

APPENDIX I
WATER SUPPLY AVAILABLE TO REGION C

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Table I.1 shows the overall water supply available to Region C. Table I.2 shows the overall water supply available to Region C that was reported in the *2006 Region C Water Plan* ⁽¹⁾. The rest of the appendix explains the sources of the data in Table I.1. The table represents the water supply that might be available to the region, whether it is currently connected to a water user group or not. The table is based on:

- Existing water rights ⁽²⁾
- Available supply for reservoirs
- Reliable supplies from run-of-the-river diversions
- Available supply from groundwater
- Estimated local supplies for mining and livestock
- Existing and permitted reuse supplies

Limits to water supply due to current water transmission facilities and wells are not considered in the development of Table I.1. They are considered in Appendix J, Current Supplies by Water User Group.

**Table I.1
Overall Water Supply Availability in Region C
(acre-feet per year)**

SUMMARY	2010	2020	2030	2040	2050	2060
Reservoirs in Region C	1,342,326	1,335,224	1,327,817	1,320,283	1,312,749	1,305,213
Local Irrigation	20,205	20,205	20,205	20,205	20,205	20,205
Other Local Supply	23,701	23,701	23,701	23,701	23,701	23,701
Surface Water Imports	598,775	576,120	552,672	549,222	545,782	542,352
Groundwater	146,152	146,152	146,152	146,152	146,152	146,152
Reuse	203,974	246,510	289,995	312,972	321,405	336,082
REGION C TOTAL	2,335,133	2,347,912	2,360,542	2,374,535	2,369,994	2,373,705

Table I.2
2006 Plan ⁽¹⁾ – Overall Water Supply Availability in Region C
(acre-feet per year)

SUMMARY	2010	2020	2030	2040	2050	2060
Reservoirs in Region C	1,165,080	1,155,771	1,146,113	1,135,964	1,125,705	1,111,096
Local Irrigation	20,205	20,205	20,205	20,205	20,205	20,205
Other Local Supply	23,701	23,701	23,701	23,701	23,701	23,701
Surface Water Imports	564,302	560,292	555,492	550,689	545,898	541,117
Groundwater	106,460	106,460	106,460	106,460	106,460	106,460
Reuse	99,979	105,810	104,800	104,175	103,697	103,429
REGION C TOTAL	1,979,727	1,972,240	1,956,770	1,941,194	1,925,666	1,906,007
Change from 2006 Plan to 2011 Plan	335,406	375,672	403,772	433,341	444,328	467,698

Water Supply Systems and Reservoirs

Table I.3 presents the water availability for water supply systems and reservoirs in Region C. The table also shows the water availability that was presented in the *2006 Region C Water Plan* ⁽¹⁾. In accordance with the Texas Water Development Board's (TWDB) established procedures ⁽³⁾, these surface water supplies are determined using the TCEQ-approved Water Availability Models (WAM). WAMs have been completed for each of the major river basins in Texas. The WAM models were developed for the purpose of reviewing and granting new surface water rights permits. The assumptions in the WAM models are based on the legal interpretation of water rights, and in some cases do not accurately reflect current operations. Availabilities for each water right are analyzed in priority date order, with water rights with the earliest permit date diverting first. WAM Run 3, which is the version used for planning, assumes full permitted diversions by all water rights and no return flows unless return flows are specifically required in the water right. Run 3 also does not include agreements or operations that are not reflected in the water right permits and does not account for reductions in reservoir capacities due to sediment accumulation. For planning purposes, adjustments were made to the WAMs to better reflect current and future surface water conditions in the region. Generally, changes to the WAMs included:

- Assessment of reservoir sedimentation rates and calculation of area-capacity conditions for 2000 and 2060 conditions.
- Inclusion of subordination agreements not already included in the TCEQ WAM
- Inclusion of system operation where appropriate
- Other corrections

The reliable supply from run-of-the-river diversions was assumed equal to the permitted diversion for water rights located on the main stem of the river and 75 percent of the permitted diversion for water rights located on tributaries.

Specific adjustments to the WAMs to more accurately reflect the water rights and agreements for water supply sources in Region C are:

Trinity River Basin WAM

- Modeling of Lake Jacksboro and Lost Creek Reservoir as a system.
- Modeling of Tarrant Regional Water District’s West Fork reservoirs (Bridgeport, Eagle Mountain, and Worth) as a system.
- An upstream diversion of Lake Livingston water from the Trinity River to Fairfield Lake.
- Inclusion of a minimum elevation for Lake Fairfield (305.0 ft. msl).
- Modeling of Dallas’ water rights in the Elm Fork of the Trinity River as a system with Lake Lewisville and Ray Roberts.

Red River Basin WAM

- Modeling of Lake Randell and Valley Lake as stand-alone reservoirs without Lake Texoma backups for the firm yield calculation. These two reservoirs are modeled one day senior to Lake Texoma’s most senior authorization. Backup supply for these reservoirs from Lake Texoma is included in the supplies from Lake Texoma. For firm yield calculations for other reservoirs, the backups for Lake Randell and Valley Lake were retained.
- Modeling of Lake Texoma as a single reservoir with inactive storage rather than modeling as multiple storage pools for the Lake Texoma firm yield calculation. For the firm yield calculation of other reservoirs, multiple storage pools were retained in Lake Texoma.
- Removal of a “dummy” Lake Texoma water right for the State of Oklahoma for 100,000 acre-feet of storage and 113,000 acre-feet per year of diversion. This water right mirrors the recent NTMWD amendment. This change was necessary to limit the water supply storage to 450,000 acre-feet, the amount currently authorized by the U.S. Congress. (TCEQ currently assumes a diversion of 168,000 acre-feet per year from the existing 150,000 acre-feet of storage reserved for

Oklahoma. Currently there are less than 5,000 acre-feet per year of permitted Oklahoma diversions.)

- Addition of 50,000 acre-feet of storage and 56,500 acre-feet per year of diversion from Lake Texoma corresponding to the recent water right obtained by the Greater Texoma Utility Authority.
- Removal of backups of individual pools in Lake Texoma from the hydropower pool. These are not invoked in the WAM because all Lake Texoma rights are reliable using only their pools.

Imports to Region C

Supplies from Lake Chapman were determined using the Sulphur River Basin WAM.

Information obtained from Region D indicated that no adjustments were made to the Sabine River WAM that would impact the currently available water supplies for Region C. Therefore, the yields for Lake Fork and Lake Tawakoni were assumed to be the same as they were in the *2006 Region C Water Plan* ⁽¹⁾.

Region C has very few water supplies in the Brazos River Basin. Thus, the water availability information as determined by the Brazos G Regional Water Planning Group was adopted.

For Lake Palestine and Lake Athens, both in the Neches River Basin, the water availability information as determined by the Region I Water Planning Group was adopted. The available supply for Dallas Water Utilities from Lake Palestine was decreased based on a decreasing firm yield in the reservoir.

For Lake Livingston, the water availability information as determined by the Region H Water Planning Group was adopted.

Table I.3
Currently Available Surface Water Supplies from Reservoirs in Region C
(Not Considering Transmission Constraints)
(Acre-Feet per Year)

	Basin	Revised Surface Water Availability							Surface Water Availability in 2006 Plan						
		2000	2010	2020	2030	2040	2050	2060	2000	2010	2020	2030	2040	2050	2060
WATER SUPPLY SYSTEMS															
Lost Creek/ Jacksboro System	Trinity	1,597	1,597	1,597	1,597	1,597	1,597	1,597	1,440	1,440	1,440	1,440	1,440	1,440	1,440
West Fork (includes Bridgeport Local)	Trinity	110,500	109,833	109,167	108,500	107,833	107,167	106,500	110,000	108,500	107,000	105,500	104,000	102,500	101,000
Elm Fork/ Lewisville/ Ray Roberts (Dallas)	Trinity	185,869	184,801	183,733	182,665	181,597	180,529	179,459	193,753	191,729	189,705	187,681	185,657	183,633	181,609
Grapevine - Dallas	Trinity	7,800	7,583	7,367	7,150	6,933	6,717	6,500	7,700	7,250	6,800	6,350	5,900	5,450	5,000
Subtotal Systems		305,766	303,815	301,863	299,912	297,961	296,009	294,056	312,893	308,919	304,945	300,971	296,997	293,023	289,049
RESERVOIRS IN REGION C															
Cedar Creek	Trinity	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000	175,000
Richland-Chambers (TRWD)	Trinity	210,000	210,000	210,000	210,000	210,000	210,000	210,000	210,000	210,000	210,000	210,000	210,000	210,000	205,650
Richland-Chambers (Corsicana) and Lake Halbert	Trinity	13,880	13,872	13,863	13,855	13,847	13,838	13,830	12,750	12,625	12,500	12,375	12,250	12,125	12,000
Moss	Red	7,410	7,410	7,410	7,410	7,410	7,410	7,410	4,500	4,500	4,500	4,500	4,500	4,500	4,500
Lake Texoma (Texas' Share – NTMWD)	Red	190,300	190,300	190,300	190,300	190,300	190,300	190,300	77,300	77,300	77,300	77,300	77,300	77,300	77,300
Lake Texoma (Texas' Share – GTUA)	Red	25,000	81,500	81,500	81,500	81,500	81,500	81,500	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Lake Texoma (Texas' Share – Denison)	Red	24,400	24,400	24,400	24,400	24,400	24,400	24,400	24,400	24,400	24,400	24,400	24,400	24,400	24,400
Lake Texoma (Texas' Share – Luminant)	Red	16,400	16,400	16,400	16,400	16,400	16,400	16,400	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Lake Texoma (Texas' Share – RRA)	Red	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Randell	Red	1,400	1,400	1,400	1,400	1,400	1,400	1,400	5,280	5,280	5,280	5,280	5,280	5,280	5,280
Valley	Red	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bonham	Red	5,340	5,340	5,340	5,340	5,340	5,340	5,340	5,340	5,340	5,340	5,340	4,850	4,250	3,650
Ray Roberts (Denton)	Trinity	19,240	18,980	18,720	18,460	18,200	17,940	17,680	21,008	20,445	19,882	19,319	18,756	18,193	17,630
Lewisville (Denton)	Trinity	8,020	7,918	7,817	7,715	7,613	7,512	7,410	7,896	7,702	7,507	7,313	7,119	6,924	6,730

Table I.3, Continued

	Basin	Revised Surface Water Availability							Surface Water Availability in 2006 Plan						
		2000	2010	2020	2030	2040	2050	2060	2000	2010	2020	2030	2040	2050	2060
Benbrook	Trinity	6,833	6,833	6,833	6,833	6,833	6,833	6,833	6,834	6,834	6,834	6,834	6,834	6,834	6,834
Weatherford	Trinity	3,010	2,967	2,923	2,880	2,837	2,793	2,750	2,900	2,750	2,600	2,450	2,300	2,150	2,000
Grapevine (PCMUD)	Trinity	17,200	17,050	16,900	16,750	16,600	16,450	16,300	16,800	16,167	15,533	14,900	14,267	13,633	13,000
Grapevine (Grapevine)	Trinity	2,050	2,017	1,983	1,950	1,917	1,883	1,850	1,900	1,833	1,767	1,700	1,633	1,567	1,500
Arlington	Trinity	10,000	9,850	9,700	9,550	9,400	9,250	9,100	8,400	8,333	8,267	8,200	8,133	8,067	8,000
Joe Pool	Trinity	15,500	15,192	14,883	14,575	14,267	13,958	13,650	16,400	15,333	14,267	13,200	12,133	11,067	10,000
Mountain Creek	Trinity	6,400	6,400	6,400	6,400	6,400	6,400	6,400	6,400	6,400	6,400	6,400	6,400	6,400	6,400
North	Trinity	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lake Ray Hubbard (Dallas)	Trinity	58,740	57,427	56,113	54,800	53,487	52,173	50,860	60,700	60,367	60,033	59,700	59,367	59,033	58,700
White Rock	Trinity	3,800	3,500	3,200	2,900	2,600	2,300	2,000	5,900	5,083	4,267	3,450	2,633	1,817	1,000
Terrell	Trinity	2,300	2,283	2,267	2,250	2,233	2,217	2,200	2,300	2,283	2,267	2,250	2,233	2,217	2,200
Clark	Trinity	210	210	210	210	210	210	210	139	139	139	139	139	139	139
Bardwell	Trinity	9,600	9,600	9,600	9,295	8,863	8,432	8,000	8,980	8,567	8,153	7,740	7,327	6,913	6,500
Waxahachie	Trinity	3,010	2,905	2,800	2,695	2,590	2,485	2,380	2,760	2,667	2,573	2,480	2,387	2,293	2,200
Forest Grove	Trinity	8,840	8,767	8,693	8,620	8,547	8,473	8,400	8,600	8,583	8,567	8,550	8,533	8,517	8,500
Trinidad City Lake	Trinity	450	450	450	450	450	450	450	500	500	500	500	500	500	500
Trinidad	Trinity	3,050	3,050	3,050	3,050	3,050	3,050	3,050	3,100	3,067	3,033	3,000	2,967	2,933	2,900
Navarro Mills	Trinity	19,400	19,342	18,333	17,325	16,317	15,308	14,300	19,400	19,400	18,800	17,850	16,900	15,950	15,000
Fairfield	Trinity	870	870	870	870	870	870	870	1,700	1,567	1,433	1,300	1,167	1,033	900
Bryson	Brazos	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mineral Wells	Brazos	2,520	2,508	2,495	2,483	2,470	2,458	2,445	2,520	2,508	2,495	2,483	2,470	2,458	2,445
Teague City Lake	Brazos	189	189	189	189	189	189	189	189	189	189	189	189	189	189
Lake Lavon	Trinity	113,300	112,033	110,767	109,500	108,233	106,967	105,700	104,000	104,000	104,000	104,000	104,000	104,000	104,000
Muenster	Trinity	300	300	300	300	300	300	300	0	0	0	0	0	0	0
Subtotal Reservoirs		986,212	1,038,511	1,033,360	1,027,905	1,022,322	1,016,740	1,011,157	874,396	869,995	864,993	859,642	853,800	847,849	837,547
TOTAL		1,291,978	1,342,326	1,335,224	1,327,817	1,320,283	1,312,749	1,305,213	1,187,289	1,178,914	1,169,938	1,160,613	1,150,797	1,140,872	1,126,596

WATER SUPPLY SYSTEMS

The water supply systems listed are operated as physical systems – the water they provide cannot easily be separated by individual source. The supply available is based on the calculation of the Water Availability Models (WAMs), as described above. More detailed discussions on water supply available for each system are given below.

Lost Creek/Jacksboro System (Jacksboro). Lake Jacksboro is a 2,129 acre-foot reservoir located just outside of the City of Jacksboro in the Trinity River Basin in Jack County, and Lost Creek Reservoir is an 11,961 acre-foot reservoir located 1.5 miles downstream of the Lake Jacksboro dam. The City of Jacksboro holds a water right for the combined use of both reservoirs for municipal water supply and the right to divert 1,440 acre-feet per year. The water right authorizes the reservoirs to be operated as a system, so the WAM was modified to include system operation and the subordination agreement with TRWD. According to the WAM, the firm yield from this system as of 2060 is 2,430 acre-feet per year. The available supply from this system is limited to 1,597 acre-feet per year, which is the permitted amount of 1,397 plus 200 acre-feet per year of return flows that Jacksboro is authorized to use.

