

Briefing Notes on Desalination in Texas

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Presentation outline:

- I. Introduction
- II. Current Capacity
- III. Desalination in the State Water Plans
- IV. Agency Activities

Estimated presentation time: 10 minutes

I. Introduction

- Texas has a long history with desalination.
- The first seawater desalination demonstration project in the United States, operated by the U.S. Department of Interior's Office of Saline Water, was put into production in Freeport in 1961.
 - The project, conducted jointly with Freeport and Dow Chemical, operated from 1961 to 1969, producing 1 million gallons per day (~1,100 acre-feet per year).
 - The plant supplied half of its production to the City of Freeport and the other half to Dow Chemical.
- The first state water plan, issued in 1961, recognized the potential of "demineralization of brackish water and sea water" and recommended researching this potential. The plan also noted limitations including cost.
- In 1965, the Texas Water Development Board commissioned a study of the state's saline water sources and potential sites for desalination.
- In 1965, the Port Mansfield Utility District built the first municipal desalination plant in Texas used for supply, a plant that desalted brackish groundwater. Port Mansfield was the fourth city in the United States to buy and operate a desalting plant.
- In 1967, Dell City installed an electro dialysis unit to desalt groundwater. That plant, since upgraded, still runs today.

II. Current Capacity

- There are currently more than 200 desalination plants in Texas.
- As of 2012, there were 46 plants for municipal use with a capacity greater than 25,000 gallons per day.
- These 46 plants are capable of producing 123 million gallons per day (about 138,000 acre-feet per year):
 - 50 million gallons per day (56,000 acre-feet per year) of the capacity is for brackish surface water.

- 73 million gallons per day (82,000 acre-feet per year) of the capacity is for brackish groundwater.
 - There is currently no seawater desalination in Texas.
- About 75 percent of the state’s municipal desalination capacity was developed in the last 16 years (Figure 1).
- Existing municipal desalination plants are distributed throughout the state (Figure 2).
- TWDB staff is currently updating the desalination plant database. The updates will be reported in the legislatively mandated biennial desalination report due December 1, 2016.

