

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 *2011 Region C Water Plan* ⁽¹⁾. The decrease in overall water supply from the *2011 Region C Water Plan* ⁽¹⁾ is mainly due to the decreased yield in Lake Chapman from the new critical drought period and decreased supplies from the use of safe yields by Dallas Water Utilities (DWU) and Tarrant Regional Water District (TRWD). 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 ^(2,3)
- 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	2020	2030	2040	2050	2060	2070
Reservoirs in Region C	1,275,970	1,256,257	1,236,417	1,216,578	1,196,738	1,177,262
Local Irrigation	8,734	8,734	8,734	8,734	8,734	8,734
Other Local Supply	19,931	19,931	19,931	19,931	19,931	19,931
Surface Water Imports	581,567	531,265	520,931	510,717	501,415	491,109
Groundwater	146,178	146,190	146,188	146,135	146,132	146,096
Reuse	283,893	316,972	343,226	380,051	408,880	429,018
REGION C TOTAL	2,316,273	2,279,349	2,275,427	2,282,147	2,281,830	2,272,150

Table I.2
2011 Plan ⁽¹⁾ – Overall Water Supply Availability in Region C
(Acre-Feet per Year)

UMMARY	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
Change from 2011 Plan to 2016 Plan		-84,210	-113,930	-132,283	-134,341	-138,533

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 *2011 Region C Water Plan* ⁽¹⁾. In accordance with the Texas Water Development Board’s (TWDB) established procedures ⁽⁴⁾, 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 calculated as the minimum annual diversion for the permitted water rights located on the main stem and tributaries of the river.

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.
- Inclusion of a minimum elevation for Lake Fairfield (305.0 ft. msl). This is the minimum operating elevation for the intake to the power plant according to the *1999 Volumetric Survey of Fairfield Lake* prepared by the Texas Water Development Board.
- 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 of these two reservoirs. Backup supply for these reservoirs from Lake Texoma is included in the supplies from Lake Texoma. This prevents double counting of the makeup water from Lake Texoma. For firm yield calculations for reservoirs other than Lake Randell, Valley Lake and Lake Texoma, the backups for Lake Randell and Valley Lake were retained.
- Use of water from Lake Texoma is authorized by multiple Texas water rights and Oklahoma water rights, as well as authorizations by the US Congress and contracts with the Corps. In the TCEQ Red River WAM, each Texas water right is given its own “evaporation allocation” pool. Oklahoma’s share of the lake, storage reserved for hydropower and dead storage in the reservoir are given their own pools as well. This type of modeling facilitates water availability modeling of the individual water rights but does not allow a meaningful calculation of the firm yield of the entire reservoir. To enable calculation of the overall firm yield of Lake Texoma, FNI modeled Lake Texoma as a single reservoir with multiple priority dates for the conservation storage and diversion, plus inactive storage corresponding to the dead storage. For the firm yield calculation of other reservoirs, multiple storage pools were retained in Lake Texoma.
- Currently the U.S. Congress has allocated 450,000 acre-feet of storage in Lake Texoma for water supply use - the original 150,000 acre-feet for Texas, 150,000 acre-feet for Oklahoma, plus the 150,000 acre-feet reallocated from hydropower storage currently contracted to NTMWD and GTUA. In the TCEQ WAM, an additional 100,000 acre-feet of new storage plus 113,000 acre-feet per year of diversion was added to the Oklahoma portion of the reservoir. The reason for this addition is not clear, but it does mirror NTMWD’s most recent application for a new Texas water right in the reservoir. Since this portion of the model does not reflect any existing or proposed

use by the State of Oklahoma, FNI removed this portion of the model. (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. This water right has been granted by TCEQ but was not included in the Red River WAM used as the basis for the Region C model.
- Removal of diversion backups of individual Texas water rights in Lake Texoma from the hydropower pool. All Texas water rights are 100% reliable in the WAM, so these backups are not invoked in the WAM. The code was removed because it made the modeling unnecessarily complicated.

Unless there were changed conditions (new water rights, WAM modifications, new area/capacity relationships, other), the firm yields from the *2011 Region C Water Plan* ⁽¹⁾ were used, extrapolating 2070 from 2060. The Region C reservoirs for which new firm yields were calculated include the Elm Fork of the Trinity River System, Forest Grove Reservoir, and Lake Lavon. The Elm Fork System and Lake Lavon yields were updated to reflect new area/capacity relationships. The yield for Forest Grove was updated to reflect that the gates on the dam at the reservoir have not been closed.

TRWD has elected to show the currently available supplies for the reservoirs they obtain water from as safe yields, rather than firm yields, based on the operation of these reservoirs. DWU has also elected to do this for most of their reservoirs. Both the firm yield and safe yields are reported for these reservoirs. However, the safe yield is what is used to determine the overall water supply availability in Region C.

At the end of this appendix, Table I.10 summarizes the WAM models used for the 2016 Region C Plan.

Imports to Region C

Supplies from Lake Chapman were determined using the Sulphur River Basin WAM with extended hydrology to include the new critical period for the reservoir.

The yields for Lake Fork and Lake Tawakoni were updated from the *2011 Region C Water Plan* ⁽¹⁾ yields to reflect new area/capacity relationships. The new yields were provided to Region D for inclusion in the 2016 Region D Water Plan.

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

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. Unless otherwise noted, the 2070 yields shown below were extrapolated from the 2060 yields calculated for the *2011 Region C Water Plan* ⁽¹⁾.

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 2070 is 1,597 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 123,459 acre-feet per year in 2020 and 120,570 acre-feet per year in 2070.

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 2011 Plan					
		2020	2030	2040	2050	2060	2070	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	1,597	1,597	1,597	1,597	1,597
West Fork (includes Bridgeport Local) ^(a)	Trinity	96,458	95,625	94,792	93,958	93,125	92,292	109,833	109,167	108,500	107,833	107,167	106,500
Elm Fork/ Lewisville/ Ray Roberts (Dallas) ^(a)	Trinity	172,975	165,580	158,185	150,791	143,396	136,001	184,801	183,733	182,665	181,597	180,529	179,459
Grapevine - Dallas ^(a)	Trinity	7,367	7,150	6,933	6,717	6,500	6,283	7,583	7,367	7,150	6,933	6,717	6,500
Subtotal Systems		278,397	269,952	261,507	253,063	244,618	236,173	303,814	301,864	299,912	297,960	296,010	294,056
RESERVOIRS IN REGION C													
Cedar Creek ^(a)	Trinity	159,367	157,850	156,333	154,817	153,300	151,783	175,000	175,000	175,000	175,000	175,000	175,000
Richland-Chambers (TRWD) ^(a)	Trinity	186,600	182,700	178,800	174,900	171,000	167,100	210,000	210,000	210,000	210,000	210,000	210,000
Richland-Chambers (Corsicana) and Lake Halbert	Trinity	13,863	13,855	13,847	13,838	13,830	13,822	13,872	13,863	13,855	13,847	13,838	13,830
Moss	Red	7,410	7,410	7,410	7,410	7,410	7,410	7,410	7,410	7,410	7,410	7,410	7,410
Lake Texoma (Texas' Share – NTMWD)	Red	197,000	197,000	197,000	197,000	197,000	197,000	190,300	190,300	190,300	190,300	190,300	190,300
Lake Texoma (Texas' Share – GTUA)	Red	83,200	83,200	83,200	83,200	83,200	83,200	81,500	81,500	81,500	81,500	81,500	81,500
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
LakeTexoma (Texas' Share – Luminant)	Red	16,400	16,400	16,400	16,400	16,400	16,400	16,400	16,400	16,400	16,400	16,400	16,400
Lake Texoma (Texas' Share – RRA)	Red	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250
Randell	Red	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400
Valley	Red	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	5,340
Ray Roberts (Denton)	Trinity	18,902	18,733	18,564	18,395	18,226	18,057	18,980	18,720	18,460	18,200	17,940	17,680
Lewisville (Denton)	Trinity	7,817	7,715	7,613	7,512	7,410	7,308	7,918	7,817	7,715	7,613	7,512	7,410