West Fork including Bridgeport Local System (Tarrant Regional Water District). Tarrant Regional Water District's West Fork Reservoir system is comprised of Lake Bridgeport, Lake Worth, and Eagle Mountain Lake. The WAM was modified to include the system operation of these three reservoirs. The resulting combined system firm yield was 110,500 acre-feet per year in 2010 and 106,500 acre-feet per year in 2060.

Under current conditions, this system provides somewhat less supply than shown. With existing facilities, it is not possible to divert water from Lake Worth when the lake is drawn down more than four feet, which makes some of the water stored in Lake Worth unavailable. In addition, the Tarrant Regional Water District operates its water supplies on a safe yield basis, which provides a smaller supply than the firm yield numbers shown. (In safe yield operation, the user takes less than the firm yield in order to leave a reserve supply in the reservoir in case a drought worse than any historical drought occurs.)

Elm Fork/Lake Lewisville/Ray Roberts System (Dallas). This system, owned by Dallas, is comprised of Lake Lewisville, Lake Ray Roberts, and run-of-the-river rights from Elm Fork. The WAM was modified to include the system operation of these supplies. The resulting combined system yield was 184,801 acre-feet per year in 2010 and 179,459 acre-feet per year in 2060. The firm yield is higher than what was shown in the 2006 *Region C Water Plan* ⁽¹⁾ due to changes made in the WAM.

Lake Grapevine (Dallas). Dallas includes its portion of supply from Lake Grapevine in its system operation with Elm Fork/Lewisville/Ray Roberts. The WAM was modified to include this system operation. The resulting yield for Dallas' portion of Lake Grapevine was 7,800 acre-feet per year in 2010 and 6,500 acre-feet per year in 2060. The WAM modeling for Lake Grapevine does not include the Lake Grapevine Accounting Plan.

RESERVOIRS IN REGION C

All major reservoirs in Region C as well as some smaller reservoirs used for municipal supply are listed in Table I.3. The supply available is based on the calculation of the Water Availability Models (WAMs), which limits the supply to the lesser of the firm yield or the permit amount.

Cedar Creek. Cedar Creek Reservoir is located on Cedar Creek in the Trinity River Basin in Henderson and Kaufman Counties. The reservoir has a permitted conservation storage of 678,900 acre-feet. Tarrant Regional Water District holds a water right for diversion of 175,000 acre-feet per year. According to the WAM, the firm yield is 211,900 acre-feet per year in 2000, decreasing to 205,200 acre-feet per year by 2060. The available supply from Cedar Creek is limited to the permit amount of 175,000 acre-feet per year.

Richland-Chambers (and Lake Halbert). Richland-Chambers Reservoir is located on Richland Creek in the Trinity River Basin in Freestone and Navarro Counties. The reservoir has a permitted conservation storage of 1,135,000 acre-feet. Tarrant Regional Water District and City of Corsicana hold water rights in the reservoir (210,000 acre-feet per year for TRWD and 13,650 acre-feet per year for Corsicana). According to the WAM, the firm yield of the TRWD water right is 228,300 acre-feet per year in 2000, decreasing to 210,800

acre-feet per year by 2060. The available supply to TRWD from Richland-Chambers is limited to the permitted amount of 210,000 acre-feet per year.

Corsicana's water right in Lake Halbert is backed up by the City's water right in Richland-Chambers. The pipeline connection from Richland-Chambers to Lake Halbert was completed since the *2006 Region C Water Plan* ⁽¹⁾. Lake Halbert is located on Elm Creek in the Trinity River Basin in Navarro County. The reservoir has permitted conservation storage of 7,357 acre-feet. The City of Corsicana holds a water right in Lake Halbert for 4,003 acre-feet per year. According to the WAM, the available supply from Richland Chambers Reservoir and Lake Halbert to Corsicana as of 2060 is 13,830 acre-feet per year.

Moss. Moss Lake is located on Fish Creek in the Red River Basin in Cooke County. The reservoir has permitted conservation storage of 23,210 acre-feet. The City of Gainesville holds water rights in the reservoir for 7,740 acre-feet per year. According to the WAM, the available supply from Moss Lake in 2060 is 7,410 acre-feet per year. The available supply from Moss Lake has increased from what was shown in the *2006 Region C Water Plan* ⁽¹⁾ because the City of Gainesville increased their water right from 4,500 acre-feet per year to 7,740 acre-feet per year.

Texoma (Texas' share). Lake Texoma is located along the Texas and Oklahoma border in the Red River Basin in Grayson and Cooke Counties. The permitted conservation storage for water supply in Texas is 300,000 acre-feet. Red River Authority, Greater Texoma Utility Authority, Denison, North Texas Municipal Water District, and Luminant all hold water rights in the reservoir. Since the *2006 Region C Water Plan* ⁽¹⁾, Luminant increased its Lake Texoma water right by 6,400 acre-feet per year, GTUA increased its Lake Texoma water right by 56,500 acre-feet per year, and North Texas Municipal Water District increased its water right by 113,000 acre-feet per year and increased its permitted storage by 100,000 acre-feet. The total Texoma supply available to Region C as of 2060 is 314,850 acre-feet per year (2,250 acre-feet per year for Red River Authority; 81,500 acre-feet per year for Greater Texoma Utility Authority; 24,400 acre-feet per year for Denison; 190,300 acre-feet per year for NTMWD; and 16,400 acre-feet per year for Luminant). In the case of Texoma, the available supply is limited to the water right amount. The firm yield of Texas' share of Lake Texoma is 643,625 acre-feet per year in 2000, decreasing to 640,575 acre-feet per year by 2060.

Randell. Randell Reservoir is located on an unnamed tributary of Shawnee Creek in the Red River Basin in Grayson County. The reservoir has permitted conservation storage of 5,400 acre-feet. The City of Denison holds a water right in the reservoir for 5,280 acre-feet per year. The supply from Lake Randell is backed up by up to 24,400 acre-feet per year of diversions from Lake Texoma, which are fully reliable. The available supply from Randell Reservoir as of 2060 is 1,400 acre-feet per year without a backup from Lake Texoma. The decrease from the available supply shown in the 2006 *Region C Water Plan* ⁽¹⁾ is due to a change in how the firm yield of Randell Reservoir is reported (without a backup from Lake Texoma).

Valley. Valley Lake is located on Sand Creek in the Red River Basin in Fannin and Grayson Counties. The reservoir has a permitted conservation storage of 15,000 acre-feet. This reservoir is operated by Luminant for steam electric power cooling in conjunction with their water right in Lake Texoma. The total amount of water that can be diverted from either Texoma or Valley Lake is 16,400 acre-feet per year. During drought, it is assumed that the full permitted diversion would be taken from Lake Texoma (see Lake Texoma discussion). Therefore the available supply from Valley Lake is 0 acre-feet per year.

Bonham. Lake Bonham is located on Timber Creek in the Red River Basin in Fannin County. The reservoir has permitted conservation storage of 13,000 acre-feet. The City of Bonham holds a water right in the reservoir for 5,340 acre-feet per year. The NTMWD has an agreement with the City of Bonham to operate the lake and water treatment plant. According to the WAM, the firm yield of Lake Bonham is 6,500 acre-feet per year in 2000, decreasing to 5,800 acre-feet per year by 2060. The available supply from Lake Bonham is limited to the permitted amount of 5,340 acre-feet per year. The increase from the available supply shown in the 2006 *Region C Water Plan* ⁽¹⁾ is due to using a lower sedimentation rate, which was calculated using the 2004 volumetric survey of Lake Bonham.

Ray Roberts (Denton). Lake Ray Roberts and Lake Lewisville were modeled to find the firm yields of Denton's water rights. Lake Ray Roberts is located on the Elm Fork of the Trinity River in Denton, Cooke, and Grayson Counties. The reservoir has a permitted conservation storage of 799,600 acre-feet. The City of Dallas and the City of Denton hold combined water rights in the reservoir totaling 799,600 acre-feet per year, which is much

greater than the actual yield of the reservoir. Dallas' share of Lake Ray Roberts was discussed above under *Water Supply Systems*. According to the WAM, Denton's available supply from Ray Roberts as of 2060 is 17,680 acre-feet per year.

Lewisville (Denton). Lake Lewisville is located on the Elm Fork of the Trinity River in Denton County. The reservoir has a permitted conservation storage of 618,400 acre-feet. The City of Dallas and the City of Denton hold combined water rights in the reservoir totaling 598,900 acre-feet per year, which is much greater than the actual yield of the reservoir. Dallas' share of Lake Lewisville was discussed above under *Water Supply Systems*. According to the WAM, Denton's available supply from Lewisville as of 2060 is 7,410 acre-feet per year.

Benbrook. Lake Benbrook is located on the Clear Fork of the Trinity River in Tarrant County. The reservoir has a permitted conservation storage of 72,500 acre-feet. The authorized use from Lake Benbrook is 6,833 acre-feet per year. Tarrant Regional Water District holds the water right, which specifies use amounts for Benbrook Water and Sewer Authority, City of Fort Worth, and City of Weatherford. According to the WAM, the firm yield of Lake Benbrook is 7,280 acre-feet per year in 2000, decreasing to 6,833 acre-feet per year by 2060. The available supply from Lake Benbrook is limited to the permitted amount of 6,833 acre-feet per year. Lake Benbrook is used as terminal storage for water pumped from Cedar Creek and Richland Chambers Reservoirs. The available supply does not include water from these sources.

Weatherford. Lake Weatherford is located on the Clear Fork of the Trinity River in Parker County. The reservoir has permitted conservation storage of 19,470 acre-feet. The City of Weatherford holds a water right for consumptive use 5,220 acre-feet per year. (The permit also authorizes 59,400 acre-feet per year of non-consumptive industrial use.) According to the WAM, available supply from Lake Weatherford as of 2060 is 2,750 acre-feet per year.

Grapevine. Lake Grapevine is located on Denton Creek in the Trinity River Basin in Tarrant and Denton Counties. The reservoir has a permitted conservation storage of 161,250 acre-feet. City of Dallas, City of Grapevine, and Dallas County Park Cities MUD hold combined water rights in the reservoir totaling 161,250 acre-feet per year, which is much greater than the actual yield of the reservoir. Dallas' share of Lake Grapevine was

discussed above under *Water Supply Systems*. According to the WAM, Dallas County PCMUD's available supply from Lake Grapevine as of 2060 is 16,300 acre-feet per year, and the City of Grapevine's available supply from Lake Grapevine as of 2060 is 1,850 acre-feet per year. The increase in available supply from the available supply shown in the 2006 *Region C Water Plan* ⁽¹⁾ is due to a change made in the TCEQ Trinity WAM to reallocate reservoir evaporation.

Arlington. Lake Arlington is located on Village Creek in the Trinity River Basin in Tarrant County. The reservoir has a permitted conservation storage of 45,710 acre-feet. The City of Arlington and Luminant jointly hold a water right for 23,120 acre-feet per year (13,000 acre-feet per year for Arlington and 10,120 acre-feet per year for Luminant). According to the WAM, available supply from Lake Arlington as of 2060 is 9,100 acre-feet per year. Like Lake Benbrook, Lake Arlington serves as terminal storage for water pumped from Richland-Chambers and Cedar Creek Reservoirs. The available supply from Lake Arlington does not include water from these sources.

Joe Pool. Joe Pool Lake is located on Mountain Creek in the Trinity River Basin in Dallas and Tarrant Counties. The reservoir has a permitted conservation storage of 176,900 acre-feet. The Trinity River Authority holds a water right for 17,000 acre-feet per year. According to the WAM, available supply from Joe Pool Lake as of 2060 is 13,650 acre-feet per year. The available supply is higher than what was shown in the 2006 *Region C Water Plan* ⁽¹⁾ because a lower sedimentation rate was used.

Mountain Creek. Mountain Creek Lake is located on Mountain Creek in the Trinity River Basin in Dallas County. The reservoir has a permitted conservation storage of 22,840 acre-feet. Luminant holds a water right for 6,400 acre-feet per year. According to the WAM, the firm yield of Mountain Creek Lake is 13,300 acre-feet per year in 2000, decreasing to 11,700 acre-feet per year by 2060. The available supply from Mountain Creek Lake is limited to the permitted amount of 6,400 acre-feet per year.

North. North Lake is an off-channel reservoir located on the South Fork of Grapevine Creek in the Trinity River Basin in Dallas County. The reservoir has a permitted conservation storage of 17,100 acre-feet. Luminant holds a water right for 1,000 acre-feet per year. According to the WAM, available supply from North Lake as of 2060 is 0 acre-feet per year without backup from the Elm Fork.

Ray Hubbard. Lake Ray Hubbard is located on the Elm Fork of the Trinity River in Dallas, Kaufman, and Rockwall Counties. The reservoir has a permitted conservation storage of 490,000 acre-feet. The City of Dallas holds a water right for 89,700 acre-feet per year. According to the WAM, available supply from Ray Hubbard as of 2000 is 58,740 acre-feet per year in 2000, decreasing to 50,860 acre-feet per year by 2060. The available supply is less than what was shown in the 2006 *Region C Water Plan*⁽¹⁾ because a higher sedimentation rate based on the 2005 volumetric survey for Lake Ray Hubbard was used.

White Rock. White Rock Lake is located on White Rock Creek in the Trinity River Basin in Dallas County. The reservoir has a permitted conservation storage of 21,345 acre-feet. The City of Dallas holds a water right for 8,703 acre-feet per year. According to the WAM, available supply from White Rock Lake as of 2060 is 2,000 acre-feet per year.

Terrell. Lake Terrell is located on Muddy Cedar Creek in the Trinity River Basin in Kaufman County. The reservoir has a permitted conservation storage of 8,712 acre-feet. The City of Terrell holds a water right for 6,000 acre-feet per year. According to the WAM, available supply from Terrell as of 2060 is 2,200 acre-feet per year.

Clark. Lake Clark is located on Little Mustang Creek in the Trinity River Basin in Ellis County. The reservoir has a permitted conservation storage of 1,549 acre-feet. The City of Ennis holds a water right for 450 acre-feet per year. According to the WAM, available supply from Lake Clark as of 2060 is 210 acre-feet per year. The City of Ennis no longer uses water from Lake Clark.

Bardwell. Lake Bardwell is located on Waxahachie Creek in the Trinity River Basin in Ellis County. The reservoir has a permitted conservation storage of 54,900 acre-feet. The Trinity River Authority holds a water right for 14,729 acre-feet per year (which includes reuse of up to 5,129 acre-feet per year of return flows). According to the WAM, the firm yield of Lake Bardwell is 10,590 acre-feet per year in 2000, decreasing to 8,000 acre-feet per year by 2060. The available supply from Lake Bardwell is the smaller of the firm yield or the permitted amount of 9,600 acre-feet per year without return flows. The available supply is higher than what was shown in the 2006 *Region C Water Plan*⁽¹⁾ because a lower sedimentation rate based on the 1999 volumetric survey for Lake Bardwell was used.