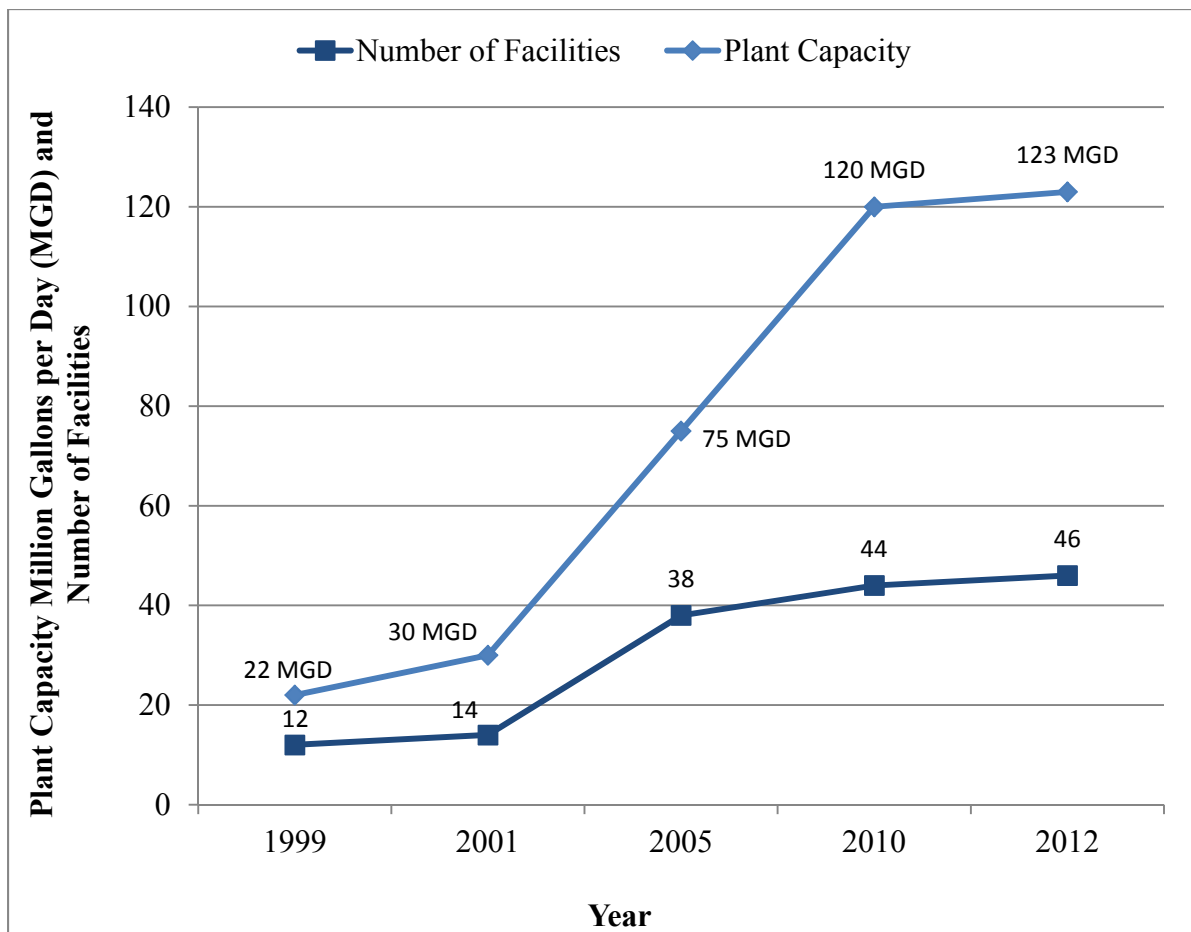


Figure 1. Number of facilities and installed design desalination capacity for municipal use in Texas in million gallons per day (MGD). Minimum plant capacity to be on this graph is 25,000 gallons per day. (1 MGD = 1,121 acre-feet per year).

