

5.33 Taylor County Water Supply Plan

Table 5.33-1 lists each water user group in Taylor County and their corresponding surplus or shortage in years 2040 and 2070. A brief summary of the water user groups and the plan for the selected water user are presented in the following subsections.

Table 5.33-1. Taylor County Surplus/(Shortage)

Water User Group	Surplus/(Shortage)		Comment
	2040 (acft/yr)	2070 (acft/yr)	
City of Abilene	(6,763)	(19,771)	Projected shortage - see plan below.
Coleman County SUD			See Callahan County
Hamby WSC			See Jones County
Hawley WSC			See Jones County
City of Lawn	20	13	Projected surplus - see plan below.
City of Merkel	(25)	(41)	Projected shortage - see plan below.
North Runnels WSC	(31)	(31)	See Region F Plan
Potosi WSC	(542)	(586)	Projected shortage - see plan below.
Steamboat Mountain WSC	(155)	(171)	Projected shortage - see plan below.
City of Tye	(4)	(13)	Projected shortage - see plan below.
View Caps WSC	0	(9)	Projected shortage - see plan below.
County-Other	287	(197)	Projected shortage - see plan below.
Manufacturing	0	0	No projected surplus or shortage
Steam-Electric	0	0	No projected demand
Mining	(232)	(181)	Projected shortage - see plan below.
Irrigation	(1,266)	(1,266)	Projected shortage - see plan below.
Livestock	0	0	No projected surplus or shortage

5.33.1 City of Abilene

Description of Supply

The City of Abilene obtains its water supply from surface water from Fort Phantom Hill Reservoir, Fort Phantom Hill Reuse, BRA Main Stem System (Possum Kingdom Reservoir), Hubbard Creek Reservoir and O.H. Ivie (Region F) Reservoir. Abilene also has a wastewater reuse system for non-potable use, with water stored in Lake Kirby. The City supplies several neighboring communities and projected demands indicate shortages through 2070. This WUG is located in Taylor and Jones Counties. Conservation is recommended to reduce the City of Abilene gallons per capita per day (gpcd) to a goal of 140 gpcd.

Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet water needs for the City of Abilene.

- a. Conservation
 - Cost Source: Volume II
 - Date to be Implemented: before 2030
 - Annual Cost: \$560/acft
- b. BRA System Operations Supply
 - Cost Source: Volume II
 - Date to be Implemented: before 2030
 - Project Cost: \$591,881
 - Unit Cost: \$76.50/acft
- c. Water Treatment Plant Expansion
 - Cost Source: Volume II
 - Date to be Implemented: before 2060
 - Project Cost: \$61,665,000
 - Unit Cost: \$0.88/acft
- d. West Texas Water Partnership
 - Cost Source: See 2021 Region F Regional Water Plan
 - Date to be Implemented: before 2030
 - Project Cost: see Region F Water Plan
- e. Unit Cost: maximum of \$1,783/acft Cedar Ridge Reservoir
 - Cost Source: Volume II
 - Date to be Implemented: 2030
 - Project Cost: \$283,646,000
 - Unit Cost: \$853/acft

Table 5.33-2. City of Abilene Demands and Supplies

Projected Demands	Year (acft/yr)					
	2020	2030	2040	2050	2060	2070
Major Water Contract Holders						
City of Abilene	22,261	22,698	23,050	23,440	23,874	24,238
Existing Contractual Sales						
City of Ballinger	1,250	1,250	1,250	1,250	1,250	1,250
City of Baird	77	77	77	77	77	77