Waxahachie. Lake Waxahachie is located on Waxahachie Creek in the Trinity River Basin in Ellis County. The reservoir has a permitted conservation storage of 13,500 acre-

feet. Ellis County Water Control and Improvement District #1 holds a water right for 3,570 acre-feet per year. According to the WAM, available supply from Lake Waxahachie as of 2060 is 2,380 acre-feet per year.

Forest Grove. Forest Grove Reservoir is located on Caney Creek in the Trinity River Basin in Henderson County. The reservoir has a permitted conservation storage of 20,038 acre-feet. Luminant holds a water right for 9,500 acre-feet per year (not including non-consumptive use). Presently, the dam for Forest Grove Reservoir is built, but the lake has not begun to store water. According to the WAM, available supply from Forest Grove as of 2060 is 8,400 acre-feet per year.

Trinidad City Lake. Trinidad City Lake is located on Cedar Creek in the Trinity River Basin in Henderson County. The reservoir has a permitted conservation storage of 498 acre-feet. The City of Trinidad holds a water right for 1,000 acre-feet per year. According to the WAM, available supply from Trinidad City Lake as of 2060 is 450 acre-feet per year.

Trinidad. Lake Trinidad is an off-channel reservoir located just off the Trinity River in Henderson County. The reservoir has a permitted conservation storage of 6,200 acre-feet. Luminant holds a water right for 4,000 acre-feet per year. According to the WAM, available supply from Lake Trinidad as of 2060 is 3,050 acre-feet per year. However, access to return flows in the watershed make the Lake Trinidad permitted supply reliable.

Navarro Mills. Lake Navarro Mills is located on Richland Creek in the Trinity River Basin in Navarro County. The reservoir has a permitted conservation storage of 63,300 acre-feet. The Trinity River Authority holds a water right for 19,400 acre-feet per year. According to the WAM, available supply from Navarro Mills as of 2060 is 14,300 acre-feet per year.

Fairfield. Lake Fairfield is located on Big Brown Creek in the Trinity River Basin in Freestone County. The reservoir has a permitted conservation storage of 50,600 acre-feet. Luminant holds a water right for 14,150 acre-feet per year. According to the WAM, available supply from Lake Fairfield as of 2060 is 870 acre-feet per year with a minimum operating level of 305.0 feet msl and without backup from the Trinity River.

Bryson. Lake Bryson is located on East Rock Creek in the Brazos River Basin in Jack County. The reservoir has a permitted conservation storage of 950 acre-feet. The City of

Bryson holds a water right for 90 acre-feet per year. According to the WAM, available supply from Bryson as of 2060 is 0 acre-feet per year.

Mineral Wells. Lake Mineral Wells is located on Rock Creek in the Brazos River Basin in Parker County. The reservoir has a permitted conservation storage of 7,065 acre-feet. The City of Mineral Wells holds a water right for 2,520 acre-feet per year. According to the WAM, available supply from Mineral Wells as of 2060 is 2,445 acre-feet per year. The City of Mineral Wells no longer uses water from Lake Mineral Wells.

Teague City Lake. Teague City Lake is located on Holman Creek in the Brazos River Basin in Freestone County. The reservoir has permitted conservation storage of 1,160 acre-feet. The City of Teague holds a water right for 605 acre-feet per year. According to the WAM, available supply from Teague City Lake as of 2060 is 189 acre-feet per year. The City of Teague no longer uses Teague City Lake for water supply.

Lavon. Lake Lavon is located on the East Fork of the Trinity River in Collin County. The reservoir has permitted conservation storage of 443,800 acre-feet. North Texas Municipal Water District holds water rights for 118,670 acre-feet per year. According to the WAM, the available supply from Lake Lavon is 113,300 acre-feet per year in 2000, decreasing to 105,700 acre-feet per year by 2060. This yield does not include return flows or imported water.

UNPERMITTED YIELDS IN REGION C RESERVOIRS

According to the WAMs, there are eight reservoirs and one reservoir system in Region C with firm yields that exceed the currently permitted diversion amounts. These reservoirs with their unpermitted yields are listed in Table I.4. Note that the Oklahoma share of Lake Texoma yield is not included in the table. The unpermitted Oklahoma yield in Lake Texoma would be about 635,781 acre-feet per year in 2060.

**Table I.4
Unpermitted Yields in Region C Reservoirs**

Reservoir	Basin	Unpermitted Yield, acre-feet per year						
		2000	2010	2020	2030	2040	2050	2060
Lost Creek/Jacksboro System	Trinity	913	900	886	873	860	846	833
Cedar Creek	Trinity	36,900	35,783	34,667	33,550	32,433	31,317	30,200
Richland Chambers	Trinity	18,300	15,383	12,467	9,550	6,633	3,717	800
Lake Texoma (Texas' Share)	Red	385,275	328,267	327,758	327,250	326,742	326,233	325,725
Benbrook	Trinity	447	373	298	224	149	75	0
Bonham	Red	1,160	1,043	927	810	693	577	460
Mountain Creek	Trinity	6,900	6,633	6,367	6,100	5,833	5,567	5,300
Bardwell	Trinity	990	558	127	0	0	0	0
Navarro Mills	Trinity	950	0	0	0	0	0	0

Groundwater

Groundwater in Region C is obtained from two major aquifers, four minor aquifers and locally undifferentiated formations referred to as “other aquifer”. The two major aquifers are the Trinity and Carrizo-Wilcox aquifers. The three minor aquifers are the Woodbine, Queen City, and Nacatoch aquifers.

The TWDB created sixteen Groundwater Management Areas in Texas. GMA 8 covers all of Region C except for Jack County, Henderson County, and a small portion of Navarro County. The GMAs are responsible for developing Desired Future Conditions (DFCs) for aquifers within their respective areas. The TWDB quantifies Managed Available Groundwater (MAG) based on the DFCs provided by the GMAs. If MAG numbers were available for an aquifer as of January 1, 2009, the regional water planning groups must use these estimates as the basis for existing groundwater supplies ⁽²⁾. MAG estimates were available for the Woodbine aquifer prior to the January 1st deadline. MAG estimates were available for the Trinity aquifer in March of 2009. The DFCs for the Nacatoch aquifer have been submitted, but the MAG estimates are not yet available. Neither DFCs nor MAG estimates are available for the Carrizo-Wilcox or Queen City aquifers.

There are currently seven Groundwater Conservation Districts (GCDs) that include one or more counties in Region C:

- Upper Trinity GCD (Wise and Parker Counties)

- Northern Trinity GCD (Tarrant County)
- Neches and Trinity Valleys GCD (Henderson County)
- Mid-East Texas GCD (Freestone County)
- Prairielands GCD (Ellis County)
- North Texas GCD (Collin, Cooke, and Denton Counties)
- Red River GCD (Grayson and Fannin Counties)

The available supply from the Trinity and Woodbine aquifers is based on the MAG estimates provided by the TWDB ^(4,5). The available supply from the Carrizo-Wilcox aquifer is assumed to be the same as was shown in the 2006 *Region C Water Plan* ⁽¹⁾ and is based on minimal lowering of the water table from current levels over the planning period. The groundwater availability for the other minor aquifers and “other aquifer” are also assumed to be the same as was shown in the 2006 *Region C Water Plan* ⁽¹⁾. Table I.5 details the groundwater availability for Region C.

The overall groundwater availability in Region C is 39,692 acre-feet per year greater than the availability shown in the 2006 *Region C Water Plan* ⁽¹⁾. This increase is due to the increased availability in the Trinity and Woodbine aquifers based on MAG estimates provided by the TWDB ^(4,5). The most significant increases to groundwater availability are in the western-most counties of Region C. Figure I.1 compares the Region C Trinity and Woodbine groundwater availability from the TWDB 2009 MAG estimates to the availability reported in the 2006 *Region C Water Plan* ⁽¹⁾. Figure I.2 compares the total groundwater availability in the Trinity and Woodbine aquifers for various counties in Region C. Figure I.2 also includes an estimate of total groundwater use in 2004 for each county.

**Table I.5
Groundwater Availability for Region C
(Acre-Feet per Year)**

Aquifer	County	Basin	Revised Groundwater Availability							Groundwater Availability in 2006 Plan							Change in Groundwater Availability since 2006 Plan						
			2000	2010	2020	2030	2040	2050	2060	2000	2010	2020	2030	2040	2050	2060	2000	2010	2020	2030	2040	2050	2060
Other	Collin	Sabine	5	5	5	5	5	5	5	5	5	5	5	5	5	5	0	0	0	0	0	0	0
Other	Collin	Trinity	134	134	134	134	134	134	134	134	134	134	134	134	134	134	0	0	0	0	0	0	0
Trinity	Collin	Sabine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trinity	Collin	Trinity	2,100	2,100	2,100	2,100	2,100	2,100	2,100	2,100	2,100	2,100	2,100	2,100	2,100	2,100	0	0	0	0	0	0	0
Woodbine	Collin	Sabine	40	40	40	40	40	40	40	130	130	130	130	130	130	130	(90)	(90)	(90)	(90)	(90)	(90)	(90)
Woodbine	Collin	Trinity	2,469	2,469	2,469	2,469	2,469	2,469	2,469	2,370	2,370	2,370	2,370	2,370	2,370	2,370	99	99	99	99	99	99	99
	Collin		4,748	4,748	4,748	4,748	4,748	4,748	4,748	4,739	4,739	4,739	4,739	4,739	4,739	4,739	9	9	9	9	9	9	9
Other	Cooke	Red	237	237	237	237	237	237	237	237	237	237	237	237	237	237	0	0	0	0	0	0	0
Other	Cooke	Trinity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trinity	Cooke	Red	1,284	1,284	1,284	1,284	1,284	1,284	1,284	950	950	950	950	950	950	950	334	334	334	334	334	334	334
Trinity	Cooke	Trinity	5,566	5,566	5,566	5,566	5,566	5,566	5,566	5,450	5,450	5,450	5,450	5,450	5,450	5,450	116	116	116	116	116	116	116
Woodbine	Cooke	Red	18	18	18	18	18	18	18	0	0	0	0	0	0	0	18	18	18	18	18	18	18
Woodbine	Cooke	Trinity	136	136	136	136	136	136	136	0	0	0	0	0	0	0	136	136	136	136	136	136	136
	Cooke		7,241	7,241	7,241	7,241	7,241	7,241	7,241	6,637	6,637	6,637	6,637	6,637	6,637	6,637	604	604	604	604	604	604	604
Other	Dallas	Trinity	593	593	593	593	593	593	593	593	593	593	593	593	593	593	0	0	0	0	0	0	0
Trinity	Dallas	Trinity	5,458	5,458	5,458	5,458	5,458	5,458	5,458	4,400	4,400	4,400	4,400	4,400	4,400	4,400	1,058	1,058	1,058	1,058	1,058	1,058	1,058
Woodbine	Dallas	Trinity	2,313	2,313	2,313	2,313	2,313	2,313	2,313	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,213	1,213	1,213	1,213	1,213	1,213	1,213
	Dallas		8,364	8,364	8,364	8,364	8,364	8,364	8,364	6,093	6,093	6,093	6,093	6,093	6,093	6,093	2,271	2,271	2,271	2,271	2,271	2,271	2,271
Other	Denton	Trinity	5	5	5	5	5	5	5	5	5	5	5	5	5	5	0	0	0	0	0	0	0
Trinity	Denton	Trinity	19,333	19,333	19,333	19,333	19,333	19,333	19,333	10,400	10,400	10,400	10,400	10,400	10,400	10,400	8,933	8,933	8,933	8,933	8,933	8,933	8,933
Woodbine	Denton	Trinity	4,126	4,126	4,126	4,126	4,126	4,126	4,126	4,700	4,700	4,700	4,700	4,700	4,700	4,700	(574)	(574)	(574)	(574)	(574)	(574)	(574)
	Denton		23,464	23,464	23,464	23,464	23,464	23,464	23,464	15,105	15,105	15,105	15,105	15,105	15,105	15,105	8,359	8,359	8,359	8,359	8,359	8,359	8,359
Other	Ellis	Trinity	139	139	139	139	139	139	139	139	139	139	139	139	139	139	0	0	0	0	0	0	0
Trinity	Ellis	Trinity	3,959	3,959	3,959	3,959	3,959	3,959	3,959	4,000	4,000	4,000	4,000	4,000	4,000	4,000	(41)	(41)	(41)	(41)	(41)	(41)	(41)
Woodbine	Ellis	Trinity	5,441	5,441	5,441	5,441	5,441	5,441	5,441	4,400	4,400	4,400	4,400	4,400	4,400	4,400	1,041	1,041	1,041	1,041	1,041	1,041	1,041
	Ellis		9,539	9,539	9,539	9,539	9,539	9,539	9,539	8,539	8,539	8,539	8,539	8,539	8,539	8,539	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Trinity	Fannin	Red	617	617	617	617	617	617	617	0	0	0	0	0	0	0	617	617	617	617	617	617	617
Trinity	Fannin	Sulphur	0	0	0	0	0	0	0	601	601	601	601	601	601	601	(601)	(601)	(601)	(601)	(601)	(601)	(601)
Trinity	Fannin	Trinity	83	83	83	83	83	83	83	99	99	99	99	99	99	99	(16)	(16)	(16)	(16)	(16)	(16)	(16)
Woodbine	Fannin	Red	2,676	2,676	2,676	2,676	2,676	2,676	2,676	2202	2202	2199	2199	2198	2198	2197	474	474	477	477	478	478	479
Woodbine	Fannin	Sulphur	21	21	21	21	21	21	21	568	568	571	571	572	572	573	(547)	(547)	(550)	(550)	(551)	(551)	(552)
Woodbine	Fannin	Trinity	600	600	600	600	600	600	600	530	530	530	530	530	530	530	70	70	70	70	70	70	70
Other	Fannin	Red	2,919	2,919	2,919	2,919	2,919	2,919	2,919	2,919	2,919	2,919	2,919	2,919	2,919	2,919	0	0	0	0	0	0	0
	Fannin		6,916	6,916	6,916	6,916	6,916	6,916	6,916	6,919	6,919	6,919	6,919	6,919	6,919	6,919	(3)	(3)	(3)	(3)	(3)	(3)	(3)