Table I.3, Continued

	Basin	Revised Surface Water Availability						Surface Water Availability in 2011 Plan					
		2020	2030	2040	2050	2060	2070	2010	2020	2030	2040	2050	2060
Benbrook ^(a)	Trinity	5,417	5,400	5,383	5,367	5,350	5,333	6,833	6,833	6,833	6,833	6,833	6,833
Weatherford	Trinity	2,923	2,880	2,837	2,793	2,750	2,707	2,967	2,923	2,880	2,837	2,793	2,750
Grapevine (PCMUD)	Trinity	16,900	16,750	16,600	16,450	16,300	16,150	17,050	16,900	16,750	16,600	16,450	16,300
Grapevine (Grapevine)	Trinity	1,983	1,950	1,917	1,883	1,850	1,817	2,017	1,983	1,950	1,917	1,883	1,850
Arlington ^(a)	Trinity	7,667	7,550	7,433	7,317	7,200	7,083	9,850	9,700	9,550	9,400	9,250	9,100
Joe Pool	Trinity	14,883	14,575	14,267	13,958	13,650	13,342	15,192	14,883	14,575	14,267	13,958	13,650
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
North	Trinity	0	0	0	0	0	0	0	0	0	0	0	0
Lake Ray Hubbard (Dallas)	Trinity	56,113	54,800	53,487	52,173	50,860	49,547	57,427	56,113	54,800	53,487	52,173	50,860
White Rock	Trinity	3,200	2,900	2,600	2,300	2,000	1,700	3,500	3,200	2,900	2,600	2,300	2,000
Terrell	Trinity	2,267	2,250	2,233	2,217	2,200	2,183	2,283	2,267	2,250	2,233	2,217	2,200
Clark	Trinity	210	210	210	210	210	210	210	210	210	210	210	210
Bardwell	Trinity	9,600	9,295	8,863	8,432	8,000	7,931	9,600	9,600	9,295	8,863	8,432	8,000
Waxahachie	Trinity	2,800	2,695	2,590	2,485	2,380	2,275	2,905	2,800	2,695	2,590	2,485	2,380
Forest Grove	Trinity	8,653	8,590	8,527	8,463	8,400	8,337	8,767	8,693	8,620	8,547	8,473	8,400
Trinidad City Lake	Trinity	450	450	450	450	450	450	450	450	450	450	450	450
Trinidad	Trinity	3,050	3,050	3,050	3,050	3,050	3,050	3,050	3,050	3,050	3,050	3,050	3,050
Navarro Mills	Trinity	18,333	17,325	16,317	15,308	14,300	13,292	19,342	18,333	17,325	16,317	15,308	14,300
Fairfield	Trinity	870	870	870	870	870	870	870	870	870	870	870	870
Bryson	Brazos	0	0	0	0	0	0	0	0	0	0	0	0
Mineral Wells	Brazos	2,495	2,483	2,470	2,458	2,445	2,433	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
Lake Lavon	Trinity	108,920	107,140	105,360	103,580	101,800	100,020	112,033	110,767	109,500	108,233	106,967	105,700
Muenster	Trinity	300	300	300	300	300	300	300	300	300	300	300	300
Subtotal Reservoirs		997,573	986,305	974,910	963,515	952,120	941,088	1,038,513	1,033,359	1,027,905	1,022,323	1,016,739	1,011,157
TOTAL		1,275,970	1,256,257	1,236,417	1,216,578	1,196,738	1,177,261	1,342,327	1,335,223	1,327,817	1,320,283	1,312,749	1,305,213

^(a) Amounts reported for 2016 Plan are safe yields.

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). The safe yield for the West Fork System, which includes Eagle Mountain Lake, Lake Worth, and Lake Bridgeport, is 96,458 acre-feet per year in 2020 and 92,292 acre-feet per year in 2070.

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 184,166 acre-feet per year in 2020 and 179,907 acre-feet per year in 2070. The firm yield is higher than what was shown in the *2011 Region C Water Plan*⁽¹⁾ due to changes made in the WAM with respect to the area/capacity relationships. The increase from the available supply shown in the *2011 Region C Water Plan*⁽¹⁾ is due to using a lower sedimentation rate, which was calculated using the 2008 volumetric survey of Lake Ray Roberts. The safe yield of the reservoir system in 2070 is 136,001 acre-feet per year.

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 7,367 acre-feet per year in 2020 and 6,283 acre-feet per year in 2070. 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. In some cases the safe yield is used as the supply available based on operational policies of the reservoir.

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 209,667 acre-feet per year in 2020 decreasing to 204,083 acre-feet per year by 2070. The available supply from Cedar Creek is limited to the permit amount of 175,000 acre-feet per year. The safe yield, which TRWD operates its supplies based on, is 159,367 acre-feet per year in 2020 decreasing to 151,783 acre-feet per year in 2070.

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 222,467 acre-feet per year in 2020, decreasing to 207,883 acre-feet per year by 2070. The available supply to TRWD from Richland-Chambers is limited to the permitted amount of 210,000 acre-feet per year. The safe yield is 186,600 acre-feet per year in 2020 decreasing to 167,100 acre-feet per year in 2070.

Corsicana's water right in Lake Halbert is backed up by the City's water right in Richland-Chambers. 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 2070 is 13,822 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 2070 is 7,410 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 *2011 Region C Water Plan*⁽¹⁾, GTUA increased its Lake Texoma water right by 1,700 acre-feet per year. The total Texoma supply available to Region C as of 2070 is 316,550 acre-feet per year (2,250 acre-feet per year for Red River Authority; 83,200 acre-feet per year for Greater Texoma Utility Authority; 24,400 acre-feet per year for Denison; 197,000 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 642,608 acre-feet per year in 2020, decreasing to 640,067 acre-feet per year by 2070.

