for the region as seen in Table 5.11.

Commented [MP9]: Data to be updated.

Table 5.10 Costs and Savings by Implementing LESA/LEPA Water Conservation Techniques (BMPs)

Commented [MP10]: Data to be updated.

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 5.11 Projected Irrigation Water Savings (acftac-ft/yr) with Conservation

WUG	Water Saved (AFY) with Voluntary Reduction in Demand of 3% by 2030; 5% by 2040; and 7% from 2050-2080					
	2030 (3%)	2040 (5%)	2050 (7%)	2060 (7%)	2070 (7%)	2080 (7%)
Irrigation, Bell	93	155	218	218	218	218
Irrigation, Comanche	788	1,314	1,839	1,839	1,839	1,839
Irrigation, Grimes	21	36	49	49	49	49
Irrigation, Hamilton	34	57	80	80	80	80
Irrigation, Haskell	1,493	2,488	3,483	3,483	3,483	3,483
Irrigation, Hill	14	23	32	32	32	32
Irrigation, Johnson	16	28	38	38	38	38
Irrigation, Jones	81	135	189	189	189	189
Irrigation, Knox	1,111	1,851	2,592	2,592	2,592	2,592
Irrigation, Lampasas	13	22	31	31	31	31
Irrigation, McLennan	154	256	359	359	359	359
Irrigation, Nolan	389	648	880	863	852	852
Irrigation, Palo Pinto	65	108	152	152	152	152
Irrigation, Robertson	2,198	3,664	5,129	5,129	5,129	5,129
Irrigation, Stephens	5	8	11	11	11	11
Irrigation, Taylor	42	72	100	100	100	100
Irrigation, Williamson	12	20	28	28	28	28
Irrigation, Young	19	32	45	45	45	45
Total Brazos G water savings for Irrigation WUGs with needs (AFY)	6,548	10,917	15,255	15,238	15,227	15,227

5.2.3 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.

5.2.4 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 ~~8,3086,548 acftac-ft/yr~~ beginning in ~~2020~~2030, ~~18,980~~10,917 acftac-ft/yr in 2040 and ~~19,183~~15,227 acftac-ft/yr in ~~2070~~2080 as shown in Table 5.11. Braz

Commented [MP11]: Data to be updated.

os 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 5.9 were used to calculate a cost per ~~ac-ft~~ ac-ft of water saved. This was then used to calculate a total estimated cost based on water saved in Table 5.11. 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 5.12.

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.

Commented [MP12]: Data to be updated.

Table 5.12 Brazos G Irrigation Water Savings and Estimated Costs

Commented [MP13]: Data to be updated.

Brazos G Water User Group	Water Saved (AFY) with Voluntary Reduction in Demand of 3% by 2030; 5% by 2040; and 7% from 2050-2080						\$ per ac-ft water saved	Costs of Water Savings (\$)					
	2030	2040	2050	2060	2070	2080		2030	2040	2050	2060	2070	2080
Irrigation, Bell	93	155	218	218	218	218							
Irrigation, Comanche	788	1,314	1,839	1,839	1,839	1,839							
Irrigation, Grimes	21	36	49	49	49	49							
Irrigation, Hamilton	34	57	80	80	80	80							
Irrigation, Haskell	1,493	2,488	3,483	3,483	3,483	3,483							
Irrigation, Hill	14	23	32	32	32	32							
Irrigation, Johnson	16	28	38	38	38	38							
Irrigation, Jones	81	135	189	189	189	189							
Irrigation, Knox	1,111	1,851	2,592	2,592	2,592	2,592							
Irrigation, Lampasas	13	22	31	31	31	31							
Irrigation, McLennan	154	256	359	359	359	359							
Irrigation, Nolan	389	648	880	863	852	852							
Irrigation, Palo Pinto	65	108	152	152	152	152							
Irrigation, Robertson	2,198	3,664	5,129	5,129	5,129	5,129							
Irrigation, Stephens	5	8	11	11	11	11							
Irrigation, Taylor	42	72	100	100	100	100							
Irrigation, Williamson	12	20	28	28	28	28							
Irrigation, Young	19	32	45	45	45	45							
Total Brazos G:	6,548	10,917	15,255	15,238	15,227	15,227		\$0	\$0	\$0	\$0	\$0	\$0

5.2.5 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 5.13 and meets most criteria.

Table 5.13 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	<ul style="list-style-type: none"> ▪ No apparent negative impacts on state water resources; no effect on navigation
D. Threats to Agriculture and Natural Resources	<ul style="list-style-type: none"> ▪ None
E. Equitable Comparison of Feasible Strategies	<ul style="list-style-type: none"> ▪ Standard analyses and methods used
F. Requirements for Interbasin Transfers	<ul style="list-style-type: none"> ▪ None
Third Party Social and Economic Impacts from Voluntary Redistribution	<ul style="list-style-type: none"> ▪ None