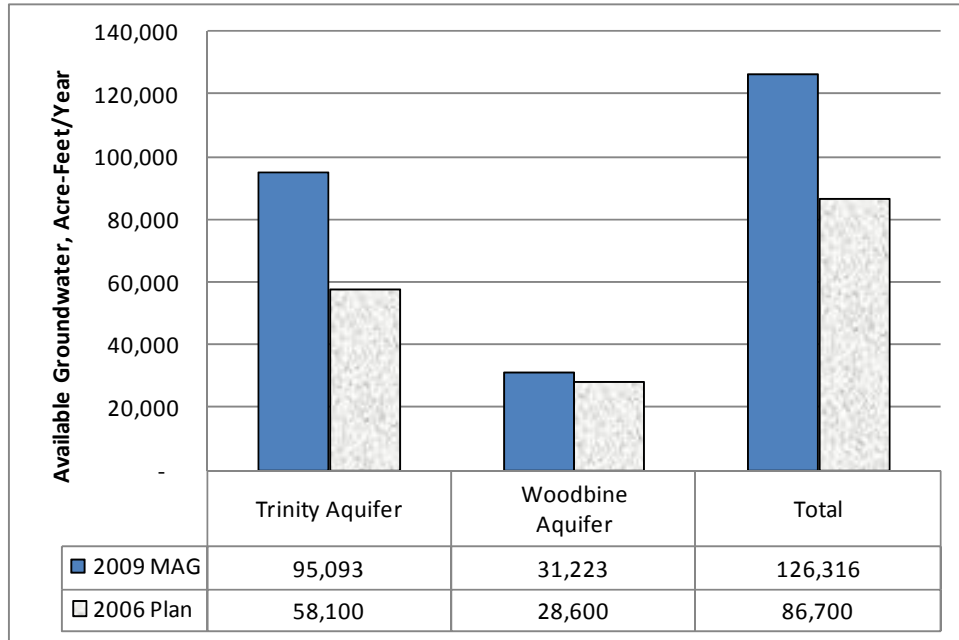
Table I.5, Continued

Aquifer	County	Basin	Revised Groundwater Availability							Groundwater Availability in 2006 Plan							Change in Groundwater Availability since 2006 Plan						
			2000	2010	2020	2030	2040	2050	2060	2000	2010	2020	2030	2040	2050	2060	2000	2010	2020	2030	2040	2050	2060
Carrizo-Wilcox	Freestone	Trinity	5,578	5,578	5,578	5,578	5,578	5,578	5,578	5,578	5,578	5,578	5,578	5,578	5,578	5,578	0	0	0	0	0	0	0
Carrizo-Wilcox	Freestone	Brazos	1,075	1,075	1,075	1,075	1,075	1,075	1,075	1,075	1,075	1,075	1,075	1,075	1,075	1,075	0	0	0	0	0	0	0
Other	Freestone	Trinity	51	51	51	51	51	51	51	51	51	51	51	51	51	51	0	0	0	0	0	0	0
Other	Freestone	Brazos	21	21	21	21	21	21	21	21	21	21	21	21	21	21	0	0	0	0	0	0	0
Queen City	Freestone	Trinity	345	345	345	345	345	345	345	345	345	345	345	345	345	345	0	0	0	0	0	0	0
Queen City	Freestone	Brazos	48	48	48	48	48	48	48	48	48	48	48	48	48	48	0	0	0	0	0	0	0
	Freestone		7,118	7,118	7,118	7,118	7,118	7,118	7,118	7,118	7,118	7,118	7,118	7,118	7,118	7,118	0	0	0	0	0	0	0
Other	Grayson	Red	35	35	35	35	35	35	35	35	35	35	35	35	35	35	0	0	0	0	0	0	0
Other	Grayson	Trinity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trinity	Grayson	Red	7,722	7,722	7,722	7,722	7,722	7,722	7,722	6,700	6,797	6,849	6,875	6,890	6,900	6,901	1,022	925	873	847	832	822	821
Trinity	Grayson	Trinity	1,678	1,678	1,678	1,678	1,678	1,678	1,678	2,700	2,603	2,552	2,525	2,510	2,500	2,499	(1,022)	(925)	(874)	(847)	(832)	(822)	(821)
Woodbine	Grayson	Red	6,590	6,590	6,590	6,590	6,590	6,590	6,590	6,380	6,310	6,288	6,277	6,272	6,267	6,265	210	280	302	313	318	323	325
Woodbine	Grayson	Trinity	5,497	5,497	5,497	5,497	5,497	5,497	5,497	5,720	5,790	5,812	5,823	5,828	5,833	5,835	(223)	(293)	(315)	(326)	(331)	(336)	(338)
	Grayson		21,522	21,522	21,522	21,522	21,522	21,522	21,522	21,535	21,535	21,536	21,535	21,535	21,535	21,535	(13)	(13)	(14)	(13)	(13)	(13)	(13)
Carrizo-Wilcox	Henderson	Trinity	5,370	5,370	5,370	5,370	5,370	5,370	5,370	5,370	5,370	5,370	5,370	5,370	5,370	5,370	0	0	0	0	0	0	0
Nacatoch	Henderson	Trinity	10	10	10	10	10	10	10	10	10	10	10	10	10	10	0	0	0	0	0	0	0
Other	Henderson	Trinity	167	167	167	167	167	167	167	167	167	167	167	167	167	167	0	0	0	0	0	0	0
Queen City	Henderson	Trinity	480	480	480	480	480	480	480	480	480	480	480	480	480	480	0	0	0	0	0	0	0
	Henderson		6,027	6,027	6,027	6,027	6,027	6,027	6,027	6,027	6,027	6,027	6,027	6,027	6,027	6,027	0	0	0	0	0	0	0
Other	Jack	Brazos	284	284	284	284	284	284	284	284	284	284	284	284	284	284	0	0	0	0	0	0	0
Other	Jack	Trinity	650	650	650	650	650	650	650	650	650	650	650	650	650	650	0	0	0	0	0	0	0
Trinity	Jack	Trinity	50	50	50	50	50	50	50	50	50	50	50	50	50	50	0	0	0	0	0	0	0
Trinity	Jack	Brazos	50	50	50	50	50	50	50	50	50	50	50	50	50	50	0	0	0	0	0	0	0
	Jack		1,034	1,034	1,034	1,034	1,034	1,034	1,034	1,034	1,034	1,034	1,034	1,034	1,034	1,034	0	0	0	0	0	0	0
Nacatoch	Kaufman	Sabine	10	10	10	10	10	10	10	10	10	10	10	10	10	10	0	0	0	0	0	0	0
Nacatoch	Kaufman	Trinity	308	308	308	308	308	308	308	308	308	308	308	308	308	308	0	0	0	0	0	0	0
Other	Kaufman	Sabine	124	124	124	124	124	124	124	124	124	124	124	124	124	124	0	0	0	0	0	0	0
Other	Kaufman	Trinity	87	87	87	87	87	87	87	87	87	87	87	87	87	87	0	0	0	0	0	0	0
Trinity	Kaufman	Sabine	45	45	45	45	45	45	45	0	0	0	0	0	0	0	45	45	45	45	45	45	45
Trinity	Kaufman	Trinity	1,136	1,136	1,136	1,136	1,136	1,136	1,136	0	0	0	0	0	0	0	1,136	1,136	1,136	1,136	1,136	1,136	1,136
Woodbine	Kaufman	Trinity	200	200	200	200	200	200	200	200	200	200	200	200	200	200	0	0	0	0	0	0	0
	Kaufman		1,910	1,910	1,910	1,910	1,910	1,910	1,910	729	729	729	729	729	729	729	1,181	1,181	1,181	1,181	1,181	1,181	1,181

Table I.5, Continued

Aquifer	County	Basin	Revised Groundwater Availability							Groundwater Availability in 2006 Plan							Change in Groundwater Availability since 2006 Plan						
			2000	2010	2020	2030	2040	2050	2060	2000	2010	2020	2030	2040	2050	2060	2000	2010	2020	2030	2040	2050	2060
Carrizo-Wilcox	Navarro	Trinity	180	180	180	180	180	180	180	180	180	180	180	180	180	180	0	0	0	0	0	0	0
Nacatoch	Navarro	Trinity	229	229	229	229	229	229	229	229	229	229	229	229	229	229	0	0	0	0	0	0	0
Other	Navarro	Trinity	104	104	104	104	104	104	104	104	104	104	104	104	104	104	0	0	0	0	0	0	0
Trinity	Navarro	Trinity	1,873	1,873	1,873	1,873	1,873	1,873	1,873	0	0	0	0	0	0	0	1,873	1,873	1,873	1,873	1,873	1,873	1,873
Woodbine	Navarro	Trinity	300	300	300	300	300	300	300	300	300	300	300	300	300	300	0	0	0	0	0	0	0
	Navarro		2,686	2,686	2,686	2,686	2,686	2,686	2,686	813	813	813	813	813	813	813	1,873	1,873	1,873	1,873	1,873	1,873	1,873
Other	Parker	Trinity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	Parker	Brazos	50	50	50	50	50	50	50	50	50	50	50	50	50	50	0	0	0	0	0	0	0
Trinity	Parker	Trinity	12,449	12,449	12,449	12,449	12,449	12,449	12,449	2,100	2,100	2,255	2,300	2,300	2,300	2,300	10,349	10,349	10,194	10,149	10,149	10,149	10,149
Trinity	Parker	Brazos	2,799	2,799	2,799	2,799	2,799	2,799	2,799	4,900	4,900	4,745	4,700	4,700	4,700	4,700	(2,101)	(2,101)	(1,946)	(1,901)	(1,901)	(1,901)	(1,901)
	Parker		15,298	15,298	15,298	15,298	15,298	15,298	15,298	7,050	7,050	7,050	7,050	7,050	7,050	7,050	8,248	8,248	8,248	8,248	8,248	8,248	8,248
Nacatoch	Rockwall	Trinity	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
Trinity	Rockwall	Trinity	958	958	958	958	958	958	958	0	0	0	0	0	0	0	958	958	958	958	958	958	958
Woodbine	Rockwall	Trinity	144	144	144	144	144	144	144	0	0	0	0	0	0	0	144	144	144	144	144	144	144
Other	Rockwall	Sabine	187	187	187	187	187	187	187	187	187	187	187	187	187	187	0	0	0	0	0	0	0
Other	Rockwall	Trinity	21	21	21	21	21	21	21	21	21	21	21	21	21	21	0	0	0	0	0	0	0
	Rockwall		1,311	1,311	1,311	1,311	1,311	1,311	1,311	209	209	209	209	209	209	209	1,102	1,102	1,102	1,102	1,102	1,102	1,102
Other	Tarrant	Trinity	207	207	207	207	207	207	207	207	207	207	207	207	207	207	0	0	0	0	0	0	0
Trinity	Tarrant	Trinity	18,747	18,747	18,747	18,747	18,747	18,747	18,747	9,200	9,200	9,200	9,200	9,200	9,200	9,200	9,547	9,547	9,547	9,547	9,547	9,547	9,547
Woodbine	Tarrant	Trinity	632	632	632	632	632	632	632	0	0	0	0	0	0	0	632	632	632	632	632	632	632
	Tarrant		19,586	19,586	19,586	19,586	19,586	19,586	19,586	9,407	9,407	9,407	9,407	9,407	9,407	9,407	10,179	10,179	10,179	10,179	10,179	10,179	10,179
Other	Wise	Trinity	106	106	106	106	106	106	106	106	106	106	106	106	106	106	0	0	0	0	0	0	0
Trinity	Wise	Trinity	9,282	9,282	9,282	9,282	9,282	9,282	9,282	4,400	4,400	4,400	4,400	4,400	4,400	4,400	4,882	4,882	4,882	4,882	4,882	4,882	4,882
	Wise		9,388	9,388	9,388	9,388	9,388	9,388	9,388	4,506	4,506	4,506	4,506	4,506	4,506	4,506	4,882	4,882	4,882	4,882	4,882	4,882	4,882
Region C Total			146,152	146,152	146,152	146,152	146,152	146,152	146,152	106,460	106,460	106,460	106,460	106,460	106,460	106,460	39,692	39,692	39,692	39,692	39,692	39,692	39,692

**Figure I.1
Region C Groundwater Availability in the Trinity and Woodbine Aquifers**



Irrigation Local Supply and Other Local Supply

The local irrigation availability is based on existing run-of-the-river surface water rights for irrigation not associated with major reservoirs. The reliable supply from run-of-the-river diversions was assumed equal to the permitted diversion for water rights located on the main stem of the river and 75 percent of the permitted diversion for water rights located on tributaries.

Other local supply includes non-irrigation run-of-the-river supplies and mining and livestock local supplies that do not have a water right. Most surface water used for livestock is taken from unpermitted stock ponds or directly from streams. For livestock and mining local supply, the available supplies were assumed to be the same as shown in the 2006 *Region C Water Plan* ⁽¹⁾. Table I.6 shows the available supply for irrigation and other local supply.

**Figure I.2
Region C Groundwater Availability by County in the Trinity and Woodbine Aquifers**

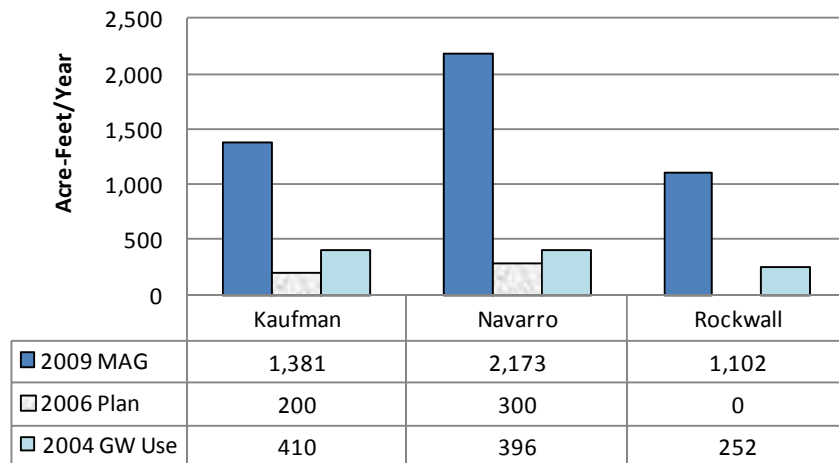
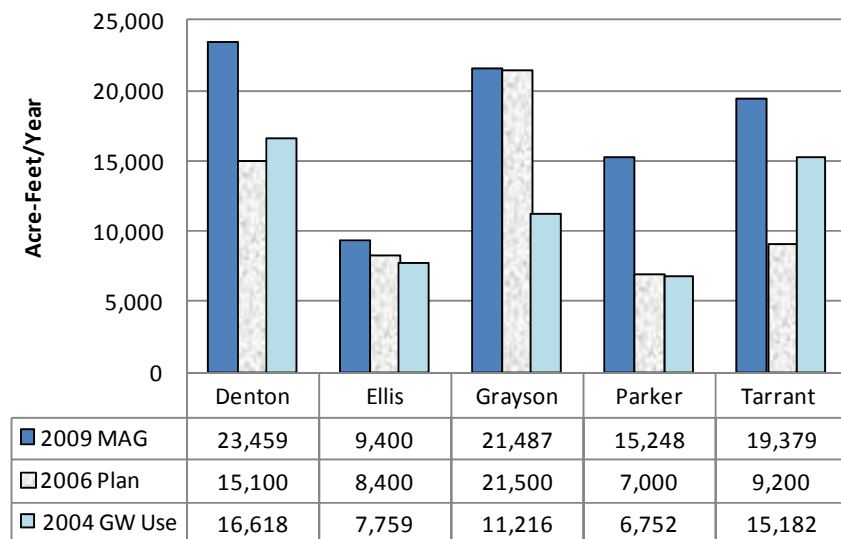
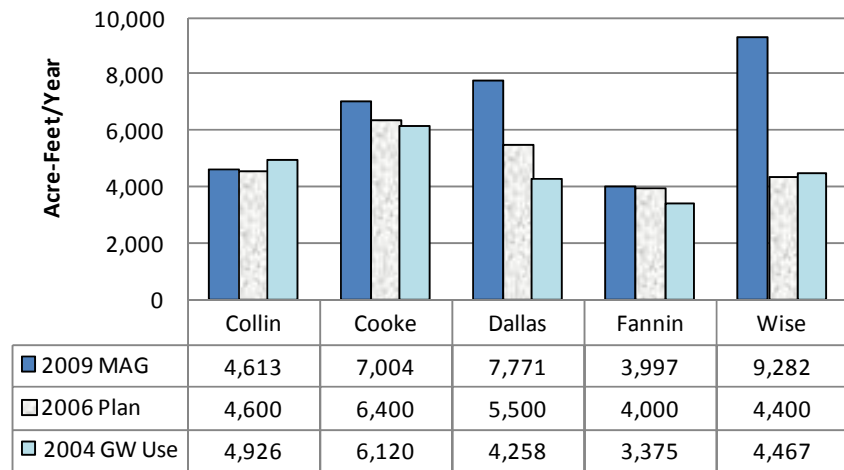