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 2070 is 1,400 acre-feet per year 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 6,267 acre-feet per year in 2020, decreasing to 5,683 acre-feet per year by 2070. The available supply from Lake Bonham is limited to the permitted amount of 5,340 acre-feet per year.

Ray Roberts (Denton). Lake Ray Roberts and Lake Lewisville were modeled as part of the Elm Fork System 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 2070 is 18,057 acre-feet per year. The increase from the available supply shown in the *2011 Region C Water Plan* is due to using a lower sedimentation rate, which was calculated using the 2008 volumetric survey of Ray Roberts.

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 2070 is 7,308 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 7,131 acre-feet per year in 2020, decreasing to 6,759 acre-feet per year by 2070. The safe yield is 5,417 acre-feet per year in 2020 and 5,333 acre-feet per year in 2070. 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 2070 is 2,707 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 2070 is 16,150 acre-feet per year, and the City of Grapevine's available supply from Lake Grapevine as of 2070 is 1,817 acre-feet per year..

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). By contract, City of Arlington has dedicated its Lake Arlington water rights to the TRWD System. According to the WAM, available supply from Lake Arlington as of 2070 is 8,950 acre-feet per year. The safe yield is 7,667 acre-feet per year in 2020 and 7,083 acre-feet per year in 2070. 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 2070 is 13,342 acre-feet per year.

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 12,767 acre-feet per year in 2020, decreasing to 11,433 acre-feet per year by 2070. 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 2070 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 2020 is 56,113 acre-feet per year, decreasing to 49,547 acre-feet per year by 2070.

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 2070 is 1,700 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 2070 is 2,183 acre-feet per year. The City of Terrell no longer uses water from Lake Terrell.

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 2070 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 18,424.5 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 9,727 acre-feet per year in 2020, decreasing to 7,931 acre-feet per year by 2070. 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.

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 2070 is 2,275 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 2070 is 8,337 acre-feet per year. The available supply is different from what was shown in the *2011 Region C Water Plan* because a different sedimentation rate was used assuming sediment gathers below the current storage elevation until the gates are closed.

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 2070 is 450 acre-feet per year.

Trinidad. Lake Trinidad is an off-channel reservoir located just off the Trinity River in Henderson County, with permitted diversions from the Trinity River. 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 with the diversions from the Trinity as of 2070 is 3,050 acre-feet per year. However, return flows in the Trinity River watershed make the Lake Trinidad permitted supply fully 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 2070 is 13,292 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 2070 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 2070 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 2070 is 2,433 acre-feet per year. The City of Mineral Wells is not currently using 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 2070 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 108,920 acre-feet per year in 2020, decreasing to 100,020 acre-feet per year by 2070. This yield does not include return flows or imported water. The decrease from the available supply shown in the *2011 Region C Water Plan* ⁽¹⁾ is due to using a higher sedimentation rate, which was calculated using the 2011 volumetric survey of Lake Lavon.

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 Oklahoma yield in Lake Texoma would be about 640,000 acre-feet per year in 2070.

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

Reservoir	Basin	Unpermitted Yield, acre-feet per year					
		2020	2030	2040	2050	2060	2070
Lost Creek/Jacksboro System	Trinity	886	873	860	846	833	820
Cedar Creek	Trinity	34,667	33,550	32,433	31,317	30,200	29,083
Richland Chambers	Trinity	12,467	9,550	6,633	3,717	800	0
Lake Texoma (Texas' Share) ^a	Red	319,358	318,850	318,342	317,833	317,325	316,817
Benbrook	Trinity	298	224	149	75	0	0
Bonham	Red	927	810	693	577	460	343
Mountain Creek	Trinity	6,367	6,100	5,833	5,567	5,300	5,033
Bardwell	Trinity	127	0	0	0	0	0
Navarro Mills	Trinity	0	0	0	0	0	0

^a This amount assumes the full permitted amount of 84,000 acre-feet per year, a portion of which NTMWD is not currently authorized to use. According to their water right, NTMWD is only authorized to use up to 77,300 acre-feet per year. The remaining 6,700 acre-feet per year are allocated to the channel losses between Lake Texoma and Lake Lavon.

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 Modeled Available Groundwater (MAG) based on the DFCs provided by the GMAs. The regional water planning groups must use MAG estimates as the basis for existing groundwater supplies for all locations that have a DFC⁽⁴⁾. The groundwater availability for “other aquifer” are based on historical pumping data obtained from the TWDB⁽⁵⁾. Table I.5 details the groundwater availability for Region C.

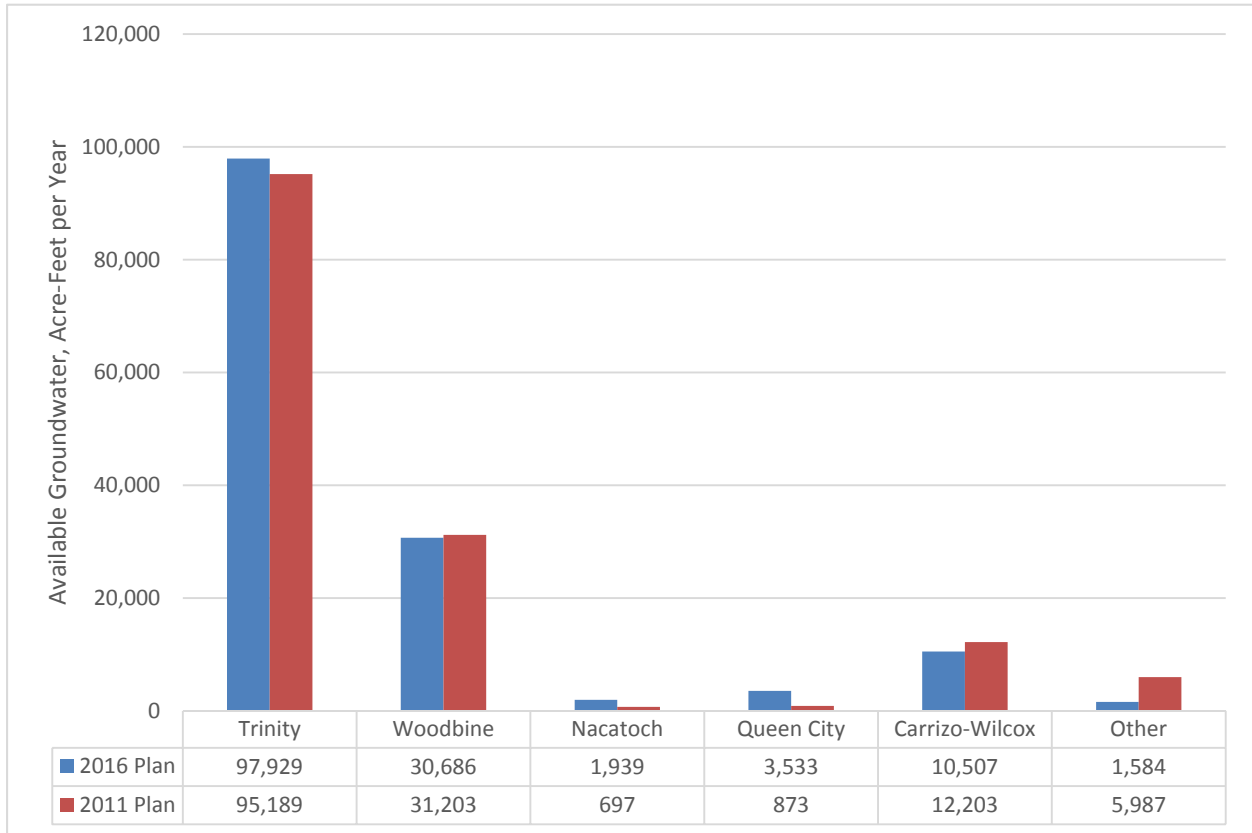
There are currently seven Groundwater Conservation Districts (GCDs) that include one or more counties in Region C:

- 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 overall groundwater availability in Region C is very similar to the availability shown in the *2011 Region C Water Plan*⁽¹⁾. In 2020 through 2040 the overall availability increased between 26 and 38 acre-feet per year. In 2050 and 2060, the overall groundwater availability decreased by 17 and 20 acre-feet per year, respectively. These changes are largely due to changes to the availability from the Nacatoch, Queen City, Carrizo-Wilcox and other aquifers. MAG estimates for these aquifers were not available for the *2011 Region C Water Plan*⁽¹⁾. The availability from the Nacatoch and Queen City aquifers has increased by 1,242 acre-feet per year and 2,660 acre-feet per year, respectively since the *2011 Region C Water Plan*⁽¹⁾. The availability from the Carrizo-Wilcox decreased by a maximum of 1,742 acre-feet per year since the *2011 Region C Water Plan*⁽¹⁾.

The availability from other aquifers has decreased by a maximum of 2,084 acre-feet per year since the 2011 Region C Water Plan⁽¹⁾. compares the 2020 Region C groundwater availability from the TWDB MAG estimates to the availability reported in the 2011 Region C Water Plan⁽¹⁾.

Figure I.1
Region C Groundwater Availability in 2020



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

Aquifer	County	Basin	Revised Groundwater Availability ^a						Groundwater Availability in 2011 Plan					Change in Groundwater Availability since 2011 Plan					
			2020	2030	2040	2050	2060	2070	2010	2020	2030	2040	2050	2060	2020	2030	2040	2050	2060
Other	Collin	Sabine	0	0	0	0	0	0	5	5	5	5	5	5	-5	-5	-5	-5	-5
Other	Collin	Trinity	0	0	0	0	0	0	134	134	134	134	134	134	-134	-134	-134	-134	-134
Trinity	Collin	Sabine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trinity	Collin	Trinity	2,104	2,104	2,104	2,104	2,104	2,104	2,100	2,100	2,100	2,100	2,100	2,100	4	4	4	4	4
Woodbine	Collin	Sabine	40	40	40	40	40	40	40	40	40	40	40	40	0	0	0	0	0
Woodbine	Collin	Trinity	2,469	2,469	2,469	2,469	2,469	2,469	2,469	2,469	2,469	2,469	2,469	2,469	0	0	0	0	0
	Collin		4,613	4,613	4,613	4,613	4,613	4,613	4,748	4,748	4,748	4,748	4,748	4,748	-135	-135	-135	-135	-135
Other	Cooke	Red	0	0	0	0	0	0	237	237	237	237	237	237	-237	-237	-237	-237	-237
Other	Cooke	Trinity	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	1,284	1,284	1,284	1,284	1,284	0	0	0	0	0
Trinity	Cooke	Trinity	5,566	5,566	5,566	5,566	5,566	5,566	5,566	5,566	5,566	5,566	5,566	5,566	0	0	0	0	0
Woodbine	Cooke	Red	18	18	18	18	18	18	18	18	18	18	18	18	0	0	0	0	0
Woodbine	Cooke	Trinity	136	136	136	136	136	136	136	136	136	136	136	136	0	0	0	0	0
	Cooke		7,004	7,004	7,004	7,004	7,004	7,004	7,241	7,241	7,241	7,241	7,241	7,241	-237	-237	-237	-237	-237
Other	Dallas	Trinity	0	0	0	0	0	0	593	593	593	593	593	593	-593	-593	-593	-593	-593
Trinity	Dallas	Trinity	5,458	5,458	5,458	5,458	5,458	5,458	5,458	5,458	5,458	5,458	5,458	5,458	0	0	0	0	0
Woodbine	Dallas	Trinity	2,313	2,313	2,313	2,313	2,313	2,313	2,313	2,313	2,313	2,313	2,313	2,313	0	0	0	0	0
	Dallas		7,771	7,771	7,771	7,771	7,771	7,771	8,364	8,364	8,364	8,364	8,364	8,364	-593	-593	-593	-593	-593
Other	Denton	Trinity	0	0	0	0	0	0	5	5	5	5	5	5	-5	-5	-5	-5	-5
Trinity	Denton	Trinity	19,333	19,333	19,333	19,333	19,333	19,333	19,333	19,333	19,333	19,333	19,333	19,333	0	0	0	0	0
Woodbine	Denton	Trinity	4,126	4,126	4,126	4,126	4,126	4,126	4,126	4,126	4,126	4,126	4,126	4,126	0	0	0	0	0
	Denton		23,459	23,459	23,459	23,459	23,459	23,459	23,464	23,464	23,464	23,464	23,464	23,464	-5	-5	-5	-5	-5
Nacatoch	Ellis	Trinity	20	20	20	20	20	20	139	139	139	139	139	139	-119	-119	-119	-119	-119
Trinity	Ellis	Trinity	3,959	3,959	3,959	3,959	3,959	3,959	3,959	3,959	3,959	3,959	3,959	3,959	0	0	0	0	0
Woodbine	Ellis	Trinity	5,441	5,441	5,441	5,441	5,441	5,441	5,441	5,441	5,441	5,441	5,441	5,441	0	0	0	0	0
	Ellis		9,420	9,420	9,420	9,420	9,420	9,420	9,539	9,539	9,539	9,539	9,539	9,539	-119	-119	-119	-119	-119
Trinity	Fannin	Red	2,919	2,919	2,919	2,919	2,919	2,919	617	617	617	617	617	617	2,302	2,302	2,302	2,302	2,302
Trinity	Fannin	Sulphur	617	617	617	617	617	617	0	0	0	0	0	0	617	617	617	617	617
Trinity	Fannin	Trinity	0	0	0	0	0	0	83	83	83	83	83	83	-83	-83	-83	-83	-83
Woodbine	Fannin	Red	83	83	83	83	83	83	2,676	2,676	2,676	2,676	2,676	2,676	-2,593	-2,593	-2,593	-2,593	-2,593
Woodbine	Fannin	Sulphur	2,676	2,676	2,676	2,676	2,676	2,676	21	21	21	21	21	21	2,655	2,655	2,655	2,655	2,655
Woodbine	Fannin	Trinity	21	21	21	21	21	21	600	600	600	600	600	600	-579	-579	-579	-579	-579
Other	Fannin	Red	600	600	600	600	600	600	2,919	2,919	2,919	2,919	2,919	2,919	-2,319	-2,319	-2,319	-2,319	-2,319
	Fannin		6,916	6,916	6,916	6,916	6,916	6,916	6,916	6,916	6,916	6,916	6,916	6,916	0	0	0	0	0
Carrizo-Wilcox	Freestone	Trinity	4,420	4,448	4,452	4,414	4,411	4,385	5,578	5,578	5,578	5,578	5,578	5,578	-1,158	-1,130	-1,126	-1,164	-1,167