Desalination Plant Capacities

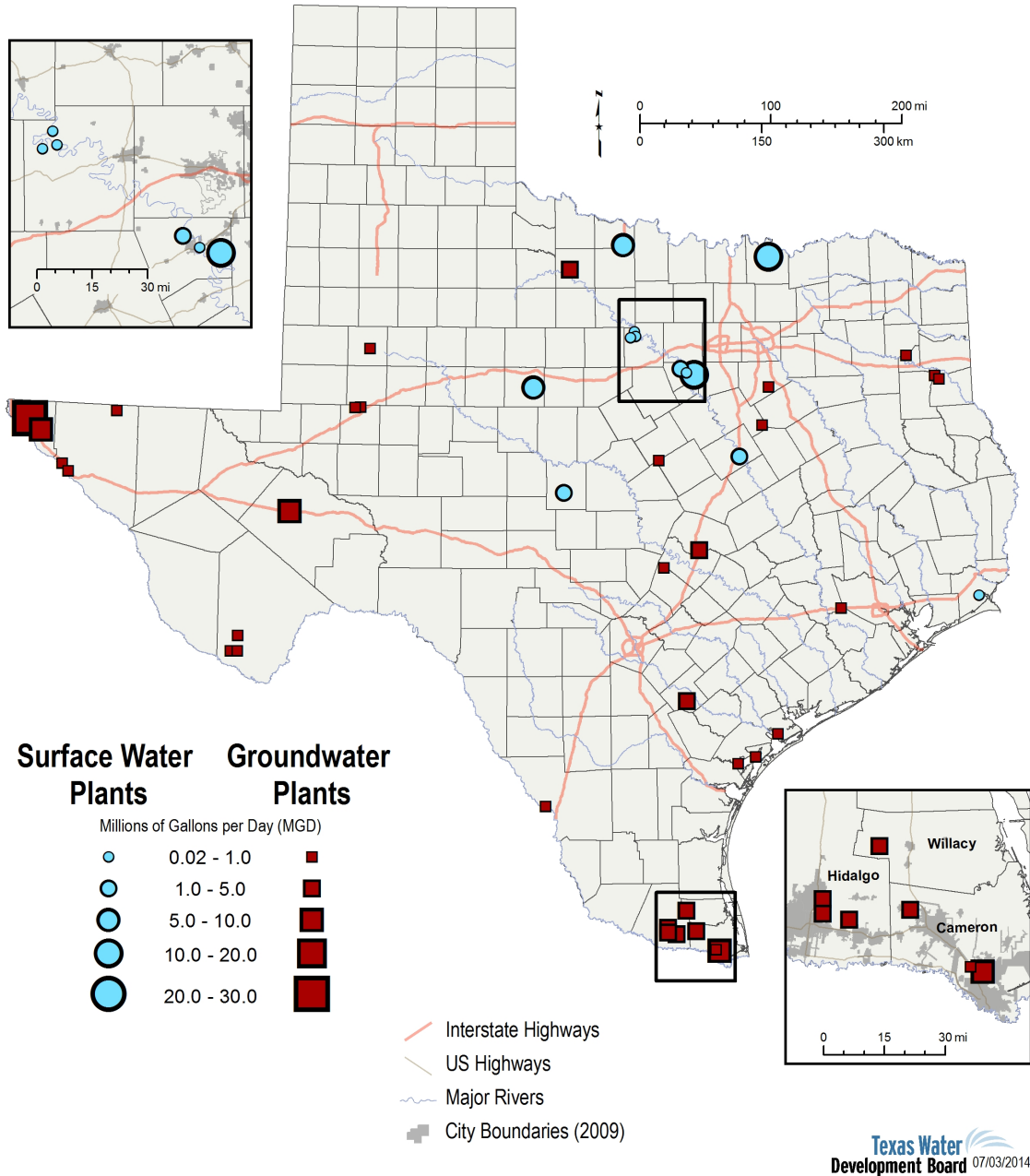


Figure 2. Distribution, size, and source water of existing municipal desalination facilities in Texas with design capacity of more than 25,000 gallons per day. Based on data from 2012.

III. Desalination in the State Water Plan

○ Draft 2017 State Water Plan

- Recommended water management strategies in the draft 2017 State Water Plan are projected to provide 230,000 acre-feet per year of desalinated water to water user groups by 2070 (Table 1), about 2.7 percent of all new water supplies. Approximate locations of the proposed plants are shown in Figure 3.
 - Regions E, F, H, J, L, M, N, and O include brackish groundwater desalination strategies.
 - Region F includes a brackish surface-water desalination strategy.
 - Regions H, L, M, and N include seawater desalination strategies.
 - Water user groups with brackish groundwater and seawater desalination strategies are listed in Appendixes A and B.
 - Brackish groundwater desalination supplies to users in the draft 2017 State Water Plan are 13 percent lower in 2030 and 23 percent lower in 2060 as compared to the 2012 State Water Plan (Table 2).
 - Seawater desalination supplies to users in the draft 2017 State Water Plan are about 10 percent lower in 2030 and 13 percent higher in 2060 as compared to the 2012 State Water Plan (Table 2).
- Seawater desalination projects proposed in the draft 2017 State Water Plan
 - **Freeport Seawater Desalination**
 - Region H
 - Potential supply: 11,200 acre-feet per year (10 million gallons per day)
 - Implementation decade: 2040
 - Capital costs: \$132,937,747
 - Unit water cost: \$2,454 per acre-foot (loan period); \$1,461 per acre-foot (after loan period)
 - **San Antonio Water System**
 - Region L
 - Potential supply: 84,012 acre-feet per year (75 million gallons per day)

- Implementation decade: 2040
 - Capital costs: \$1,590,590,000
 - Unit water cost: \$2,713 per acre-foot
- **Guadalupe Blanco River Authority**
 - Region L
 - Potential supply: 100,000 acre-feet per year (about 89 million gallons per day)
 - Implementation date: Unspecified
 - Capital costs: \$1,600,000,000
 - Unit water cost: \$2,393 per acre-foot
- **City of Brownsville**
 - Region M
 - Potential supply: 28,000 acre-feet per year (25 million gallons per day)
 - Implementation decade: 2020 (demonstration) and 2060 (full-scale)
 - Capital costs: \$56,002,000 (demonstration); \$393,497,000 (full-scale)
 - Unit water cost: \$5,522 per acre-foot (demonstration); \$3,889 per acre-foot (full-scale)
- **City of Corpus Christi**
 - Region N
 - Potential supply: 22,420 acre-feet per year (20 million gallons per day)
 - Implementation decade: 2030
 - Capital costs: \$248,000,000
 - Unit water cost: \$1,418—\$1,450

Table 1. Desalination strategies in the draft 2017 State Water Plan and the supplies they are projected to provide to water user groups. Volumes (acre-feet per year) are cumulative from decade to decade.