Table I.6
Summary of Local Surface Water Supplies for Region C
(Acre-Feet per Year)

Use	County	Basin	2000	2010	2020	2030	2040	2050	2060
IRRIGATION RUN-OF-THE-RIVER SUPPLIES									
Irrigation	Cooke	Red	23	23	23	23	23	23	23
Irrigation	Fannin	Red	14,758	14,758	14,758	14,758	14,758	14,758	14,758
Irrigation	Grayson	Red	2,394	2,394	2,394	2,394	2,394	2,394	2,394
Irrigation	Fannin	Sulphur	0	0	0	0	0	0	0
Irrigation	Collin	Trinity	408	408	408	408	408	408	408
Irrigation	Cooke	Trinity	0	0	0	0	0	0	0
Irrigation	Dallas	Trinity	791	791	791	791	791	791	791
Irrigation	Denton	Trinity	0	0	0	0	0	0	0
Irrigation	Ellis	Trinity	3	3	3	3	3	3	3
Irrigation	Fannin	Trinity	0	0	0	0	0	0	0
Irrigation	Grayson	Trinity	0	0	0	0	0	0	0
Irrigation	Henderson	Trinity	415	415	415	415	415	415	415
Irrigation	Jack	Trinity	110	110	110	110	110	110	110
Irrigation	Kaufman	Trinity	64	64	64	64	64	64	64
Irrigation	Navarro	Trinity	226	226	226	226	226	226	226
Irrigation	Parker	Trinity	122	122	122	122	122	122	122
Irrigation	Rockwall	Trinity	0	0	0	0	0	0	0
Irrigation	Tarrant	Trinity	549	549	549	549	549	549	549
Irrigation	Wise	Trinity	139	139	139	139	139	139	139
Irrigation	Freestone	Trinity	87	87	87	87	87	87	87
Irrigation	Jack	Brazos	0	0	0	0	0	0	0
Irrigation	Parker	Brazos	117	117	117	117	117	117	117
Irrigation	Freestone	Brazos	0	0	0	0	0	0	0
SUBTOTAL			20,205	20,205	20,205	20,205	20,205	20,205	20,205

Table I.6, Continued

Use	County	Basin	2000	2010	2020	2030	2040	2050	2060
NON-IRRIGATION RUN-OF-THE-RIVER SUPPLIES									
Mining	Fannin	Red	72	72	72	72	72	72	72
Mining	Wise	Trinity	133	133	133	133	133	133	133
Municipal	Fannin	Red	20	20	20	20	20	20	20
Municipal	Fannin	Sulphur	49	49	49	49	49	49	49
Municipal	Freestone	Trinity	41	41	41	41	41	41	41
Municipal	Navarro	Trinity	252	252	252	252	252	252	252
Municipal	Parker	Trinity	33	33	33	33	33	33	33
Industrial	Dallas	Trinity	368	368	368	368	368	368	368
Industrial	Grayson	Red	30	30	30	30	30	30	30
Industrial	Tarrant	Trinity	959	959	959	959	959	959	959
LIVESTOCK AND MINING LOCAL SUPPLIES									
Livestock	Collin	Sabine	31	31	31	31	31	31	31
Livestock	Collin	Trinity	971	971	971	971	971	971	971
Livestock	Cooke	Red	380	380	380	380	380	380	380
Livestock	Cooke	Trinity	807	807	807	807	807	807	807
Livestock	Dallas	Trinity	712	712	712	712	712	712	712
Livestock	Denton	Trinity	935	935	935	935	935	935	935
Livestock	Ellis	Trinity	1,688	1,688	1,688	1,688	1,688	1,688	1,688
Livestock	Fannin	Red	1,139	1,139	1,139	1,139	1,139	1,139	1,139
Livestock	Fannin	Sulphur	364	364	364	364	364	364	364
Livestock	Fannin	Trinity	80	80	80	80	80	80	80
Livestock	Freestone	Brazos	83	83	83	83	83	83	83
Livestock	Freestone	Trinity	960	960	960	960	960	960	960
Livestock	Grayson	Red	1,077	1,077	1,077	1,077	1,077	1,077	1,077
Livestock	Grayson	Trinity	606	606	606	606	606	606	606
Livestock	Henderson	Trinity	341	341	341	341	341	341	341
Livestock	Jack	Brazos	450	450	450	450	450	450	450

Table I.6, Continued

Use	County	Basin	2000	2010	2020	2030	2040	2050	2060
LIVESTOCK AND MINING LOCAL SUPPLIES (Continued)									
Livestock	Jack	Trinity	1,215	1,215	1,215	1,215	1,215	1,215	1,215
Livestock	Kaufman	Sabine	98	98	98	98	98	98	98
Livestock	Kaufman	Trinity	1,524	1,524	1,524	1,524	1,524	1,524	1,524
Livestock	Navarro	Trinity	1,603	1,603	1,603	1,603	1,603	1,603	1,603
Livestock	Parker	Brazos	903	903	903	903	903	903	903
Livestock	Parker	Trinity	1,019	1,019	1,019	1,019	1,019	1,019	1,019
Livestock	Rockwall	Sabine	32	32	32	32	32	32	32
Livestock	Rockwall	Trinity	136	136	136	136	136	136	136
Livestock	Tarrant	Trinity	442	442	442	442	442	442	442
Livestock	Wise	Trinity	1,117	1,117	1,117	1,117	1,117	1,117	1,117
Mining	Collin	Trinity	195	195	195	195	195	195	195
Mining	Cooke	Red	77	77	77	77	77	77	77
Mining	Cooke	Trinity	160	160	160	160	160	160	160
Mining	Dallas	Trinity	1,525	1,525	1,525	1,525	1,525	1,525	1,525
Mining	Denton	Trinity	103	103	103	103	103	103	103
Mining	Freestone	Trinity	66	66	66	66	66	66	66
Mining	Jack	Trinity	370	370	370	370	370	370	370
Mining	Kaufman	Trinity	75	75	75	75	75	75	75
Mining	Parker	Brazos	17	17	17	17	17	17	17
Mining	Parker	Trinity	3	3	3	3	3	3	3
Mining	Rockwall	Sabine	33	33	33	33	33	33	33
Mining	Tarrant	Trinity	342	342	342	342	342	342	342
SUBTOTAL NON-IRRIGATION SUPPLIES			23,701	23,701	23,701	23,701	23,701	23,701	23,701
TOTAL RUN-OF-THE-RIVER AND LOCAL SUPPLIES			43,906	43,906	43,906	43,906	43,906	43,906	43,906

Reuse

The reuse quantities listed in Table I.1 are limited to currently permitted and operating indirect reuse projects and existing direct reuse for irrigation or industrial purposes. Table I.7 shows the individual reuse projects that make up the total reuse amount in Table I.1. These amounts reflect the results of a detailed study of existing and potential reuse projects in Region C. The topics addressed in the study included:

- Water reuse projects being performed under a Chapter 210 notification,
- Water reuse plans for large dischargers,
- Consolidation of water reuse plans into a regional plan
- Recent water right amendments involving reuse, and
- Existing reuse quantities

The findings of this study are presented below.

Water Reuse Projects Being Performed Under a Chapter 210 Reuse Authorization

Title 30, Chapter 210 of the Texas Administrative Code establishes general requirements, quality criteria, design, and operational requirements for direct reuse of reclaimed water. Before implementing a direct reuse project, the reclaimed water provider must notify the Executive Director of the Texas Commission on Environmental Quality (TCEQ) and obtain written approval to provide the reclaimed water. Table I.8 shows Region C entities that have notified the TCEQ of their intent to provide reclaimed water (as of July 2009) and have received a reuse authorization. Authorization does not necessarily mean that an entity has followed through and developed a reuse project. Detailed descriptions of projects operating under a Chapter 210 Authorization are provided below.

Azle. The City of Azle provides reclaimed water from its wastewater treatment plant for irrigation at the Cross Timbers Golf Course in Azle.

Crandall. The City of Crandall provides reclaimed water from the Crandall Wastewater Treatment Plant (WWTP) for irrigation at the Creekview Golf Club in Crandall.

Dallas. The City of Dallas provides reclaimed water from the Central WWTP for irrigation at Cedar Crest Golf Course in Dallas. The authorization also allows the use of reclaimed water for turf and landscape irrigation, maintenance of impoundments, soil compaction, and cooling tower makeup water.

**Table I.7
Summary of Supplies Available from Reuse
(Acre-Feet per Year)**

Provider	Project Name	User/Receiving Water	Type	County	2010	2020	2030	2040	2050	2060
Alcatel Network Systems	Alcatel Network Systems Reuse	internal reuse	direct	Dallas	20	20	20	20	20	20
Athens	Athens Fish Hatchery Reuse	Fish Hatchery	direct	Henderson	2,872	0	0	0	0	0
Azle	Azle Reuse	Cross Timbers Golf Course	direct	Tarrant	300	300	300	300	300	300
Bryson	Jack County Reuse	Clayton Ranch Irrigation	direct	Jack	27	27	26	26	25	25
Country Club WSC	Country Club WSC Reuse	Cedar Creek Country Club	direct	Kaufman	92	92	92	92	92	92
Crandall	Crandall Reuse	Creekview Golf Club	direct	Kaufman	484	666	666	666	666	666
Dallas	Cedar Crest Golf Course Reuse	Cedar Crest Golf Course	direct	Dallas	561	561	561	561	561	561
Dallas	Indirect Reuse	Dallas	indirect	Denton	29,961	42,046	53,147	60,646	69,861	85,000
DCCPMUD	Grapevine Reuse	Lake Grapevine	indirect	Tarrant	1,493	1,663	1,784	1,864	1,924	1,974
Deer Creek Waterworks/ Willow Park	Willow Park Reuse	Split Rails Links and Golf Club	direct	Parker	11	11	11	11	11	11
Denton	Denton Power Direct Reuse	City of Garland Steam Electric Power Plant, Denton Regional Medical Office Building, Caruthers Oil Co. Inc., Robert Donnelly, Day Surgery Center DRMC, Denton Landfill, Denton State School, Oakmont Country Club	direct	Denton	1,233	2,242	2,690	3,251	3,924	4,708
Denton	Denton Indirect Reuse	indirect reuse	indirect	Denton	1,682	8,861	11,557	12,907	12,726	12,545
Denton County FWSD#1/ UTRWD/Lewisville	UTRWD Reuse	Castle Hills Golf Course	direct	Denton	897	897	897	897	897	897
Ennis	Ennis Reuse	Tractabel Steam Electric Power Plant	direct	Ellis	800	800	800	800	800	800
Fort Worth	Village Creek Reuse	Waterchase Golf Course	direct	Tarrant	897	897	897	897	897	897
Gainesville	Kenetso Park Reuse	City of Gainesville - Keneteso Park	direct	Cooke	9	9	9	9	9	9

¹ County reflects location of reuse project.

Table I.7, Continued

Provider	Project Name	User/Receiving Water	Type	County ¹	2010	2020	2030	2040	2050	2060
Garland/Forney	Garland/Forney Reuse	FPLE Steam Electric Power Plant	direct	Kaufman	8,979	8,979	8,979	8,979	8,979	8,979
Grapevine	Grapevine Reuse	Lake Grapevine	indirect	Tarrant	1,824	2,033	2,180	2,278	2,352	2,412
Jacksboro	Jacksboro Reuse	City of Jacksboro Golf Course	indirect	Jack	385	385	385	385	385	385
Millsap WWTP	Millsap ISD Reuse	Millsap High School Athletic Fields	direct	Parker	2	2	2	2	2	2
NTMWD	Rowlett Creek Reuse	Los Rios Country Club, Golf Center of Plano, Pecan Hollow Municipal Golf Course	direct	Collin	1,540	1,540	1,540	1,540	1,540	1,540
NTMWD	Buffalo Creek Reuse	Buffalo Creek Golf Course	direct	Rockwall	672	672	672	672	672	672
NTMWD/Royse City	Royse City Reuse	Aaki Golf	direct	Rockwall	112	112	112	112	112	112
NTMWD	Wilson Creek Reuse	Lake Lavon	indirect	Collin	50,000	60,941	71,882	71,882	71,882	71,882
NTMWD	East Fork Reuse	Trinity River	indirect	Kaufman	51,790	67,148	87,102	102,000	102,000	102,000
NTMWD/Frisco	Stewart Creek West Reuse	Trails of Frisco Golf Course	direct	Collin	307	307	307	307	307	307
Pinnacle Club	Pinnacle Club Reuse	Pinnacle Club Golf Course	direct	Henderson	32	32	32	32	32	32
TRWD	Richland Chambers Reservoir Reuse Project	Richland Chambers	indirect	Navarro	10,000	10,000	10,000	10,000	10,000	10,000
The Colony	Collin County Reuse	Stonebriar Country Club	direct	Collin	380	380	380	380	380	380
TRA	Ten Mile Creek WWTP Reuse	Pecan Orchard	direct	Dallas	250	250	250	250	250	250
TRA	TRA/Waxahachie Reuse		indirect	Ellis	4,998	5,129	5,129	5,129	5,129	5,129
TRA/DCURD	Las Colinas Reuse	Las Colinas - golf course irrigation, landscape irrigation, and lake level maintenance	direct/ indirect	Dallas	8,000	8,000	8,000	8,000	8,000	8,000
Trophy Club	Denton County Golf Reuse	Trophy Club Country Club	direct	Denton	800	800	800	800	800	800
UTRWD	Lake Chapman Indirect Reuse	Lewisville Lake	indirect	Denton	6,634	6,634	6,634	6,634	6,634	6,634
Wise County	Wise County Mining Reuse	Mining	direct	Wise	15,930	14,074	12,152	10,643	9,236	8,061
Total					203,974	246,510	289,995	312,972	321,405	336,082

¹ County reflects location of reuse project.