Table 5.33-2. City of Abilene Demands and Supplies

Projected Demands	Year (acft/yr)					
	2020	2030	2040	2050	2060	2070
Major Water Contract Holders						
Blair WSC (Taylor C-O)	77	77	77	77	77	77
City of Buffalo Gap (Taylor C-O)	153	153	153	153	153	153
City of Clyde	307	307	307	307	307	307
City of Clyde	11,837	11,837	11,837	11,837	11,837	11,837
City of Lawn	153	153	153	153	153	153
City of Merkel	353	353	353	353	353	353
City of Tye	184	184	184	184	184	184
Eula WSC	61	61	61	61	61	61
Hamby WSC	308	308	308	308	308	308
Hawley WSC	307	307	307	307	307	307
Potosi WSC	307	307	307	307	307	307
Steamboat Mountain WSC	307	307	307	307	307	307
S.U.N. WSC (Taylor C-O)	230	230	230	230	230	230
Tuscola-Taylor County WCID No. 1 (Taylor C-O)	92	92	92	92	92	92
View Caps WSC	199	199	199	199	199	199
County Aggregated Demands						
Taylor County Manufacturing	585	671	671	671	671	671
Total Existing Demands	16,787	16,873	16,873	16,873	16,873	16,873
Recommended Strategies¹						
BAIRD (increase contract amount)	155	152	150	154	159	164
MERKEL (increase contract amount)	20	23	25	29	35	41
Potosi WSC (increase contract amount)	506	525	542	557	572	586
Steamboat Mountain WSC (increase contract amount)	148	151	155	159	165	171
Sweetwater	1,614	1,651	1,668	1,731	1,787	1,839
City of Tye (increase contract amount)	–	2	4	7	11	13
View Caps WSC (increase contract amount)	–	–	–	3	6	9
City of Winters (Region F Recommended Strategy)	212	212	212	212	212	212
CALLAHAN COUNTY-MINING	141	136	119	107	97	87
JONES COUNTY-OTHER	68	82	92	102	112	121
JONES COUNTY-IRRIGATION	106	50	–	–	–	–

Table 5.33-2. City of Abilene Demands and Supplies

Projected Demands	Year (acft/yr)					
	2020	2030	2040	2050	2060	2070
Major Water Contract Holders						
JONES COUNTY-MINING	153	143	124	106	91	78
TAYLOR COUNTY-OTHER	93	93	96	113	125	135
TAYLOR COUNTY-IRRIGATION	1,217	1,184	1,152	1,152	1,152	1,152
TAYLOR COUNTY-MINING	245	237	206	188	172	–
Total Recommended Strategies	4,678	4,641	4,545	4,620	4,696	4,608
Total Demands	43,726	44,212	44,468	44,933	45,443	45,719
Supply Source						
Lake Abilene ²	0	0	0	0	0	0
Lake Kirby ³	0	0	0	0	0	0
BRA Main Stem System ⁴	10,400	10,400	10,400	7,910	7,910	7,910
Lake O.H. Ivie (Colorado River MWD) ⁵	4,794	4,634	4,460	4,030	3,600	3,190
Fort Phantom Hill ⁶	2,300	2,200	2,100	2,000	1,900	1,100
Fort Phantom Hill Reuse ⁷	7,840	7,840	7,840	7,840	7,840	7,840
West Central Texas MWD (Hubbard)	13,077	10,720	8,360	6,000	3,640	1,300
Total Supply	38,411	35,794	33,160	27,780	24,890	21,340
Projected Balance						
Water Balance/(Shortage) (current contracts and supplies)	(637)	(3,777)	(6,763)	(12,533)	(15,857)	(19,771)
Water Balance/(Shortage) (with Recommended Strategies)	(5,315)	(8,418)	(11,308)	(17,153)	(20,553)	(24,379)

¹ WUG needs after conservation

² Lake Abilene is not considered a dependable supply by the City and is currently not used.

³ Lake Kirby is used primarily to store reuse water for the City's reuse customers. Reuse demands are not included in the water demand projections for the City.

⁴ Consistent with the City of Abilene's Purpose and Need memorandum, BRA supplies to Abilene are assumed to be reduced by 24% to account for reductions in supply due to future more severe droughts.

⁵ Updated yields with subordination, 16.54% of the projected yield of Ivie. Reduced by 6% for RO efficiency. 2020-2040 are the supply numbers provided by Region F while 2050-2070 are from the City's P&N.

⁶ Fort Phantom Hill Reservoir Supply is 2-year safe yield less 2,500 acft/yr (Clyde Water Right) for 2020-2060. The 2070 supply matches the City's P&N.

⁷ Fort Phantom Hill Reuse is indirect potable reuse into the reservoir from Abilene's advanced treatment plant known as the Hamby Water Reclamation Facility.