Table I.5, continued

Aquifer	County	Basin	Revised Groundwater Availability ^a						Groundwater Availability in 2011 Plan						Change in Groundwater Availability since 2011 Plan				
			2020	2030	2040	2050	2060	2070	2010	2020	2030	2040	2050	2060	2020	2030	2040	2050	2060
Carrizo-Wilcox	Freestone	Brazos	885	869	863	848	848	838	1,075	1,075	1,075	1,075	1,075	1,075	-190	-206	-212	-227	-227
Other	Freestone	Trinity	0	0	0	0	0	0	51	51	51	51	51	51	-51	-51	-51	-51	-51
Other	Freestone	Brazos	0	0	0	0	0	0	21	21	21	21	21	21	-21	-21	-21	-21	-21
Queen City	Freestone	Trinity	0	0	0	0	0	0	345	345	345	345	345	345	-345	-345	-345	-345	-345
Queen City	Freestone	Brazos	0	0	0	0	0	0	48	48	48	48	48	48	-48	-48	-48	-48	-48
	Freestone		5,305	5,317	5,315	5,262	5,259	5,223	7,118	7,118	7,118	7,118	7,118	7,118	-1,813	-1,801	-1,803	-1,856	-1,859
Other	Grayson	Red	0	0	0	0	0	0	35	35	35	35	35	35	-35	-35	-35	-35	-35
Other	Grayson	Trinity	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	7,722	7,722	7,722	7,722	7,722	0	0	0	0	0
Trinity	Grayson	Trinity	1,678	1,678	1,678	1,678	1,678	1,678	1,678	1,678	1,678	1,678	1,678	1,678	0	0	0	0	0
Woodbine	Grayson	Red	6,590	6,590	6,590	6,590	6,590	6,590	6,590	6,590	6,590	6,590	6,590	6,590	0	0	0	0	0
Woodbine	Grayson	Trinity	5,497	5,497	5,497	5,497	5,497	5,497	5,497	5,497	5,497	5,497	5,497	5,497	0	0	0	0	0
	Grayson		21,487	21,487	21,487	21,487	21,487	21,487	21,522	21,522	21,522	21,522	21,522	21,522	-35	-35	-35	-35	-35
Carrizo-Wilcox	Henderson	Trinity	5,187	5,187	5,187	5,187	5,187	5,187	5,370	5,370	5,370	5,370	5,370	5,370	-183	-183	-183	-183	-183
Nacatoch	Henderson	Trinity	0	0	0	0	0	0	10	10	10	10	10	10	-10	-10	-10	-10	-10
Other	Henderson	Trinity	0	0	0	0	0	0	167	167	167	167	167	167	-167	-167	-167	-167	-167
Queen City	Henderson	Trinity	3,533	3,533	3,533	3,533	3,533	3,533	480	480	480	480	480	480	3,053	3,053	3,053	3,053	3,053
	Henderson		8,720	8,720	8,720	8,720	8,720	8,720	6,027	6,027	6,027	6,027	6,027	6,027	2,693	2,693	2,693	2,693	2,693
Other	Jack	Brazos	284	284	284	284	284	284	284	284	284	284	284	284	0	0	0	0	0
Other	Jack	Trinity	650	650	650	650	650	650	650	650	650	650	650	650	0	0	0	0	0
Trinity	Jack	Trinity	0	0	0	0	0	0	50	50	50	50	50	50	-50	-50	-50	-50	-50
Trinity	Jack	Brazos	0	0	0	0	0	0	50	50	50	50	50	50	-50	-50	-50	-50	-50
	Jack		934	934	934	934	934	934	1,034	1,034	1,034	1,034	1,034	1,034	-100	-100	-100	-100	-100
Nacatoch	Kaufman	Sabine	49	49	49	49	49	49	10	10	10	10	10	10	39	39	39	39	39
Nacatoch	Kaufman	Trinity	877	877	877	877	877	877	308	308	308	308	308	308	569	569	569	569	569
Other	Kaufman	Sabine	0	0	0	0	0	0	124	124	124	124	124	124	-124	-124	-124	-124	-124
Other	Kaufman	Trinity	0	0	0	0	0	0	87	87	87	87	87	87	-87	-87	-87	-87	-87
Trinity	Kaufman	Sabine	45	45	45	45	45	45	45	45	45	45	45	45	0	0	0	0	0
Trinity	Kaufman	Trinity	1,136	1,136	1,136	1,136	1,136	1,136	1,136	1,136	1,136	1,136	1,136	1,136	0	0	0	0	0
Woodbine	Kaufman	Trinity	200	200	200	200	200	200	200	200	200	200	200	200	0	0	0	0	0
	Kaufman		2,307	2,307	2,307	2,307	2,307	2,307	1,910	1,910	1,910	1,910	1,910	1,910	397	397	397	397	397
Carrizo-Wilcox	Navarro	Trinity	15	15	15	15	15	15	180	180	180	180	180	180	-165	-165	-165	-165	-165
Nacatoch	Navarro	Trinity	980	980	980	980	980	980	229	229	229	229	229	229	751	751	751	751	751
Other	Navarro	Trinity	0	0	0	0	0	0	104	104	104	104	104	104	-104	-104	-104	-104	-104
Trinity	Navarro	Trinity	1,873	1,873	1,873	1,873	1,873	1,873	1,873	1,873	1,873	1,873	1,873	1,873	0	0	0	0	0
Woodbine	Navarro	Trinity	300	300	300	300	300	300	300	300	300	300	300	300	0	0	0	0	0
	Navarro		3,168	3,168	3,168	3,168	3,168	3,168	2,686	2,686	2,686	2,686	2,686	2,686	482	482	482	482	482