Table I.8
Region C Entities That Have Received a Chapter 210 Reuse Authorization ⁽⁶⁾

Permittee	County	Permit Number
City of Azle	Tarrant/Parker	Pending
City of Crandall	Kaufman	R10834-001
City of Dallas	Dallas	R10060-001
City of Dallas	Dallas	R10060-006
City of Denison	Grayson	R10079-005
City of Denton	Denton	R10027-003
City of Denton	Denton	R10027-004
City of Ennis	Ellis	R10443-002
City of Fort Worth	Tarrant	R10494-013
City of Frisco	Collin	R10172-003
City of Gainesville	Cooke	R10726-001
City of Garland	Kaufman	R10090-001
City of Grapevine	Tarrant	R10486-002
City of Lewisville	Denton	R10662-001
City of Royse City	Rockwall	R10366-001
City of Runaway Bay	Wise	R10862-001
City of Sanger	Denton	R10271-001
City of the Colony	Denton	R11570-001
City of Weatherford	Parker	R10380-002
City of Weatherford	Parker	R14198-001
Deer Creek Waterworks/ City of Willow Park	Parker	R13759-001/ R13834-001
Millsap ISD	Parker	R13357-001
Munson Point LTD	Grayson	R14487-001
North Texas Municipal Water District	Collin	R10363-001
North Texas Municipal Water District	Rockwall	R11894-001
North Texas Municipal Water District	Rockwall	R12047-001
North Texas Municipal Water District	Denton	R14008-001
North Texas Municipal Water District	Collin	R14245-001
North Texas Municipal Water District	Rockwall	R14469-001
Town of Flower Mound	Denton	R11321-001
Trinity River Authority	Dallas	R10303-001
Trinity River Authority	Dallas	R10984-001

Denison. The City of Denison previously provided reclaimed water from its Grayson County Airport WWTP for irrigation at the Grayson County College Golf Course; however, this project has been discontinued.

Denton. The City of Denton operates a non-potable reclaimed water system that supplies reclaimed water directly from its Pecan Creek Water Reclamation Plant (WRP) to several customers, including the City landfill, the Denton Regional Medical Center, Oakmont Country Club, the Denton State School, and the City of Garland's Spencer Generating Station. Primary uses include irrigation, dust control, and cooling water for steam electric power generation. Denton plans to expand its existing direct reuse program.

Ennis. The City of Ennis provides reclaimed water from its Oak Grove WWTP for cooling water for steam electric power generation at the Suez-Tractebel power plant in Ennis.

Fort Worth. The City of Fort Worth provides reclaimed water from its Village Creek WWTP for irrigation at the Links at Waterchase Golf Course in Fort Worth. By the end of 2010 it is anticipated that the Village Creek WWTP will also provide reclaimed water to the Cities of Arlington and Euless, Dallas-Fort Worth International Airport, and additional retail customers within the Fort Worth city limits.

Frisco. Reclaimed water is provided for irrigation purposes from the Stewart Creek West WWTP in Frisco to the Trails of Frisco Golf Club. NTMWD operates the Stewart Creek West WWTP.

Gainesville. The City of Gainesville irrigates athletic fields at Keneteso Park, a municipal park, with reclaimed water from its WWTP.

Garland. The City of Garland produces reclaimed water at its Duck Creek WWTP. The City sells reclaimed water to the City of Forney, which in turn provides the reclaimed water to the FPL Energy power plant near Forney. The authorization also allows the use of reclaimed water for irrigation of golf courses, sod farms, silviculture, and food crops.

Grapevine. Although the City of Grapevine does use reclaimed water, it does so indirectly by discharging reclaimed water from its Peach Street WWTP to Lake Grapevine and using raw water from Lake Grapevine for municipal and irrigation purposes. This reuse project is permitted under a water right and is not operated under the authority of the Chapter 210 reuse authorization.

Lewisville. The City of Lewisville produces reclaimed water at its WWTP. The City sells reclaimed water to the Upper Trinity Regional Water District, which in turn provides the reclaimed water to the Denton County Fresh Water Supply District No. 1 for irrigation at the Castle Hills Golf Club. The City is permitted to provide reclaimed water for maintenance of wetlands at the Lewisville Lake Environmental Learning Area. The authorization would also allow the use of reclaimed water for irrigation of a tree nursery and of landscaped areas within the city.

Royse City. Reclaimed water is provided for irrigation purposes from the Sabine Creek West WWTP in Royse City to Aaki Golf. NTMWD operates the Sabine Creek West WWTP.

Runaway Bay. The City of Runaway Bay reuse authorization would allow the use of reclaimed water for golf course irrigation. However, the golf course currently uses raw water for irrigation and has not implemented the reuse project.

Sanger. The City of Sanger reuse authorization would allow the use of reclaimed water for agricultural and golf course irrigation. The City intends to provide reclaimed water for irrigation at a golf course that has not yet been designed or constructed.

The Colony. The City of The Colony provides reclaimed water from its Stewart Creek WWTP for irrigation at Stonebriar Country Club in Frisco.

Weatherford. The City of Weatherford's authorization would allow the use of reclaimed water for cooling tower makeup water, gas industry use, soil compaction and dust control in construction areas, irrigation of animal feed crops (other than pastures for milking animals), fire protection, golf course irrigation, and maintenance of water features. The City previously provided reclaimed water for irrigation to the Crown Valley Country Club, but this project has been discontinued. The City may expand its system in the future to serve the natural gas industry.

Deer Creek Waterworks. The City of Willow Park owns Deer Creek Water Works which has a single water reuse customer. The Deer Creek Waterworks provides reclaimed water from its WWTP for irrigation at the Split Rail Golf Links in Aledo. The authorization also allows the use of reclaimed water for athletic field irrigation and horticultural use.

Millsap ISD. The Millsap Independent School District uses reclaimed water from its WWTP to irrigate its football field and land around the athletic fields. The District irrigates the football field with reclaimed water during the off-season when the field is not in use.

Munson Point LTD. Munson Point LTD has obtained a 210 authorization for a planned residential development near Lake Texoma.

North Texas Municipal Water District. The North Texas Municipal Water District has Chapter 210 authorizations for reclaimed water from the Buffalo Creek WWTP, Rowlett Creek WWTP, Sabine WWTP, Frisco Cottonwood Branch WWTP, the Shepards Glen WWTP, and the Stewart Creek West WWTP. The District does not operate reuse projects from the Frisco Cottonwood Branch or Shepards Glen WWTPs at this time. Reclaimed water is provided for irrigation purposes to the following users: Buffalo Creek Golf Course (from Buffalo Creek WWTP), Los Rios Country Club (from Rowlett Creek WWTP), Pecan Hollow Municipal Golf Course (from Rowlett Creek WWTP), Soccer Complex (from Rowlett Creek WWTP), Aaki Golf (from Sabine Creek West WWTP via Royse City), and the Trails of Frisco Golf Club (from Stewart Creek West WWTP via the City of Frisco).

Flower Mound. The Town of Flower Mound's reuse authorization would allow the use of reclaimed water for maintenance of impoundments or natural water bodies, toilet or urinal flush water, silviculture, soil compaction or dust control in construction areas, cooling tower makeup water, and irrigation. This project has not been implemented.

Trinity River Authority. The Trinity River Authority provides reclaimed water from its Central Regional Wastewater System plant to the Dallas County Utility and Reclamation District for golf course irrigation, landscape irrigation, and lake level maintenance in Las Colinas. The Authority has also received an authorization that would allow it to supply reclaimed water from the Ten Mile Creek Regional Wastewater System plant for steam-electric power generation process water, irrigation of a pecan grove, and maintenance of impoundments. Under this authorization, the Authority currently provides reclaimed water to South Creek Ranch for irrigation and maintenance of impoundments.

Water Reuse Plans for Large Dischargers

Table I.9 lists wastewater treatment plants that currently have an annual average flowrate of two million gallons per day (mgd) or more. In addition to the dischargers listed in Table I.9, several other dischargers are permitted to discharge more than 2 mgd but currently have annual average discharges of less than 2 mgd. Of the dischargers in Table I.9, the following have provided written reuse plans (some in draft form): Dallas, Flower

Mound, Fort Worth, Lewisville, North Texas Municipal Water District, and Weatherford. These reuse plans are summarized below. In addition to these dischargers, the Cities of Irving, Frisco and Arlington have developed reuse plans.

Table I.9
Region C Wastewater Dischargers That Currently Discharge 2 MGD or More ⁽¹¹⁾

Discharger	Plant	NPDES Number	County	2008 Annual Average Flow (MGD)
The Colony	Stewart Creek	TX0053112	Denton	2.40
Corsicana	STP No. 2	TX0056731	Navarro	2.71
Dallas	Dallas Southside	TX0047848	Dallas	60.84
Dallas	Dallas Central	TX0047830	Dallas	93.93
Denison	Paw Paw	TX0047228	Grayson	2.02
Denton	Pecan Creek	TX0047180	Denton	13.18
Flower Mound	Flower Mound	TX0020711	Denton	4.33
Fort Worth	Village Creek	TX0047295	Tarrant	106.35
Garland	Rowlett Creek	TX0024686	Dallas	17.23
Garland	Duck Creek	TX0024678	Dallas	10.17
Grapevine	Peach Street	TX0032018	Tarrant	3.42
Lewisville	Prairie Creek	TX0052892	Denton	7.65
NTMWD	Muddy Creek	TX0123561	Collin	5.26
NTMWD	Rowlett Creek	TX0047911	Collin	15.33
NTMWD	Wilson Creek	TX0088633	Collin	36.55
NTMWD	Mesquite	TX047431	Dallas	16.14
NTMWD	Stewart Creek West	TX0103501	Denton	5.46
Sherman	Post Oak	TX0024325	Grayson	7.45
TRA	Denton Creek	TX0104957	Denton	4.67
TRA	Red Oak	TX0104345	Ellis	2.20
TRA	Ten Mile Creek	TX0022811	Ellis	14.50
TRA	TRA Central	TX0022802	Dallas	131.95
UTRWD	Lakeview	TX0020354	Denton	3.62
Waxahachie	Waxahachie	TX0027537	Ellis	3.75
Weatherford	Weatherford	TX0047724	Parker	2.03

Dallas. The City has developed a *Recycled Water Implementation Plan* ^(7,8). The plan recommends two direct reuse projects and two water supply augmentation projects (indirect reuse) for near-term implementation. Currently, the City irrigates Cedar Crest

Golf Course with reclaimed water from the Central Wastewater Treatment Plant. One direct reuse project involves extending the pipeline from Cedar Crest Golf Course to the Dallas Zoo, an industrial customer, and Stevens Golf Course. The projected average supply from this project would be 2.5 mgd. As of July 2009, the projected capital cost is \$15 million, operation and maintenance costs are estimated to be \$230,000 per year, and energy costs are expected to be \$85,000 per year. The Cedar Crest Pipeline Extension Project is currently being designed. Construction is anticipated to begin in 2011.

The second direct reuse project, the White Rock Pipeline, would involve a pipeline from the Central Wastewater Treatment Plant northward to serve customers in the White Rock Creek Basin. The projected average supply from this project would be 16.5 mgd. The projected capital cost is \$55.2 million, operation and maintenance costs are estimated to be \$1,380,000 per year, and energy costs are expected to be \$825,200 per year. DWU is planning to move forward with development of customer agreements and preliminary engineering on this project in 2013.

Water supply augmentation projects are recommended for Lake Lewisville and Lake Ray Hubbard. The Lake Lewisville augmentation project would involve pumping an annual average of 60 mgd of reclaimed water from the Central Wastewater Treatment Plant to Lake Lewisville for storage, blending, and future use. The projected capital cost for the Lake Lewisville project is \$185.7 million, and operation and maintenance costs are estimated to be \$45 million per year.

The Lake Ray Hubbard augmentation project would involve pumping an annual average of 60 mgd of reclaimed water from the Southside Wastewater Treatment Plant to Lake Ray Hubbard for storage, blending, and future use. The projected capital cost for the Lake Ray Hubbard project is \$201.3 million, and operation and maintenance costs are estimated to be \$5.0 million per year.

Flower Mound. The Town of Flower Mound has identified a potential service area that includes the corporate Town limits and the Grapevine Municipal Golf Course complex adjacent to the Town's southern limits ⁽⁹⁾. Potential reclaimed water uses include maintenance of impoundments or natural water bodies, toilet or urinal flush water, silviculture, soil compaction or dust control in construction areas, cooling tower makeup water, and irrigation. Initially, it is anticipated that reclaimed water would be delivered to

users in Lakeside Business District, for irrigation of vegetated medians along FM 2499, and for irrigation of Gerault Park.

Fort Worth. The City of Fort Worth has provided reclaimed water from its Village Creek WWTP for irrigation at the Links at Waterchase Golf Course in Fort Worth since 1999. In 2007, the City developed a *Reclaimed Water Priority and Implementation Plan* ⁽¹⁰⁾ to evaluate an additional five direct reuse projects, which would be used for local irrigation, natural gas exploration, cooling water makeup and electric power generation. The first of these projects, the Village Creek Reclaimed Water Delivery System, is anticipated to be online by the end of 2010. The Village Creek Reclaimed Water Delivery System will serve the Cities of Arlington and Euless, Dallas-Fort Worth International Airport, and other potential retail customers within the City of Fort Worth with up to 4,423 acre-feet per year of reclaimed water from the Village Creek WWTP. The remaining direct reuse projects are still in the planning phase and are described below:

The western direct reuse project involves the construction of a satellite wastewater treatment plant and conveyance facilities to provide reclaimed water to the Mary's Creek drainage basin in western Fort Worth. The Mary's Creek Direct Reuse Project would be constructed to provide a supply for non-potable water needs for the Walsh Ranch development and other nearby areas.

The central direct reuse project involves the construction of conveyance facilities to provide reclaimed water from the Village Creek WWTP to the Central Business District, including the planned Trinity River Vision Central City Project.

The northern direct reuse project involves the construction of conveyance facilities to provide reclaimed water from the Trinity River Authority's Denton Creek Regional Wastewater System to serve developments in the Alliance Airport area.

The southern direct reuse project involves the construction of a satellite WWTP and conveyance facilities to provide reclaimed water in the southern portion of the City for irrigation, cooling water, and other non-potable uses near the intersection of I-20 and I-35W.