Water management strategies	Decade					
	2020	2030	2040	2050	2060	2070
Brackish groundwater	70,137	72,944	86,337	91,906	99,706	110,773
Brackish surface water	0	0	2,153	2,266	2,415	2,566
Seawater	2,800	25,220	54,439	65,457	104,684	115,598
Total	72,937	98,164	142,929	159,629	206,805	228,937

Table 2. Desalination strategies in the draft 2017 State Water Plan and the 2012 State Water Plan and the supplies they are projected to provide to water user groups. Volumes (acre-feet per year) are cumulative from decade to decade.

Water management strategies	2017 State Water Plan		2012 State Water Plan	
	Decade		Decade	
	2030	2060	2030	2060
Brackish groundwater	72,944	99,706	83,655	129,188
Brackish surface water	0	2,415	2,700	2,700
Seawater	25,220	104,684	28,143	92,965
Total	98,164	206,805	114,498	224,853

Recommended Desalination Plants

Water Management Strategies DRAFT 2017 State Water Plan

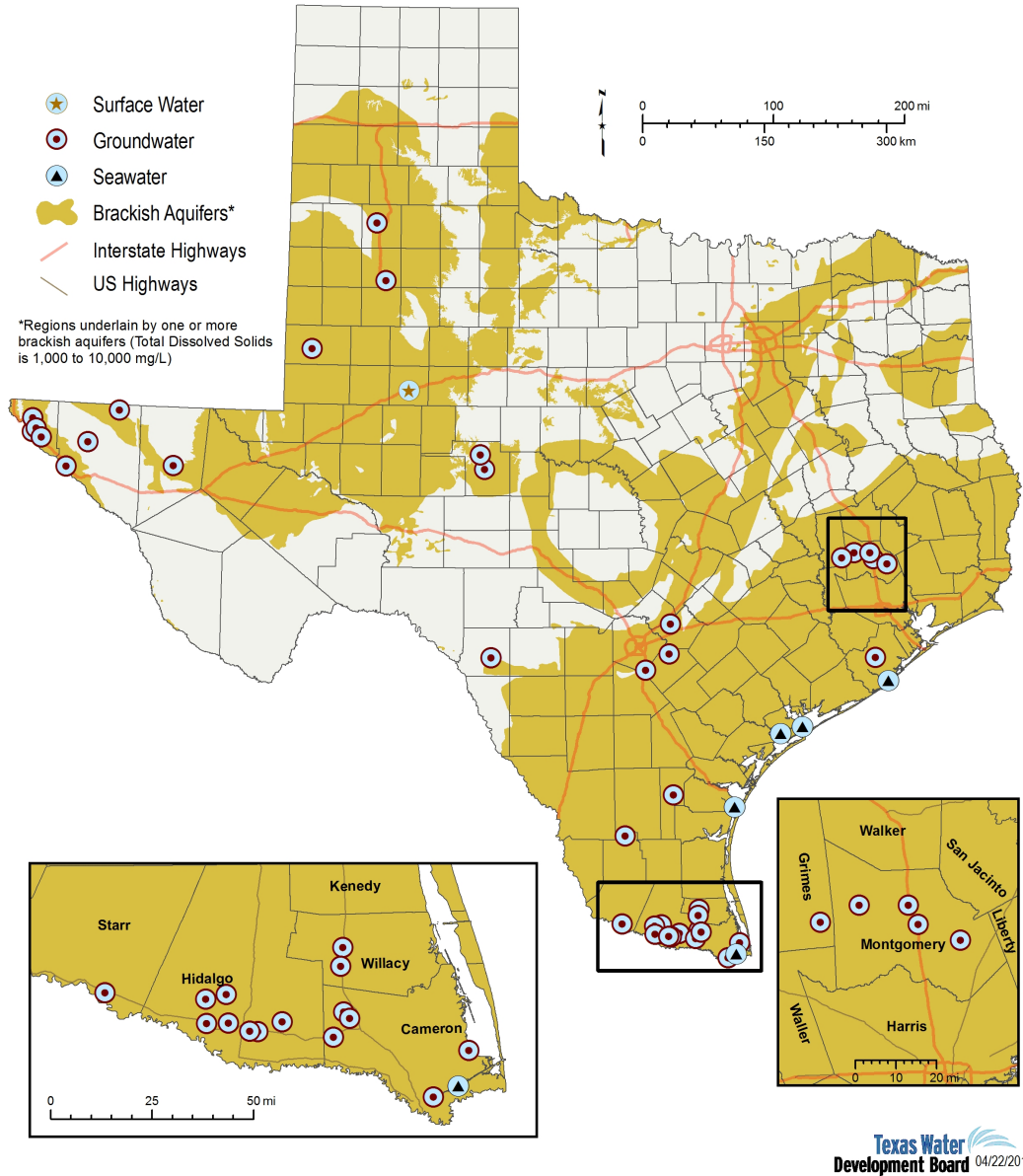


Figure 3. Approximate location of the recommended desalination plants in the draft 2017 State Water Plan.