Table I.5, continued

Aquifer	County	Basin	Revised Groundwater Availability ^a						Groundwater Availability in 2011 Plan					Change in Groundwater Availability since 2011 Plan					
			2020	2030	2040	2050	2060	2070	2010	2020	2030	2040	2050	2060	2020	2030	2040	2050	2060
Other	Parker	Trinity	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	0	0	0	0	0
Trinity	Parker	Trinity	12,449	12,449	12,449	12,449	12,449	12,449	12,449	12,449	12,449	12,449	12,449	12,449	0	0	0	0	0
Trinity	Parker	Brazos	2,799	2,799	2,799	2,799	2,799	2,799	2,799	2,799	2,799	2,799	2,799	2,799	0	0	0	0	0
	Parker		15,298	15,298	15,298	15,298	15,298	15,298	15,298	15,298	15,298	15,298	15,298	15,298	0	0	0	0	0
Nacatoch	Rockwall	Trinity	13	13	13	13	13	13	1	1	1	1	1	1	12	12	12	12	12
Other	Rockwall	Sabine	0	0	0	0	0	0	187	187	187	187	187	187	-187	-187	-187	-187	-187
Other	Rockwall	Trinity	0	0	0	0	0	0	21	21	21	21	21	21	-21	-21	-21	-21	-21
Trinity	Rockwall	Sabine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trinity	Rockwall	Trinity	958	958	958	958	958	958	958	958	958	958	958	958	0	0	0	0	0
Woodbine	Rockwall	Trinity	144	144	144	144	144	144	144	144	144	144	144	144	0	0	0	0	0
	Rockwall		1,115	1,115	1,115	1,115	1,115	1,115	1,311	1,311	1,311	1,311	1,311	1,311	-196	-196	-196	-196	-196
Other	Tarrant	Trinity	0	0	0	0	0	0	207	207	207	207	207	207	-207	-207	-207	-207	-207
Trinity	Tarrant	Trinity	18,747	18,747	18,747	18,747	18,747	18,747	18,747	18,747	18,747	18,747	18,747	18,747	0	0	0	0	0
Woodbine	Tarrant	Trinity	632	632	632	632	632	632	632	632	632	632	632	632	0	0	0	0	0
	Tarrant		19,379	19,379	19,379	19,379	19,379	19,379	19,586	19,586	19,586	19,586	19,586	19,586	-207	-207	-207	-207	-207
Other	Wise	Trinity	0	0	0	0	0	0	106	106	106	106	106	106	-106	-106	-106	-106	-106
Trinity	Wise	Trinity	9,282	9,282	9,282	9,282	9,282	9,282	9,282	9,282	9,282	9,282	9,282	9,282	0	0	0	0	0
	Wise		9,282	9,282	9,282	9,282	9,282	9,282	9,388	9,388	9,388	9,388	9,388	9,388	-106	-106	-106	-106	-106
Region C Total			146,178	146,190	146,188	146,135	146,132	146,096	146,152	146,152	146,152	146,152	146,152	146,152	26	38	36	-17	-20

^a All values, with the exception of "other" aquifer, are MAG ⁽⁷⁾ values.

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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 calculated using the WAM as the minimum annual diversion for the permitted water rights located on the main stem and tributaries of the river. In the previous Region C Water Plans 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. This revision decreased the local irrigation availability in the Red River Basin.

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 supplies, some of the available supplies were revised considering the historical use over the past ten years ⁽⁶⁾, 2011 use ⁽⁶⁾, and the projected demands. Table I.6 shows the available supply for irrigation and other local supplies.

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

Use	County	Basin	2020	2030	2040	2050	2060	2070
IRRIGATION RUN-OF-THE-RIVER SUPPLIES								
Irrigation	Cooke	Red	0	0	0	0	0	0
Irrigation	Fannin	Red	4,613	4,613	4,613	4,613	4,613	4,613
Irrigation	Grayson	Red	1,091	1,091	1,091	1,091	1,091	1,091
Irrigation	Fannin	Sulphur	0	0	0	0	0	0
Irrigation	Collin	Trinity	408	408	408	408	408	408
Irrigation	Cooke	Trinity	0	0	0	0	0	0
Irrigation	Dallas	Trinity	791	791	791	791	791	791
Irrigation	Denton	Trinity	0	0	0	0	0	0
Irrigation	Ellis	Trinity	3	3	3	3	3	3
Irrigation	Fannin	Trinity	0	0	0	0	0	0
Irrigation	Grayson	Trinity	0	0	0	0	0	0
Irrigation	Henderson	Trinity	415	415	415	415	415	415
Irrigation	Jack	Trinity	110	110	110	110	110	110
Irrigation	Kaufman	Trinity	64	64	64	64	64	64
Irrigation	Navarro	Trinity	226	226	226	226	226	226
Irrigation	Parker	Trinity	122	122	122	122	122	122
Irrigation	Rockwall	Trinity	0	0	0	0	0	0
Irrigation	Tarrant	Trinity	549	549	549	549	549	549
Irrigation	Wise	Trinity	139	139	139	139	139	139
Irrigation	Freestone	Trinity	87	87	87	87	87	87

Table I.6, continued

Use	County	Basin	2020	2030	2040	2050	2060	2070
IRRIGATION RUN-OF-THE-RIVER SUPPLIES, Continued								
Irrigation	Jack	Brazos	0	0	0	0	0	0
Irrigation	Parker	Brazos	117	117	117	117	117	117
Irrigation	Freestone	Brazos	0	0	0	0	0	0
SUBTOTAL			8,734	8,734	8,734	8,734	8,734	8,734
NON-IRRIGATION RUN-OF-THE-RIVER SUPPLIES								
Mining	Fannin	Red	72	72	72	72	72	72
Mining	Wise	Trinity	133	133	133	133	133	133
Municipal	Fannin	Red	20	20	20	20	20	20
Municipal	Fannin	Sulphur	49	49	49	49	49	49
Municipal	Freestone	Trinity	41	41	41	41	41	41
Municipal	Navarro	Trinity	252	252	252	252	252	252
Municipal	Parker	Trinity	33	33	33	33	33	33
Industrial	Dallas	Trinity	368	368	368	368	368	368
Industrial	Grayson	Red	30	30	30	30	30	30
Industrial	Tarrant	Trinity	959	959	959	959	959	959
LIVESTOCK AND MINING LOCAL SUPPLIES								
Livestock	Collin	Sabine	31	31	31	31	31	31
Livestock	Collin	Trinity	971	971	971	971	971	971
Livestock	Cooke	Red	380	380	380	380	380	380
Livestock	Cooke	Trinity	807	807	807	807	807	807
Livestock	Dallas	Trinity	198	198	198	198	198	198
Livestock	Denton	Trinity	622	622	622	622	622	622
Livestock	Ellis	Trinity	1,112	1,112	1,112	1,112	1,112	1,112
Livestock	Fannin	Red	973	973	973	973	973	973
Livestock	Fannin	Sulphur	272	272	272	272	272	272
Livestock	Fannin	Trinity	61	61	61	61	61	61
Livestock	Freestone	Brazos	83	83	83	83	83	83
Livestock	Freestone	Trinity	960	960	960	960	960	960
Livestock	Grayson	Red	687	687	687	687	687	687
Livestock	Grayson	Trinity	388	388	388	388	388	388
Livestock	Henderson	Trinity	341	341	341	341	341	341
Livestock	Jack	Brazos	231	231	231	231	231	231