Lewisville. The City of Lewisville has identified a potential service area that includes the City and its Extraterritorial Jurisdiction (ETJ) and selected locations outside the ETJ ⁽¹²⁾. The City plans to continue to produce reclaimed water for existing users (Denton County

Fresh Water Supply District No. 1 and the City) and may provide reclaimed water to other users including but not limited to: the Lake Park Golf Complex, the Lake Park athletic fields, a tree farm near Jones Street and Kealy Avenue, the City's Fire Training Center, a Heavy Industry Zone roughly bounded by State Highway 121 to the south, the Elm Fork Trinity River to the east, Prairie Creek and Sewage Treatment Plant Road to the north, and the Atchison, Topeka & Santa Fe Railroad to the west, Coyote Ridge Golf Club, Indian Creek Golf Course, and Riverchase Golf Club.

North Texas Municipal Water District. NTMWD utilizes return flows diverted from the East Fork of the Trinity River (East Fork) to augment existing supplies at Lake Lavon. The East Fork Raw Water Supply Project includes a 43 mile pipeline to transport treated water from a 1,840 acre constructed wetland near Seagoville to Lake Lavon. In 2007, NTMWD was granted a water rights permit authorizing the diversion and use of up to 157,393 acre-feet per year for the project. The project is currently planned to provide approximately 102,000 acre-feet per year of additional supply to Lake Lavon.

The NTMWD is now permitted to divert from Lake Lavon up to 71,882 acre-feet per year of return flows from the Wilson Creek WWTP. This plant currently provides nearly 48,000 acre-feet per year of supply for indirect reuse in Lake Lavon. In addition to these indirect reuse projects, the District plans to expand its direct reuse program.

Weatherford. The City of Weatherford has defined its potential service area as the City and its ETJ. Potential uses include cooling tower makeup water, gas industry use, soil compaction and dust control in construction areas, irrigation of animal feed crops (other than pastures for milking animals), fire protection, golf course irrigation, and maintenance of water features, and other acceptable uses where human contact with reclaimed water is unlikely to occur ⁽¹³⁾.

Dallas/North Texas Municipal Water District Collaboration. Dallas Water Utilities and NTMWD have entered into an agreement which would allow NTMWD to exchange up to 157,393 acre-feet per year of return flows from District water supplies into Lake Ray Hubbard for Dallas return flows into the mainstem Trinity River. Under this agreement, Dallas will have the right to divert the NTMWD return flows from Lake Ray Hubbard and will pump an equal amount of flow from the mainstem Trinity River to the NTMWD East Fork Water Supply Project wetland for use by NTMWD. In addition, once water rights for

Elm Fork return flows (from NTMWD return flows to the Lake Lewisville watershed) have been secured by NTMWD, NTMWD will support Dallas efforts to secure bed and banks transport, storage and diversion rights for the Elm Fork return flows. In exchange, Dallas will pump a quantity equal to NTMWD's future Elm Fork return flows to the East Fork Water Supply Project wetland for use by NTMWD.

Consolidation of Reuse Plans into a Regional Reuse Plan

All of the projects discussed in the 210 authorizations and the reuse plans are included in the current *Region C Water Plan*. Additional reuse projects were identified where possible to meet water needs. The recommended regional reuse plan is outlined in Table 4B.2 in Section 4B of the Region C plan.

Recent Water Right Amendments Involving Reuse

The Texas Commission on Environmental Quality (TCEQ) has granted reuse-based amendments to water right certificates of adjudication held by the Tarrant Regional Water District, Trinity River Authority, City of Dallas, Upper Trinity Regional Water District, City of Irving, and the North Texas Municipal Water District. These recent amendments are discussed below and summarized in Table I.10.

Tarrant Regional Water District. On February 8, 2005, the District received amendments to its water rights in Richland-Chambers Reservoir (Certificate of Adjudication 08-5035C) and Cedar Creek Reservoir (Certificate of Adjudication 08-4976C). The amended certificates allow the District to divert from the Trinity River a portion of the historic and future return flows that originate from water stored in District reservoirs. The return flows will be diverted into off-channel, wetland impoundments to improve water quality and then delivered into Richland-Chambers Reservoir and/or Cedar Creek Reservoir for storage and future diversion. The maximum annual diversion from the Trinity River shall not exceed any one of the following:

- 90,799 acre-feet per year (Certificate of Adjudication 08-4976C),
- 105,019 acre-feet per year (Certificate of Adjudication 08-5035C),
- 195,818 acre-feet per year for both certificates, or

- 70 percent of District return flows, less carriage losses.

**Table I.10
Water Right Amendments and Permit Applications Involving Reuse**

Entity	Flow Description	Certification of Adjudication/ Permit Number	Status	Amendment Date	Additional Annual Diversion for Water Supply (ac-ft/year)
Tarrant Regional Water District	Multiple WWTPs to Wetland/Cedar Creek Reservoir	08-4976C	Amended	02/08/05	52,500
Tarrant Regional Water District	Multiple WWTPs to Wetland/Richland-Chambers Reservoir	08-5035C	Amended	02/08/05	63,000
Trinity River Authority	Mountain Creek WWTP to Joe Pool Lake	08-3404D	Amended	06/27/05	4,368
Trinity River Authority	Multiple WWTPs to Lake Livingston	08-4248	Amended	10/12/06	246,960
City of Dallas	Multiple WWTPs to Lewisville Lake	08-2456E	Amended	10/12/06	0
City of Dallas	Multiple WWTPs to Lake Ray Hubbard	08-2462G	Amended	10/12/06	150,000
Upper Trinity Regional Water District	Multiple WWTPs to Lewisville Lake	5778	Amended	03/03/06	9,664
City of Irving	Unspecified	03-4799C	Amended	01/06/06	31,600
North Texas Municipal Water District	Wilson Creek WWTP to Lake Lavon	08-2410E	Amended	09/08/05	35,941
North Texas Municipal Water District	Multiple WWTPs to Wetland/Lake Lavon	08-2410F	Amended	07/05/07	157,393

The maximum annual delivery from the Richland-Chambers wetland impoundment to Richland-Chambers Reservoir is 100,465 acre-feet per year. Similar to the operation of the Cedar Creek wetland project, the water from the Richland-Chambers wetland impoundment will augment existing storage in Richland-Chambers Reservoir for diversion under the reservoir’s original permit of 210,000 acre-feet per year, with additional authorized diversion from Richland-Chambers Reservoir up to 63,000 acre-feet per year for municipal, mining, industrial, and agricultural purposes. The Richland-Chamber Reservoir reuse project began operation in 2009.

The maximum annual delivery from the Cedar Creek wetland impoundment to Cedar Creek Reservoir is 88,059 acre-feet per year. This water will augment existing storage in Cedar Creek Reservoir for diversion under the reservoir's original permit of 175,000 acre-feet per year, plus additional authorized diversion from Cedar Creek Reservoir up to 52,500 acre-feet per year for municipal, mining, industrial, and agricultural purposes. The Cedar Creek Reservoir reuse project is expected to be completed by 2018.

Trinity River Authority. On October 12, 2006, the TCEQ granted an amendment to the Authority's Certificate of Adjudication 08-4248. The amendment allows the Authority to impound, in its share of the storage in Lake Livingston, historical and future return flows from its Central, Red Oak Creek, and Ten Mile Creek wastewater treatment plants. According to the amendment, these treatment plants have a cumulative permitted discharge of 220.5 million gallons per day (MGD). The amendment allows the Authority to impound return flows in Lake Livingston and to divert and use the return flows as authorized in the amended certificate. Lake Livingston is located in Region H.

On June 27, 2005, the Authority received an amendment to its water right in Joe Pool Lake (Certificate of Adjudication 08-3404D). The amended certificate allows the Authority to impound in and use from Joe Pool Lake an amount not to exceed 4,368 acre-feet per year of return flows from the Authority's Mountain Creek Regional Wastewater Treatment Plant. The amendment also provides a bed and banks authorization to use an unnamed tributary of Newton Branch, tributary of Soap Creek, tributary of Mountain Creek, and Joe Pool Lake to convey the discharged water to Joe Pool Lake for storage and subsequent diversion.

City of Dallas. On October 12, 2006, the TCEQ granted an amendment to the City's Certificate of Adjudication 08-2456E, an amendment to its water right in Lake Lewisville, and Certificate of Adjudication 08-2462G, an amendment to its water right in Lake Ray Hubbard. The amendments allow the diversion of historical and future return flows contributed by the City of Lewisville and Town of Flower Mound Wastewater Treatment Plants from the Elm Fork Trinity River to the City's Elm Fork and Bachman Water Treatment Plants. The amendment also provides the right to discharge, store, divert, and use historical and future return flows from the City's Central and Southside Wastewater Treatment Plants. The City plans to convey by pipeline a portion of the return flows from

the Central and Southside Wastewater Treatment Plants to Lake Lewisville and Lake Ray Hubbard. The five-year average discharges stated in the amendment from these plants are 157,030 acre-feet per year from the Central plant and 85,800 acre-feet per year from the Southside plant. The amendments require that the City leave at least 114,000 acre-feet per year of water discharged from the Central and Southside Wastewater Treatment Plants in the Trinity River to meet downstream flow requirements. The amendments also include a bed and banks authorization to convey the return flows from the pipeline discharge point to previously authorized diversion points. The amendments provide diversion authorization of up to an additional 150,000 acre-feet per year from Lake Ray Hubbard but do not request a new appropriation of water in Lake Lewisville.

Return flows covered by this request include the following:

- Dallas Trinity Basin origin water historically discharged into the Trinity River,
- Sabine River water (Lake Tawakoni) historically discharged into the Trinity River,
- Future increases in return flows originating from the Trinity River and Sabine River Basins, and
- Developed water to be transferred from the Sabine River (Lake Fork) and Neches River Basins.

Upper Trinity Regional Water District. On March 3, 2006, the TCEQ granted the District's amendment to Permit Number 5778. The amendment allows the District to divert from Lake Lewisville up to 9,664 acre-feet per year of return flows, originating from the District's Lake Chapman water, for municipal and industrial purposes. The proposed amendment authorizes the use of bed and banks to convey return flows from their points of discharge to the diversion point in Lake Lewisville.

City of Irving. On January 6, 2006, the TCEQ issued Certificate of Adjudication 03-4799C, an amendment to the City's water right in Lake Chapman. The amendment removes the requirement to return unconsumed water to the Trinity River Basin and adds an authorization to reuse its imported Sulphur River Basin water as "developed" water. The Certificate of Adjudication authorizes the City to reuse up to 31,600 acre-feet per year (less carriage losses). However, an agreement between the City and the Trinity River Authority limits this quantity to 28,000 acre-feet/year. The reuse authorization is subject to obtaining

future authorizations after identifying specific points of discharge and diversion and satisfying bed and banks requirements.

North Texas Municipal Water District (Lake Lavon). The District has been granted Certificates of Adjudication 08-2410E and 08-2410F to reuse return flows from District water supplies. Each of these is discussed below.

On September 8, 2005, the TCEQ authorized Certificate of Adjudication 08-2410E, which amended the District's water right in Lake Lavon. The amendment allows the District to divert from Lake Lavon up to an additional 35,941 acre-feet per year (for a total of 71,882 acre-feet per year) of return flows from the District's Wilson Creek Wastewater Treatment Plant. This diversion is for municipal purposes and is limited to the amount actually discharged from the treatment plant, less conveyance losses. On July 5, 2007, the TCEQ authorized Certificate of Adjudication 08-2410F, which amended the District's water right in Lake Lavon. The amendment allows the diversion of up to 157,393 acre-feet per year of return flows originating from District water supplies from the East Fork Trinity River for municipal, industrial, agricultural, and recreational purposes. This amount includes all future District return flows from wastewater treatment plants currently discharging to the watershed of the East Fork of the Trinity River with the following exceptions:

- 64 MGD of discharges from the District's Wilson Creek Wastewater Treatment Plant, which the District has appropriated through CA 08-2410E
- 30 percent of all Trinity Basin-based return flows authorized pursuant to Certificate of Adjudication No. 08-2410, as amended, which the District will leave in the East Fork Trinity River to address downstream water rights and the needs of the environment.

The amendment also includes a bed and banks authorization to use streams within the Trinity River Basin to convey District return flows to the diversion point.

Existing Reuse Quantities

During early August 2009, a survey of Chapter 210 reuse providers (Table I.11) and operating indirect reuse providers (Table 1-12) in Region C was conducted. Two significant, indirect reuse projects, the TRWD Richland-Chambers Wetland and NTMWD

East Fork Raw Water Supply Project, have both recently began operation and are not included in Table I.12 for this reason. A summary of information obtained from these surveys is included in this section.

The 2006 *Region C Water Plan* ⁽¹⁾ showed the available supply from direct reuse projects included in Table 1-11 to be 35,738 ac-ft/yr by the year 2010. Over the course of the period evaluated here (2005-2008), reuse quantities ranging from 10,000 to 14,000 ac-ft/yr were used from these projects. The 2006 *Region C Water Plan* ⁽¹⁾ showed the available supply from indirect reuse projects included in Table 1-12 to be 83,640 ac-ft/yr of water by the year 2010. In 2008, approximately 52,284 ac-ft/yr of reuse supplies from these projects were used.