Agency Activities

- Seawater Desalination
 - In 2002, Governor Perry made an announcement in San Antonio on securing abundant water supplies for Texas and directed the Texas Water Development Board to recommend a large-scale seawater desalination demonstration project.
 - In 2003 and 2005, Board received funding from the legislature (\$4.6 million) to conduct seawater desalination feasibility and pilot plant studies.
 - Accomplishments from this program:
 - Completed feasibility studies for Brownsville, Corpus Christi, and Brazos River Authority.
 - Completed seawater pilot plant studies for Brownsville and Laguna Madre Water District.
 - Developed guidance manual for seawater desalination permitting requirements.
 - Developed stakeholder scoping document for implementing seawater desalination projects in the Brownsville Ship Channel and South Padre Island.
 - The Board is required to biennially report to the Governor, the Lt. Governor, and the Speaker of the House on the progress, challenges, and recommended next steps to advance seawater desalination in Texas. The next biennial report is due on December 1, 2016.
 - All appropriated funds for seawater desalination demonstration projects and applied research projects have been exhausted.
 - The Board has sought funding and partnering opportunities to advance seawater desalination in Texas, including a project with the U.S. Bureau of Reclamation to assess the feasibility of variable salinity processes
 - Due to the drought in 2011, there is greater interest in seawater desalination. We continue to monitor various discussions and potential projects and provide assistance as needed.

- M&G Resins USA, LLC is presently building a 22-million gallons per day (design capacity) seawater desalination plant in Corpus Christi for use in their plastics manufacturing plant. The desalination plant is scheduled to be operational by the end of 2016 and will be the first full-scale seawater desalination plant in Texas.

- **Brackish Groundwater Desalination**
 - To complement the seawater desalination initiative and with funding from the legislature (\$1.2 million), the Board established the brackish groundwater desalination demonstration program.
 - Since 2005, the Board has funded projects to identify and address practical challenges to implementing brackish groundwater desalination projects in Texas. The categories of projects funded include:
 - Preparing guidelines for implementing brackish desalination projects.
 - Improving the economics of desalination by reducing and optimizing energy use.
 - Demonstrating methods for reducing the volume of concentrate.
 - Seeking cost-effective methods for disposing of the concentrate.
 - Increasing knowledge of the state's brackish aquifers
 - The last round of funding received from the legislature for the brackish groundwater desalination demonstration program was in 2009.
 - The Board has sought funding and partnering opportunities to advance desalination issues, including several projects with the U. S. Bureau of Reclamation:
 - Preparing guidance for rapid assessment and implementation of temporary emergency supplies using desalination.
 - Developing desalination cost curves to assist in the cost estimating of brackish groundwater desalination projects.

- **Brackish Aquifer Mapping**
 - With funding from the legislature in 2009, the Board established the Brackish Resources Aquifer Characterization System, a program to map the state's brackish resources in much greater detail to facilitate the planning and engineering of brackish groundwater desalination projects.
 - Between 2009 and 2015, TWDB staff completed a study of the Pecos Valley Aquifer, a portion of the Queen City-Sparta aquifers in a 2-county area in Central Texas, and a portion of the Gulf Coast Aquifer in a 4-county area in the Lower Rio Grande Valley. Two other studies (portion of the Carrizo-Wilcox Aquifer in Central Texas and the Lipan Aquifer in West Texas) were initiated and will be completed in 2016.
 - The 84th Texas Legislature passed House Bill 30, directing TWDB to conduct studies to identify and designate brackish groundwater production zones in the Carrizo-Wilcox Aquifer located between the Colorado and Rio Grande rivers, the Gulf Coast Aquifer and sediments bordering that aquifer, the Blaine Aquifer, and the Rustler Aquifer (Figure 5) by December 1, 2016.
 - TWDB has identified an additional three aquifers (Trinity, Nacatoch, and Blossom) to study with a completion date of August 31, 2017. Studies on the remainder of the aquifers in the state are legislatively required to be completed by December 1, 2022.
 - A contingency rider for House Bill 30, the 84th Texas Legislature, provided TWDB with two full-time employees and an appropriation of \$2,000,000 for contract and administrative costs.
 - TWDB is also required to biennially report to the Governor, the Lt. Governor, and the Speaker of the House on the brackish groundwater production zones until completion of all aquifer studies. The reports will be part of the biennial seawater desalination reports. The next biennial report is due on December 1, 2016.