Table 5.33-3. Recommended Plan Costs by Decade for the City of Abilene

Plan Element	2020	2030	2040	2050	2060	2070
<i>Projected Surplus/(Shortage) (acft/yr)</i>	(637)	(3,777)	(6,763)	(12,533)	(15,857)	(19,771)
Conservation						
Supply From Plan Element (acft/yr)	0	1,624	2,197	2,001	1,995	2,023
Annual Cost (\$/yr)	\$0	\$909,351	\$1,230,407	\$1,120,538	\$1,117,158	\$1,132,889
<i>Projected Surplus/(Shortage) after Conservation</i>	(637)	(2,153)	(4,566)	(10,532)	(13,862)	(17,748)
BRA System Operations Supply						
Supply From Plan Element (acft/yr) ¹	5,673	6,890	6,890	5,230	5,230	5,230
Annual Cost (\$/yr)	\$2,391,000	\$2,391,000	\$2,391,000	\$1,616,000	\$1,616,000	\$1,616,000
Unit Cost (\$/acft)	\$347	\$347	\$347	\$309	\$309	\$309
Abilene WTP Expansion (23.2 MGD)						
Supply From Plan Element (acft/yr)	–	26,005	26,005	26,005	26,005	26,005
Annual Cost (\$/yr)	–	\$22,884	\$22,884	\$22,884	\$22,884	\$22,884
Unit Cost (\$/acft)	–	\$0.88	\$0.88	\$0.88	\$0.88	\$0.88
West Texas Water Partnership Supply						
Supply From Plan Element (acft/yr)	–	8,400	8,400	8,400	8,400	8,400
Annual Cost (\$/yr)	–	\$14,977,200	\$14,977,200	\$3,385,200	\$3,385,200	\$3,385,200
Unit Cost (\$/acft)	–	\$1,783	\$1,783	\$403	\$403	\$403
Cedar Ridge Reservoir						
Supply From Plan Element (acft/yr)	–	18,815	18,889	16,300	13,200	10,100
Annual Cost (\$/yr)	–	\$24,535,000	\$28,560,000	\$29,340,000	\$5,016,000	\$5,020,000
Unit Cost (\$/acft)	–	\$1,304	\$1,512	\$1,800	\$380	\$497
¹ Supplies assumed to decrease due to reductions in BRA System Operations supply from future more severe droughts.						

5.33.2 City of Lawn

Description of Supply

City of Lawn obtains its water a contract with the City of Abilene at 153 acft/yr. No shortages are projected for City of Lawn and no changes in water supply are recommended.

Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water supply plan is recommended to meet water needs for the City of Abilene. Conservation is recommended to reduce usage to a goal of 140 gpcd.

- a. Conservation
 - Cost Source: Volume II
 - Date to be Implemented: before 2030
 - Annual Cost: \$560/acft

Table 5.33-4. Recommended Plan Costs by Decade for City of Lawn

Plan Element	2020	2030	2040	2050	2060	2070
<i>Projected Surplus/(Shortage) (acft/yr)</i>	25	22	20	17	15	13
Conservation						
Supply From Plan Element (acft/yr)	–	10	20	23	23	23
Annual Cost (\$/yr)	\$0	\$5,619	\$10,944	\$13,018	\$12,908	\$13,062
<i>Projected Surplus/(Shortage) after Conservation</i>	25	32	40	40	38	36

5.33.3 City of Merkel

Description of Supply

The City of Merkel obtains surface water from local sources and from the City of Abilene at 353 acft/yr. A shortage is projected starting in year 2020 for the City of Merkel.

Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water management strategy is recommended to meet water needs for the City of Merkel. Conservation was considered; however, the entity’s usage is below the selected goal of 140 gpcd.