**Table I.11
Direct Reuse Quantities by Provider**

Sponsor	Project	Use	2010 Available Supply (2006 Plan) (ac-ft/yr)	2005 (ac-ft/yr)	2006 (ac-ft/yr)	2007 (ac-ft/yr)	2008 (ac-ft/yr)
NTMWD	Rowlett Creek	Golf Course Irrigation	1,540	383.65	422.59	140.06	221.95
NTMWD	Buffalo Creek	Golf Course Irrigation	672	187.69	244.99	145.77	159.34
NTMWD	Royse City	Golf Course Irrigation	112	112.26	129.00	0.00	0.00
NTMWD Subtotal			2,324	683.60	796.59	285.83	381.28
TRA	Las Colinas	Irrigation	8,000	1,684.41	2,192.30	227.16	1,756.72
TRA	Ten Mile Creek	Irrigation	N/A	41.93	46.06	13.42	35.87
TRA Subtotal			8,000	1,726.34	2,238.36	240.58	1,792.58
Garland	Forney	Steam Electric Power	8,979	6,522.64	8,015.82	7,997.97	7,910.11
Garland Subtotal			8,979	6,522.64	8,015.82	7,997.97	7,910.11
Frisco	Stewart Creek	Golf Course Irrigation	307	320.04	356.92	257.96	107.76
Frisco Subtotal			307	320.04	356.92	257.96	107.76
Fort Worth	Waterchase Golf	Golf Course Irrigation	897	438.12	594.36	304.78	449.44
Fort Worth Subtotal			897	438.12	594.36	304.78	449.44
Dallas	Cedar Crest	Golf Course Irrigation	561	250.61	232.28	166.04	
Dallas Subtotal			561	250.61	232.28	166.04	0.00
Ennis	Tractabel	Steam Electric Power	3,363	707.59	706.13	861.27	
Ennis Subtotal			3,363	707.59	706.13	861.27	0.00
Gainesville	Keneteso Park	Irrigation	9	0.73	0.94	3.87	4.05
Gainesville Subtotal			9	0.73	0.94	3.87	4.05
Azle	Cross Timbers	Golf Course Irrigation	811	242.96	285.20	32.49	56.10
Azle Subtotal			811	242.96	285.20	32.49	56.10
The Colony	Stonebriar Country Club	Golf Course Irrigation	380	114.96	326.28	180.23	
The Colony Subtotal			380	114.96	326.28	180.23	0.00
Lewisville	Castlehills Golf Course	Golf Course Irrigation	897	383.05	379.03	210.46	
Lewisville Subtotal			897	383.05	379.03	210.46	0.00
Denton	City of Garland	Steam Electric Power	3,363	388.15	644.24	172.78	108.39
Denton	Oakmont Country Club	Golf Course Irrigation	800	309.54	232.61	118.56	215.45
Denton	Various	Irrigation	6,165	64.49	106.98	82.08	69.40
Denton Subtotal			10,328	762.18	983.83	373.41	393.24
TOTAL			35,738	11,590	14,274	10,624	10,931

**Table I.12
Indirect Reuse Quantities by Provider**

Sponsor	Project	2010 Available Supply (2006 Plan) (ac-ft/yr)	2005 (ac-ft/yr)	2006 (ac-ft/yr)	2007 (ac-ft/yr)	2008 (ac-ft/yr)
NTMWD	Wilson Creek	71,882.00	4,208.37	43,933.45	50,104.20	42,831.31
NTMWD Subtotal		71,882.00	4,208.37	43,933.45	50,104.20	42,831.31
UTRWD	Lakeview Regional WRP	8,441.00	2,686.38	2,691.13	4,264.19	4,070.85
UTRWD	Riverbend Regional WRP		404.27	582.53	924.47	934.41
UTRWD	Peninsula Regional WRP		75.64	116.37	147.22	191.44
UTRWD	Celina WWTP		329.50	305.40	513.08	417.68
UTRWD		8,441.00	3,495.78	3,695.44	5,848.96	5,614.37
Grapevine	Peach St. WWTP	3,317.00	3,501.68	3,376.64	3,924.26	3,838.40
Grapevine Subtotal		3,317.00	3,501.68	3,376.64	3,924.26	3,838.40
TOTAL		83,640.00	11,205.83	51,005.53	59,877.42	52,284.08

Desalination

Two desalination facilities are currently operated by public water systems within Region C. The City of Sherman operates a 7.50 MGD (design hydraulic capacity) electro dialysis reversal membrane plant to treat brackish water from Lake Texoma. The City of Bardwell operates a reverse osmosis facility to treat 0.036 MGD (design hydraulic capacity) of brackish groundwater. In addition, the Brazos River Authority (BRA) operates the Lake Granbury Surface Water and Treatment System (SWATS). Although Lake Granbury is located in Region G, BRA provides water from SWATS to the Johnson County SUD, which serves customers within Region C. The amount of water provided by SWATS is accounted for as an import to Region C (Table I.14).

Existing Desalination Quantities

During October 2009, a survey of operating desalination facilities in Region C was conducted. The information obtained from the City of Sherman’s survey is shown in Table I.13.

**Table I.13
Desalination Quantities by Provider**

Sponsor	2006 (MG/year)	2007 (MG/year)	2008 (MG/year)	2006 (ac-ft/yr)	2007 (ac-ft/yr)	2008 (ac-ft/yr)
City of Sherman	1,557.15	1,261.66	1,372.79	4,779	3,872	4,213

Imports

The supply available from imports is based upon the Water Availability Models (WAMs) from the TCEQ and the current contracts with the owners of the water sources. Table I.14 shows those imports. Below is a discussion of each of the imported water sources.

Table I.14
Currently Available Surface Water Supplies – Imports
(Acre-Feet per Year)

Source	Basin of Origin	2000	2010	2020	2030	2040	2050	2060	2060 from 2006 Plan
Chapman (NTMWD) ^a	Sulphur	47,132	47,132	47,132	47,132	47,132	47,132	47,132	45,843
Chapman (Irving)	Sulphur	44,484	44,484	44,484	44,484	44,484	44,484	44,484	43,268
Chapman (Upper Trinity MWD)	Sulphur	13,268	13,268	13,268	13,268	13,268	13,268	13,268	12,905
Tawakoni (Terrell)	Sabine	9,790	0	0	0	0	0	0	9,356
Tawakoni (Dallas)	Sabine	184,991	183,619	182,251	180,882	179,515	178,146	176,777	176,777
Fork (Dallas) ^b	Sabine	120,000	120,000	119,943	119,095	118,248	117,400	116,551	116,551
Upper Sabine Basin (NTMWD) ^c	Sabine	0	49,718	29,646	9,573	9,501	9,428	9,356	0
Palestine (Dallas) ^d	Neches	112,700	112,881	111,776	110,670	109,563	108,455	107,347	108,980
Livingston ^e	Trinity	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Lake Athens ^f	Neches	3,960	3,908	3,856	3,804	3,751	3,699	3,647	3,647
Possum Kingdom ^g	Brazos	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Lake Aquilla	Brazos	245	264	276	285	295	309	329	329
Lake Granbury	Brazos	185	231	231	231	231	231	231	231
Lake Palo Pinto	Brazos	850	1,270	1,257	1,248	1,234	1,230	1,230	1,230
TOTAL		559,605	598,775	576,120	552,672	549,222	545,782	542,352	541,117

- a. The supplies from Lake Chapman for NTMWD include NTMWD's share of Lake Chapman and sales from the City of Cooper.
- b. The import of water from Lake Fork to the Trinity Basin is limited to 120,000 acre-feet per year. The first phase of the infrastructure to transport this water to DWU is completed. The second phase is scheduled to be completed in the next five years.
- c. NTMWD acquired Terrell's supply in Lake Tawakoni with additional water from the Upper Sabine Basin for 2010 and 2020.
- d. There is no current infrastructure to transport the water from Lake Palestine to DWU.
- e. Water supply contract from Lake Livingston is for 20,000 acre-feet per year in any one year with no more than 48,000 acre-feet per year over a three year period.
- f. The amount of water from Lake Athens is the amount that is imported to Region C.
- g. The supply from Possum Kingdom Lake is for Vulcan Materials (Parker County Mining).

Chapman. North Texas Municipal Water District, the City of Irving, and the Sulphur River Water District hold water rights in Lake Chapman totaling 146,520 acre-feet per year. Of this total, 127,320 acre-feet per year can be exported for use in Region C – 57,214 acre-feet per year for North Texas Municipal Water District, 54,000 acre-feet per year for Irving, and 16,106 acre-feet per year for the Upper Trinity Regional Water District (purchased from the Sulphur River Water District). According to the Operations Plan for Lake Chapman, prepared by R.J. Brandes Company in June 2003⁽¹⁴⁾, the year 2000 firm yield of

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Lake Chapman is about 130,100 acre-feet per year, decreasing to 117,400 acre-feet per year by 2060. The modified Water Availability Model for the Sulphur Basin indicates that the year 2000 and year 2060 firm yield of Lake Chapman is 120,700 acre-feet per year, which is less than the permitted 146,520 acre-feet per year. Changes in the available supply since the 2006 *Region C Water Plan* ⁽¹⁾ can be attributed to extensive changes made to the TCEQ Sulphur Basin WAM.

The values in Table I.14 show Lake Chapman's computed firm yield divided proportionally among the Region C water suppliers with a share of the water. The water supply for Upper Trinity Regional Water District could reduce by 25 percent in 2050 because the City of Commerce has the option to reclaim a portion of the water it has sold to UTRWD after 2040. However, based on water projections for the City of Commerce, it is expected that Commerce may not need to exercise the option, thereby letting the water remain available to UTRWD.

Tawakoni. Lake Tawakoni is located in the Sabine River Basin. The Sabine River Authority holds water rights for 238,100 acre-feet per year. The City of Dallas has a contract for 190,480 acre-feet per year. The North Texas Municipal Water District has a contract for 10,081 acre-feet per year that was transferred from the City of Terrell since the 2006 *Region C Water Plan* ⁽¹⁾. Using the Sabine River WAM, the firm yield of Lake Tawakoni is 231,520 in year 2000, reducing to 221,240 acre-feet per year by 2060. The supplies available to the cities of Dallas and NTMWD are based on the proportion of the contracted amount to the firm yield. Adjustments were made to ensure that supplies to each customer of the Sabine River Authority were reduced proportionally. NTMWD's share of the Lake Tawakoni supply is included in the Upper Sabine Basin Supply in Table I.14.

Lake Fork (Dallas). Lake Fork is located in the Sabine River Basin. The Sabine River Authority holds water rights for 188,660 acre-feet per year. The City of Dallas has a contract for 131,860 acre-feet per year. Of this amount, 120,000 acre-feet per year can be exported to the Trinity Basin in Region C. The remainder can only be used in the Sabine River Basin. The Region I water planning group reports the firm yield of Lake Fork as 174,250 acre-feet per year in year 2000, reducing due to sedimentation to 166,960 acre-feet per year. The supply to Dallas was reduced in proportion to the reduced yield. The

total amount exported to Region C was limited to the 120,000 acre-feet per year specified in the trans-basin diversion permit.

Upper Sabine Basin Supply (NTMWD). In addition to the Lake Tawakoni supply transferred to NTMWD from Terrell, NTMWD has a temporary water right for additional supply from the Upper Sabine Basin. The additional supply is 40,000 acre-feet per year in 2010 and 20,000 acre-feet per year in 2020. The available supply to NTMWD from the Upper Sabine Basin that is shown in Table I.14 includes the temporary supply (2010 and 2020 only) and the firm yield of the Lake Tawakoni water right that was transferred from Terrell to NTMWD.

Palestine (Dallas). Lake Palestine is located on the Neches River in the Neches River Basin. The lake is owned and operated by the Upper Neches River Municipal Water Authority (UNRMWA) in conjunction with a downstream diversion point (Rocky Point). The UNRMWA holds water rights totaling 238,110 acre-feet per year from the Lake Palestine system. The firm yield of the Palestine system using the numbers provided by Region I is estimated at 222,200 acre-feet per year in year 2000, reducing to 214,600 acre-feet per year by 2060. The City of Dallas has a contract with the UNRMWA for 114,337 acre-feet per year. The supply to Dallas was reduced due to the reduced yield. Presently there is no infrastructure to transport this water from Lake Palestine to Dallas. This will be considered as a water management strategy.

Athens (Athens). Lake Athens is located in Henderson County in the Neches River Basin. The Athens Municipal Water Authority holds water rights in Lake Athens totaling 8,500 acre-feet per year. Of this amount 3,023 acre-feet per year is designated for industrial use for the Athens Fish Hatchery, which is located at the lake. The yield of Lake Athens was determined by Region I using the Neches Basin Water Availability Model and is currently 6,145 acre-feet per year. The amount that is exported to Region C for use by the City of Athens is 3,960 acre-feet per year, reducing to 3,647 acre-feet per year in 2060.

Possum Kingdom Lake (Vulcan Materials). Vulcan Materials has a contract to purchase 2,000 acre-feet per year of water originating in Possum Kingdom Lake from the

Brazos River Authority for mining use. Possum Kingdom Lake is in the Brazos River Basin in Region G. This supply is assumed to be available through the planning period.

Lake Aquilla. Lake Aquilla is located in the Brazos River Basin in Region G. The Aquilla Water Supply Corporation provides water to entities in Ellis and Navarro Counties in Region C. The total estimated supply provided to Region C from Lake Aquilla is 245 acre-feet per year in 2000, increasing to 329 acre-feet per year by 2060.

Lake Granbury. Lake Granbury is located in the Brazos River Basin in Region G. The Brazos River Authority owns and operates the lake as part of the Authority's water system. Currently, the Authority sells water from Lake Granbury to Johnson County Special Utility District (SUD). Johnson County SUD provides water to customers in both Region C and Region G. The amount of water imported to Region C is estimated at 231 acre-feet per year.

Lake Palo Pinto. Lake Palo Pinto is located in Palo Pinto County in the Brazos River Basin in Region G. A portion of Mineral Wells is in Parker County in Region C, and Mineral Wells also sells water to Millsap Water Supply Corporation (WSC), Parker County WSC, and the portions of North Rural and Santo WSCs in Parker County. All of Mineral Wells' water supply currently comes from Lake Palo Pinto. (Mineral Wells has a water right in Lake Mineral Wells in Parker County but has no plans to use that source for water supply.) The supply from Lake Palo Pinto to Region C consists of:

- All projected City of Mineral Wells demand in Parker County
- 25 acre-feet per year of demand for Parker County Manufacturing, provided through the City of Mineral Wells
- 479 acre-feet per year for Parker County Other.

APPENDIX I
LIST OF REFERENCES

- (1) Freese and Nichols, Inc., Alan Plummer Associates, Inc., Chiang, Patel & Yerby, Inc., and Cooksey Communications, Inc.: *2006 Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, January 2006.
- (2) Texas Commission on Environmental Quality: Water Rights Database, provided on January 22, 2009 by Marian Chervenka with TCEQ to be used in regional water planning.
- (3) Texas Water Development Board, *Exhibit C General Guidelines for Regional Water Plan Development (2007-2011)*, Austin, [Online] Available URL: <http://www.twdb.state.tx.us/wrpi/rwp/docu.htm>, September 8, 2008.
- (4) Texas Water Development Board: "GAM Run 08-14mag," Managed available groundwater estimates for the Woodbine Aquifer in Groundwater Management Area 8, Austin, December 2008.
- (5) Texas Water Development Board: "GAM Run 08-84mag," Managed available groundwater estimates for the Trinity Aquifer in Groundwater Management Area 8, Austin, March 2009.
- (6) Texas Commission on Environmental Quality: Chapter 210 Authorization Database, emailed July 17, 2009 by Sherry Smith.
- (7) Alan Plummer Associates, Inc., and Chiang, Patel & Yerby, Inc.: *Recycled Water Implementation Plan, Volume I, Final Review Draft*, prepared for Dallas Water Utilities, May 2005.
- (8) Alan Plummer Associates, Inc., and Chiang, Patel & Yerby, Inc.: *Recycled Water Implementation Plan, Volume II, Water Supply Augmentation with Recycled Water, Draft*, prepared for Dallas Water Utilities, August 2005.
- (9) Alan Plummer Associates, Inc.: *Reclaimed Water Use Notification*, prepared for the Town of Flower Mound, April 2002.
- (10) Alan Plummer Associates, Inc.: *Reclaimed Water Priority and Implementation Plan*, prepared for the City of Fort Worth, May 2007.
- (11) Environmental Protection Agency: Water Discharge Permits Query, downloaded August 2009 from http://www.epa.gov/enviro/html/pcs/pcs_query_java.html.
- (12) Alan Plummer Associates, Inc.: *Chapter 210 Reclaimed Water Use Notification*, prepared for the City of Lewisville, February 2004.

- (13) Alan Plummer Associates, Inc.: *Reclaimed Water Use Notification*, prepared for the City of Weatherford, July 2001.
- (14) R.J. Brandes Company: *Operations Plan for Lake Chapman*, June 2003.