○ Financing Desalination Plants

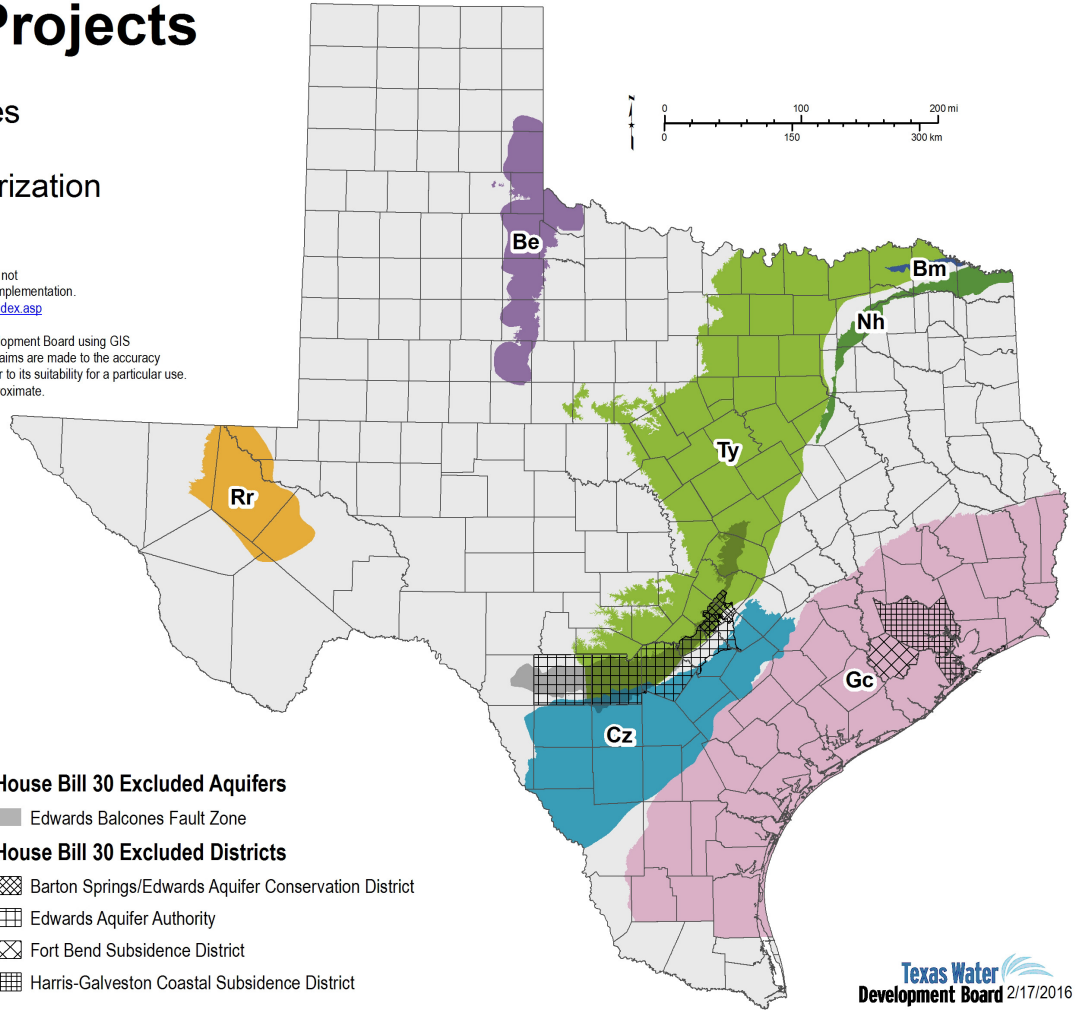
- Since 1989, TWDB has financed 34 desalination projects (Appendix C) for a total of approximately \$337 million.
- Desalination is eligible for financing from various agency programs, including the Drinking Water State Revolving Fund, the Water Development Fund, and State Participation.
- Desalination projects in the state water plan are eligible to benefit from the State Water Implementation Fund for Texas. To date, two projects (Guadalupe Blanco River Authority and Brazosport Water Authority) have been funded through this program.