Table I.6, continued

Use	County	Basin	2020	2030	2040	2050	2060	2070
Livestock	Jack	Trinity	571	571	571	571	571	571
Livestock	Kaufman	Sabine	98	98	98	98	98	98
Livestock	Kaufman	Trinity	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
Livestock	Parker	Brazos	903	903	903	903	903	903
Livestock	Parker	Trinity	1,019	1,019	1,019	1,019	1,019	1,019
Livestock	Rockwall	Sabine	58	58	58	58	58	58
Livestock	Rockwall	Trinity	59	59	59	59	59	59
Livestock	Tarrant	Trinity	442	442	442	442	442	442
Livestock	Wise	Trinity	1,117	1,117	1,117	1,117	1,117	1,117
Mining	Collin	Trinity	0	0	0	0	0	0
Mining	Dallas	Trinity	1,525	1,525	1,525	1,525	1,525	1,525
Mining	Freestone	Trinity	120	120	120	120	120	120
Mining	Jack	Trinity	370	370	370	370	370	370
Mining	Kaufman	Trinity	86	86	86	86	86	86
Mining	Parker	Brazos	12	12	12	12	12	12
Mining	Parker	Trinity	8	8	8	8	8	8
Mining	Rockwall	Sabine	0	0	0	0	0	0
Mining	Tarrant	Trinity	342	342	342	342	342	342
SUBTOTAL NON-IRRIGATION SUPPLIES			19,931	19,931	19,931	19,931	19,931	19,931
TOTAL RUN-OF-THE-RIVER AND LOCAL SUPPLIES			28,665	28,665	28,665	28,665	28,665	28,665

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. The recommended regional reuse plan is outlined in Chapter 5E of the Region C plan.

Water Right Amendments Involving Reuse Since the 2011 Region C Water Plan ⁽¹⁾

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. These recent amendments are discussed below and summarized in .

On December 4, 2014, the District received amendments to its water rights in Richland-Chambers Reservoir (Certificate of Adjudication 08-5035D) and Cedar Creek Reservoir (Certificate of Adjudication 08-4976D). The amended certificates allow the District to divert District Return Flows from Richland-Chambers and Cedar Creek Reservoirs up to the maximum annual delivery amount.

**Table I.7
Water Right Amendments and Permit Applications Involving Reuse**

Entity	Description	Certification of Adjudication/ Permit Number	Status	Amendment Date	Additional Annual Diversion for Water Supply (ac-ft/year)
Tarrant Regional Water District	District return flow diversions from Cedar Creek Reservoir	08-4976D	Amended	12/04/14	35,559
Tarrant Regional Water District	District return flow diversions from Richland-Chambers Reservoir	08-5035D	Amended	12/04/14	37,465

The maximum annual delivery from the Richland-Chambers wetland impoundment to Richland-Chambers Reservoir is 100,465 acre-feet per year. The recent amendment increases the authorized reuse from the reservoir by 37,465 acre-feet per year from 63,000 acre-feet per year to 100,465 acre-feet per year. The total authorized diversion from the lake, including reuse, will be 310,465 acre-feet per year. The Richland-Chambers Reuse project began operation in 2009 and was expanded in 2013.

**Table I.8
Summary of Supplies Available from Reuse
(Acre-Feet per Year)**

Provider	Project Name	User/Receiving Water	Type	County	2020	2030	2040	2050	2060	2070
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	26	26	25	25	24
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	455	558	666	666	666	666
Denton	Denton Power Plant 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	646	836	1,051	1,328	1,818	2,216
Denton	Denton Indirect Reuse	indirect reuse	indirect	Denton	6,775	8,729	10,922	12,953	12,818	12,683
Denton County	Denton Direct Reuse	Direct Reuse	direct	Denton	455	503	556	614	678	749
Denton County FWSD#1/ UTRWD/Lewisville	UTRWD Reuse	Castle Hills Golf Course	direct	Denton	897	897	897	897	897	897
Dallas	Cedar Crest Golf Course Reuse	Cedar Crest Golf Course	direct	Dallas	561	561	561	561	561	561
Dallas	Indirect Reuse	Dallas	indirect	Dallas	32,550	38,223	41,048	55,000	73,091	87,511
Ennis	Ennis Reuse	Tractabel Steam Electric Power Plant	direct	Ellis	909	909	909	909	909	909
Fort Worth	Village Creek Reuse		direct	Tarrant	3,469	3,526	3,526	3,526	3,526	3,526
Fort Worth	Waterchase Golf Course	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
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	3,311	3,677	3,716	3,701	3,698	3,698
Dallas	Stevens Park Golf Course Direct Reuse (Dallas)	Dallas	direct	Dallas	560	560	560	560	560	560
Annetta	Annetta Direct Reuse	Golf Course	direct	Parker	95	95	95	95	95	95
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

Table I.8, continued

Provider	Project Name	User/Receiving Water	Type	County	2020	2030	2040	2050	2060	2070
NTMWD	Buffalo Creek Reuse	Buffalo Creek Golf Course	direct	Rockwall	672	672	672	672	672	672
NTMWD	Wilson Creek Reuse	Lake Lavon	indirect	Collin	47,418	56,386	63,785	71,882	71,882	71,882
NTMWD	East Fork Reuse	Trinity River	indirect	Kaufman	47,802	62,977	75,524	87,291	97,655	102,897
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	100,465	100,465	100,465	100,465	100,465	100,465
The Colony	Collin County Reuse	Stonebriar Country Club	direct	Collin	457	457	457	457	457	457
TRA	Ten Mile Creek WWTP Reuse	Pecan Orchard	direct	Dallas	125	125	125	125	125	125
TRA	TRA/Waxahachie Reuse		indirect	Ellis	3,479	3,882	4,614	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	Lake Chapman	indirect	Henderson	5,546	5,689	5,832	5,976	6,119	6,262
Wise County	Wise County Mining Reuse	Mining	direct	Wise	6,261	6,261	6,261	6,261	6,076	6,076
Total					283,893	316,972	343,226	380,051	408,880	429,018

¹ County reflects location of reuse project.

The maximum annual delivery from the Cedar Creek wetland impoundment to Cedar Creek Reservoir is 88,059 acre-feet per year. The recent amendment increases the authorized reuse from the reservoir by 35,559 acre-feet per year from 52,500 acre-feet per year to 88,059 acre-feet per year. The total authorized diversion from the lake, including reuse, will be 263,059 acre-feet per year. The Cedar Creek Reservoir reuse project is expected to be completed by 2020.