5.3 Industrial Water Conservation

5.3.1 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 ~~fourteen (14)~~ ~~ten (10)~~ counties in the Brazos G Area with projected manufacturing needs: Bell, Burleson, ~~Comanche, Eastland,~~ Erath, ~~Hamilton~~ ~~Knex~~, Lampasas, Limestone, McLennan, Nolan, ~~Taylor, Stonewall, and~~ Washington, ~~Williamson, and Young~~. In ~~2070~~ ~~2080~~, the estimated water needs are 1,891 ~~acftac-ft~~/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 ~~acftac-ft~~/yr from 2030 through ~~2070~~ ~~2080~~. Grimes, Limestone, Milam, Robertson, and Somervell Counties comprise over 80 percent of the projected regional steam-electric water use in ~~2070~~ ~~2080~~. The Brazos G Area steam-electric users are projected to receive around 90% of their water supplies from surface water sources in ~~2070~~ ~~2080~~. 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 ~~acftac-ft~~/yr, which is 32% of the steam-electric water demand for the Brazos G Area. No conservation recommendations suggested due to the widely differing water use among the different facilities.

In the Brazos G Area, the mining water demands increase from ~~59,340~~ ~~27,387~~ ~~acftac-ft~~/yr in ~~2040~~ ~~2030~~ to ~~60,838~~ ~~26,280~~ ~~acftac-ft~~/yr in ~~2070~~ ~~2080~~. In ~~2070~~ ~~2080~~, the Brazos G Area mining users are projected to receive over 90% of their water supplies from groundwater sources. ~~Fourteen (14)~~ ~~Thirty-one (31)~~ of the thirty-seven counties in the Brazos G Area have projected mining needs over the planning period. In ~~2070~~ ~~2080~~, the estimated water needs are 28,236 ~~acftac-ft~~, which is about 46% of the mining water demand for the Brazos G Area.

5.3.2 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 savings⁸:

1. Industrial Water Audit
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 5.14. 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 14 manufacturing users with projected needs, the total water savings after 7 percent water demand reduction in 2070-2080 is 708 ~~acftac-ft~~/yr as shown in Table 5.15, which amounts to a ~~3722.2~~% reduction in total regional manufacturing shortages.

For the ~~thirty-one (31)~~fourteen (14) mining users with projected needs, the total water savings after 7 percent water demand reduction in 2070-2080 is ~~3,3171,571~~ ~~acftac-ft~~/yr as also shown in Table 5.15, which amounts to a ~~2010.6~~% reduction in total regional mining shortages.

⁸ TWDB website: <https://www.twdb.texas.gov/conservation/BMPs/Ind/index.asp>

Table 5.14 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 5.15 Projected Water Savings for Manufacturing and Mining Water User Groups Considering up to a 7 Percent Demand Reduction by 2040-2050

WUG	Water Saved (AFY) with Voluntary Reduction in Demand of 3% by 2030; 5% by 2040; and 7% from 2050-2080					
	2030 (3%)	2040 (5%)	2050 (7%)	2060 (7%)	2070 (7%)	2080 (7%)
Manufacturing						
Manufacturing, Bell	29	50	73	75	78	81
Manufacturing, Burleson	4	7	10	11	11	12
Manufacturing, Comanche	1	1	2	2	2	2
Manufacturing, Coryell	0	0	0	0	0	0
Manufacturing, Eastland	2	3	4	5	5	5
Manufacturing, Erath	3	5	7	7	7	8
Manufacturing, Hamilton	1	1	2	2	2	2
Manufacturing, Lampasas	7	12	18	18	19	20
Manufacturing, Limestone	7	13	19	19	21	22
Manufacturing, McLennan	172	298	433	449	465	483
Manufacturing, Nolan	16	28	41	42	44	45
Manufacturing, Taylor	22	37	54	56	58	61
Manufacturing, Washington	21	36	52	54	56	59
Manufacturing, Williamson	58	101	147	152	158	164
Manufacturing, Young	3	5	7	8	8	8
Total Brazos G Manufacturing	346	597	869	900	934	972
Mining						
Mining, Brazos	80	135	191	192	194	196
Mining, Burleson	167	278	390	390	390	390
Mining, Eastland	10	16	23	23	23	23
Mining, Grimes	7	11	16	16	16	16
Mining, Haskell	0	0	0	0	0	0
Mining, Hood	131	237	356	375	389	399
Mining, Lee	24	39	55	55	55	55
Mining, Limestone	106	181	262	268	204	209
Mining, Milam	25	42	58	59	59	59
Mining, Nolan	2	4	5	5	5	5
Mining, Palo Pinto	1	1	2	2	2	2
Mining, Somervell	41	73	107	112	115	118
Mining, Taylor	15	27	38	39	39	40
Mining, Throckmorton	3	6	8	8	8	8
Mining, Washington	22	36	51	51	51	51
Total Brazos G Mining	634	1,086	1,562	1,595	1,550	1,571

5.3.3 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.

5.3.4 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.

5.3.5 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 potential. 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 5.16 and the option meets each criterion.

Table 5.16 Comparison of Industrial Conservation to Plan Development Criteria

Impact Category	Comment(s)
A. Water Supply	
1. Quantity	1. Manufacturing Firm Yield: up to 972 acftac-ft /yr (2080) -2. Steam-Electric Firm Yield: up to 14,307 acftac-ft /yr (2080) -3. Mining Firm Yield: up to 5,680 acftac-ft /yr (2080)
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