- a. Water Supply from Abilene
 - Cost Source: Assumed wholesale rate
 - Date to be Implemented: 2020
 - Project Cost: \$0 (Current infrastructure assumed to be adequate)
 - Unit Cost: \$1,694/acft

Table 5.33-5. Recommended Plan Costs by Decade for the City of Merkel

Plan Element	2020	2030	2040	2050	2060	2070
<i>Projected Surplus/(Shortage) (acft/yr)</i>	(20)	(23)	(25)	(29)	(35)	(41)
Conservation						
Supply From Plan Element (acft/yr)	–	–	–	–	–	–
Annual Cost (\$/yr)	–	–	–	–	–	–
<i>Projected Surplus/(Shortage) after Conservation</i>	(20)	(23)	(25)	(29)	(35)	(41)
Purchase from Abilene						
Supply From Plan Element (acft/yr)	20	23	25	29	35	41
Annual Cost (\$/yr)	\$33,880	\$38,962	\$42,350	\$49,126	\$59,290	\$69,454
Unit Cost (\$/acft)	\$1,694	\$1,694	\$1,694	\$1,694	\$1,694	\$1,694

5.33.4 North Runnels WSC

See the Region F plan. The need in Brazos G will be met with sales from the City of Winters.

5.33.5 Potosi WSC

Description of Supply

The Potosi WSC purchases water from the City of Abilene at 307 acft/yr, and shows a projected shortage starting in 2020. This WUG is located in multiple counties (Taylor and Callahan). The shortages shown in the table below represent the cumulative totals for Potosi WSC.

Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water management strategy is recommended to meet water needs for Potosi WSC. Conservation was considered; however, the entity’s current per capita use rate is below the selected target rate of 140 gpcd.

- a. Purchase Additional Water Supply from Abilene
 - Cost Source: Assumed wholesale rate
 - Date to be Implemented: before 2020
 - Project Cost: \$0 (Current infrastructure assumed to be adequate)
 - Unit Cost: \$1,694/acft

Table 5.33-6. Recommended Plan Costs by Decade for Potosi WSC

Plan Element	2020	2030	2040	2050	2060	2070
<i>Projected Surplus/(Shortage) (acft/yr)</i>	(506)	(525)	(542)	(557)	(572)	(586)
Conservation						
Supply From Plan Element (acft/yr)	–	–	–	–	–	–
Annual Cost (\$/yr)	–	–	–	–	–	–
<i>Projected Surplus/(Shortage) after Conservation (acft/yr)</i>	(506)	(525)	(542)	(557)	(572)	(586)
Purchase from City of Abilene						
Supply From Plan Element (acft/yr)	506	525	542	557	572	586
Annual Cost (\$/yr)	\$857,164	\$889,350	\$918,148	\$943,558	\$968,968	\$992,684
Unit Cost (\$/acft)	\$1,694	\$1,694	\$1,694	\$1,694	\$1,694	\$1,694

5.33.6 Steamboat Mountain WSC

Description of Supply

Steamboat Mountain WSC purchases water from the City of Abilene at 228 acft/yr, and shows a projected shortage starting in 2020.

Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water management strategy is recommended to meet water needs for Steamboat Mountain WSC. Conservation was considered; however, the entity’s current per capita use rate is below the selected target rate of 140 gpcd.

- a. Purchase Additional Water Supply from Abilene
 - Cost Source: Assumed wholesale rate
 - Date to be Implemented: before 2020
 - Project Cost: \$0 (Current infrastructure assumed to be adequate)
 - Unit Cost: \$1,694/acft



Table 5.33-7. Recommended Plan Costs by Decade for Steamboat Mountain WSC

Plan Element	2020	2030	2040	2050	2060	2070
<i>Projected Surplus/(Shortage) (acft/yr)</i>	(148)	(151)	(155)	(159)	(165)	(171)
Conservation						
Supply From Plan Element (acft/yr)	–	–	–	–	–	–
Annual Cost (\$/yr)	–	–	–	–	–	–
<i>Projected Surplus/(Shortage) after Conservation</i>	(148)	(151)	(155)	(159)	(165)	(171)
Purchase from City of Abilene						
Supply From Plan Element (acft/yr)	148	151	155	159	165	171
Annual Cost (\$/yr)	\$250,712	\$255,794	\$262,570	\$269,346	\$279,510	\$289,674
Unit Cost (\$/acft)	\$1,694	\$1,694	\$1,694	\$1,694	\$1,694	\$1,694

5.33.7 City of Tye

Description of Supply

The City of Tye purchases water from the City of Abilene at 184 acft/yr, and shows a small need throughout the planning period starting in 2030.

Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water management strategy is recommended for the City of Tye. Conservation was considered; however, the entity’s current per capita use rate is below the selected target rate of 140 gpcd.

- a. Water Supply from Abilene (BRA System Operations Supply)
 - Cost Source: Assumed wholesale rate
 - Date to be Implemented: before 2020
 - Project Cost: \$0 (Current infrastructure assumed to be adequate)
 - Unit Cost: \$1,694/acft

Table 5.33-8. Recommended Plan Costs by Decade for the City of Tye

Plan Element	2020	2030	2040	2050	2060	2070
<i>Projected Surplus/(Shortage) (acft/yr)</i>	0	(2)	(4)	(7)	(11)	(13)
Conservation						
Supply From Plan Element (acft/yr)	–	–	–	–	–	–
Annual Cost (\$/yr)	–	–	–	–	–	–
<i>Projected Surplus/(Shortage) after Conservation</i>	0	(2)	(4)	(7)	(11)	(13)
Purchase from Abilene (BRA System Operations Supply)						
Supply From Plan Element (acft/yr)	0	2	4	7	11	13
Annual Cost (\$/yr)	–	\$3,388	\$6,776	\$11,858	\$18,634	\$22,022
Unit Cost (\$/acft)	–	\$1,694	\$1,694	\$1,694	\$1,694	\$1,694

5.33.8 View Caps WSC

Description of Supply

View Caps WSC purchases water from the City of Abilene at 199 acft/yr. There is a small need starting in 2050. Conservation was considered; however, the entity’s current per capita use rate is below the selected target rate of 140 gpcd.

Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water management strategy is recommended for View Caps WSC.

- a. Water Supply from Abilene (BRA System Operations Supply)
 - Cost Source: Assumed wholesale rate
 - Date to be Implemented: before 2020
 - Project Cost: \$0 (Current infrastructure assumed to be adequate)
 - Unit Cost: \$1,694/acft

Table 5.33-9. Recommended Plan Costs by Decade for the View Caps WSC

Plan Element	2020	2030	2040	2050	2060	2070
<i>Projected Surplus/(Shortage) (acft/yr)</i>	4	2	0	(3)	(6)	(9)
Conservation						
Supply From Plan Element (acft/yr)	–	–	–	–	–	–
Annual Cost (\$/yr)	–	–	–	–	–	–
<i>Projected Surplus/(Shortage) after Conservation</i>	4	2	0	(3)	(6)	(9)
Purchase from Abilene (BRA System Operations Supply)						
Supply From Plan Element (acft/yr)	–	–	–	9	13	15
Annual Cost (\$/yr)	–	–	–	\$15,246	\$22,022	\$25,410
Unit Cost (\$/acft)	–	–	–	\$1,694	\$1,694	\$1,694

5.33.9 County-Other

Description of Supply

County-Other Taylor obtains water supply from Abilene, Steamboat Mountain WSC, and Sweetwater. The water supply entities for Taylor County-Other show a projected shortage.

Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water management strategy is recommended for the County-Other entities. Conservation was considered; however, the entity’s current per capita use rate is below the selected target rate of 140 gpcd.

- a. Water Supply from Abilene (Cedar Ridge Reservoir)
 - Cost Source: Assumed wholesale rate
 - Date to be Implemented: before 2020
 - Project Cost: \$0 (Current infrastructure assumed to be adequate)
 - Unit Cost: \$1,694/acft

Table 5.33-10. Recommended Plan Costs by Decade for Taylor County-Other

Plan Element	2020	2030	2040	2050	2060	2070
<i>Projected Surplus/(Shortage) (acft/yr)</i>	382	336	287	224	166	(197)
Conservation						
Supply From Plan Element (acft/yr)	–	–	–	–	–	–
Annual Cost (\$/yr)	–	–	–	–	–	–
<i>Projected Surplus/(Shortage) after Conservation</i>	382	336	287	224	166	(197)
Purchase from Abilene (Cedar Ridge Reservoir)						
Supply From Plan Element (acft/yr)	–	93	96	113	125	197
Annual Cost (\$/yr)	–	\$157,542	\$162,624	\$191,422	\$211,750	\$228,690
Unit Cost (\$/acft)	–	\$1,694	\$1,694	\$1,694	\$1,694	\$1,694

5.33.10 Manufacturing

Taylor County Manufacturing receives water from the City of Abilene at 1,248 to 2,019 acft/yr, from 2020 to 2070 respectively. A surplus is projected for Manufacturing in Taylor County. No changes in water supply are recommended.