Desalination

Two desalination facilities are currently operated by public water systems within Region C. The City of Sherman operates an electro dialysis reversal membrane plant to treat brackish water from Lake Texoma. The City of Bardwell operates a reverse osmosis facility to treat 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.9).

Imports

The total supply available (not limited to infrastructure constraints) 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.9 shows those imports. Below is a discussion of each of the imported water sources.

Table I.9
Currently Available Surface Water Supplies – Imports
(Acre-Feet per Year)

Source	Basin of Origin	2020	2030	2040	2050	2060	2070	2060 from 2011 Plan
Chapman (NTMWD) ^a	Sulphur	44,792	44,505	44,218	43,931	43,644	43,357	47,132
Chapman (Irving)	Sulphur	42,280	42,009	41,739	41,468	41,197	40,926	44,484
Chapman (Upper Trinity MWD)	Sulphur	12,606	12,525	12,445	12,364	12,283	12,202	13,268
Tawakoni (Dallas) ^h	Sabine	174,080	169,120	164,160	159,200	154,240	149,280	176,777
Fork (Dallas) ^b	Sabine	50,120	55,080	60,040	65,000	69,960	74,920	116,551
Upper Sabine Basin (NTMWD) ^c	Sabine	50,707	10,629	10,550	10,472	10,394	10,315	9,356
Palestine (Dallas) ^d	Neches	111,694	110,589	109,484	108,378	107,270	106,164	107,347
Livingston ^e	Trinity	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Lake Athens ^f	Neches	2,432	2,711	2,949	3,293	4,534	4,759	3,647
Possum Kingdom ^g	Brazos	1,000	1,000	1,000	1,000	1,000	1,000	2,000
Lake Aquilla	Brazos	262	298	340	391	452	523	329
Lake Granbury	Brazos	276	304	334	368	405	444	231
Lake Palo Pinto	Brazos	1,328	1,314	1,302	1,292	1,284	1,276	1,230
TOTAL		581,567	531,265	520,931	510,717	501,415	491,109	542,352

- 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 224,200 acre-feet per year.
- c. NTMWD acquired Terrell's and Ables Springs WSC's supply in Lake Tawakoni with additional water from the Upper Sabine Basin for 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).
- h. Supply amount reported is the safe yield.

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). Yields for Lake Chapman were updated because of a new critical period. The previous critical period was from June 1953 to January 1957. The new critical period is from April 2003 to November 2006. Flows from 1940 to 1996 are based on WAM inflows. The hydrology from 1997 through March 2012 was extended using mass balance of the reservoir.

Accounting for the new critical period, the year 2020 firm yield of Lake Chapman is about 114,705 acre-feet per year, decreasing to 111,030 acre-feet per year by 2070.

The values in Table I.9 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 2040 through 2060 and by 50 percent in 2070 because the City of Commerce has the option to reclaim a portion of the water it has sold to UTRWD beginning in 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 contracts for 11,098 acre-feet per year that were transferred from the City of Terrell and Ables Springs WSC. Using the Sabine River WAM, the firm yield of Lake Tawakoni is 229,710 in year 2020, reducing to 221,310 acre-feet per year by 2070. The available supply shown in the *2011 Region C Water Plan*⁽¹⁾ differs slightly from the yields presented here because a new sedimentation rate, which was calculated using the 2009 volumetric survey of Tawakoni, was used. 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.9.

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 firm yield of Lake Fork was calculated as 171,260 acre-feet per year in year 2020, reducing due to sedimentation to 161,360 acre-feet per year in 2070. The decrease from the available supply shown in the *2011 Region C Water Plan*⁽¹⁾ is due to using a higher sedimentation rate, which was calculated using the 2009 volumetric survey of Lake Fork. 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 and Ables Springs WSC, 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 2020. The available supply to NTMWD from the Upper Sabine Basin that is shown in Table I.19 includes the temporary supply (2020 only) and the firm yield of the Lake Tawakoni water rights that were transferred from Terrell and Ables Springs WSC 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 205,417 acre-feet per year in year 2020, reducing to 195,229 acre-feet per year by 2070. 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 estimated at 5,983 acre-feet per year in 2020. The amount that is exported to Region C for use by the City of Athens is 2,432 acre-feet per year, increasing to 4,759 acre-feet per year in 2070.

Possum Kingdom Lake (Vulcan Materials). Vulcan Materials has a contract to purchase 1,000 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.

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 178 acre-feet per year in 2020, increasing to 429 acre-feet per year by 2070.

Lake Granbury. Lake Granbury is located in the Brazos River Basin in Region G. The Brazos River Authority (BRA) 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 276 acre-feet per year in 2020, increasing to 444 acre-feet per year in 2070. Parker County SUD also has a contract with the BRA for 700 acre-feet per year from Lake Granbury.

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. 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
- 957 acre-feet per year for Parker County Other.
- 294 acre-feet per year for Parker County SUD.

Table I.10
Summary of Water Availability Models (WAM) Used by Region C

Name of Model	Summary of Modifications	Entity That Performed the Model Run	Date of Model Run
TCEQ WAM trin3	See letter to EA dated March 5, 2009; EA modifications approved by EA in April 6, 2009 letter	Freese and Nichols, Inc	March 2009
TCEQ WAM trin3	See letter to EA dated April 30, 2012; EA modifications approved by EA in December 2012 letter	Freese and Nichols, Inc	April 2012
TCEQ Sabine WAM	None requested by Region C	Freese and Nichols, Inc	November 2013
TCEQ Red River WAM	None requested by Region C	Freese and Nichols, Inc	December 2013

APPENDIX I LIST OF REFERENCES

- (1) Freese and Nichols, Inc., Alan Plummer Associates, Inc., CP&Y, Inc., and Cooksey Communications, Inc.: *2011 Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, October 2010.
- (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 Commission on Environmental Quality: *Water Rights Database Files*, Austin, [Online] Available URL: http://www.tceq.state.tx.us/permitting/water_rights/wr_databases.html, April 16, 2012.
- (4) Texas Water Development Board, Exhibit C First Amended General Guidelines for Regional Water Plan Development (October 2012), Austin, [Online] Available URL: http://www.twdb.texas.gov/waterplanning/rwp/planningdocu/2016/doc/current_docs/contract_docs/2012_exhC_1st_amended_gen_guidelines.pdf, January 28, 2013.
- (5) Texas Water Development Board: Groundwater Pumpage Estimates, Pumpage Detail, 2000 and Later, Austin, [Online] Available URL: <http://www.twdb.texas.gov/waterplanning/waterusesurvey/historical-pumpage.asp>, September 2013.
- (6) Texas Water Development Board: Water Use Summary Estimates, County, Summary, 2000 and Later, Austin, [Online] Available URL: <http://www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/>, February 2, 2015.
- (7) Texas Water Development Board: Updated MAG Estimates, provided on April 4, 2012 by Temple McKinnon with TWDB.