5.33.11 Steam-Electric

The water supply entities for Taylor County Steam-Electric show no projected demand.

5.33.12 Mining

Description of Supply

Mining operations in Taylor County obtains water from the Edwards-Trinity Plateau at 134 acft/yr. Mining is projected to show shortages beginning in 2020. Conservation is recommended for Mining.

Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water management strategies are recommended to meet water needs for Taylor County-Mining. Associated costs are included for each strategy.

a. Conservation

- Cost Source: Volume II
- Date to be Implemented: before 2020
- Annual Cost: not determined



b. Purchase from Abilene

- Cost Source: Assumed wholesale rate
- Date to be Implemented: 2020
- Project Cost: Not enough information to cost delivery
- Unit Cost: \$1,694/acft (BRA wholesale rate only)

Table 5.33-11. Recommended Plan Costs by Decade for Taylor County – Mining

Plan Element	2020	2030	2040	2050	2060	2070
<i>Projected Surplus/(Shortage) (acft/yr)</i>	(257)	(257)	(232)	(212)	(195)	(181)
Conservation						
Supply From Plan Element (acft/yr)	12	20	26	24	23	22
Annual Cost (\$/yr)	ND	ND	ND	ND	ND	ND
<i>Projected Surplus/(Shortage) after Conservation (acft/yr)</i>	(245)	(237)	(206)	(188)	(172)	(159)
Purchase from Abilene						
Supply From Plan Element (acft/yr)	–	237	206	188	172	159
Annual Cost (\$/yr)	–	\$401,478	\$348,964	\$318,472	\$291,368	\$269,346
Unit Cost (\$/acft)	–	\$1,694	\$1,694	\$1,694	\$1,694	\$1,694
ND – Not determined. Costs to implement industrial conservation technologies will vary based on each location						

5.33.13 Irrigation

Description of Supply

Taylor County Irrigation is supplied by groundwater from the Edwards-Trinity at 355 acft/yr and Trinity Aquifer at 14 acft/yr. Irrigation is projected to have shortages beginning in 2020.

Water Supply Plan

Working within the planning criteria established by the Brazos G RWPG and TWDB, the following water management strategies are recommended to meet water needs for Taylor County-Irrigation.

a. Conservation

- Cost Source: Volume II
- Date to be Implemented: before 2020
- Annual Cost: \$1,924/acft

b. Purchase from Abilene

- Cost Source: Assumed wholesale rate
- Date to be Implemented: 2020
- Project Cost: Not enough information to cost delivery
- Unit Cost: \$1,694/acft (BRA wholesale rate only)

Table 5.33-12. Recommended Plan Costs by Decade for Taylor County – Irrigation

Plan Element	2020	2030	2040	2050	2060	2070
<i>Projected Surplus/(Shortage) (acft/yr)</i>	(1,266)	(1,266)	(1,266)	(1,266)	(1,266)	(1,266)
Conservation						
Supply From Plan Element (acft/yr)	49	82	114	114	114	114
Annual Cost (\$/yr)	\$94,375	\$157,291	\$220,207	\$220,207	\$220,207	\$220,207
<i>Projected Surplus/(Shortage) after Conservation (acft/yr)</i>	(1,217)	(1,184)	(1,152)	(1,152)	(1,152)	(1,152)
Purchase from Abilene						
Supply From Plan Element (acft/yr)	1,217	1,184	1,152	1,152	1,152	1,152
Annual Cost (\$/yr)	\$2,061,598	\$2,005,696	\$1,951,488	\$1,951,488	\$1,951,488	\$1,951,488
Unit Cost (\$/acft)	\$1,694	\$1,694	\$1,694	\$1,694	\$1,694	\$1,694

5.33.14 Livestock

Livestock water supply is projected to meet demands through 2070 and no changes in water supply are recommended.