BRACS Projects

Brackish Resources Aquifer Characterization System

Proposed projects are conceptual and may or may not represent a precise location and extent or actual implementation.
<http://www.twdb.texas.gov/innovativewater/bracs/index.asp>

This map was generated by the Texas Water Development Board using GIS (Geographical Information System) software. No claims are made to the accuracy or completeness of the information shown herein or to its suitability for a particular use. The scale and location of all mapped data are approximate.



House Bill 30 Projects

2016 Aquifers

- Be. Blaine
- Cz. Carrizo
- Gc. Gulf Coast
- Rr. Rustler

2017 Aquifers

- Bm. Blossom
- Nh. Nacatoch
- Ty. Trinity

House Bill 30 Excluded Aquifers

- Edwards Balcones Fault Zone

House Bill 30 Excluded Districts

- Barton Springs/Edwards Aquifer Conservation District
- Edwards Aquifer Authority
- Fort Bend Subsidence District
- Harris-Galveston Coastal Subsidence District

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Figure 5. House Bill 30 brackish aquifer study areas planned for completion in 2016 and 2017.

APPENDIX A

Recommended Groundwater Desalination Water Management Strategies in the Draft 2017 State Water Plan and the Supplies They Are Projected to Provide to Water User Groups

RWPG	Water Management Strategy and/or Project Sponsor	Counties	Aquifer name	Water supply volume (acre-feet per year) in decade					
				2020	2030	2040	2050	2060	2070
E	El Paso Water Utilities - KBH	El Paso	Hueco-Mesilla Bolson Aquifer	1,260	2,520	2,520	2,520	2,520	2,520
E	El Paso Water Utilities - Jonathan Rogers WWTP	El Paso	Other aquifer	0	0	11,000	11,000	11,000	11,000
E	Horizon Regional MUD	El Paso	Hueco-Mesilla Bolson Aquifer	17,304	18,761	20,499	22,227	23,866	25,411
E	Lower Valley Water District	El Paso	Other aquifer	6,800	6,800	6,800	6,800	6,800	6,800
E	Dell City	Hudspeth	Bone Spring-Victorio Peak Aquifer	111	111	111	111	111	111
E	Hudspeth County Conservation and Reclamation District #1	Hudspeth	Other aquifer	230	230	230	230	230	230
E	Hudspeth County - Mining	Hudspeth	West Texas Bolsons Aquifer	30	30	30	30	30	30
E	Culberson County - Mining	Culberson	West Texas Bolsons Aquifer	1,180	1,180	1,180	1,180	1,180	1,180
F	San Angelo	Tom Green	Other aquifer	0	0	0	3,336	3,071	3,513
F	Concho Rural WSC	Tom Green	Other aquifer	150	150	150	150	150	150
H	Conroe	Montgomery	Gulf Coast Aquifer	5,600	5,600	5,600	5,600	5,600	5,600
H	Brazosport Water Authority	Brazoria	Gulf Coast Aquifer	1,147	1,063	1,003	937	865	800
H	Brackish Groundwater Supplies	Montgomery	Gulf Coast Aquifer	0	0	0	0	3,622	10,000
H	Brackish Groundwater Supplies	Montgomery	Gulf Coast Aquifer	153	327	570	890	1,337	1,930
H	San Jacinto River Authority	Montgomery	Gulf Coast Aquifer	7,840	7,840	7,840	7,840	7,840	7,840
H	Panoram and Shenandoah	Montgomery	Gulf Coast Aquifer	0	0	472	472	472	472
J	Kinney County - Livestock	Kinney	Austin Chalk Aquifer	22	22	22	22	22	22
L	San Antonio Water System	Bexar Medina	Carrizo-Wilcox Aquifer	5,622	5,622	5,622	5,622	5,622	5,622
L	Canyon Regional Water Authority	Bexar Caldwell Comal Hays Guadalupe	Carrizo-Wilcox Aquifer	0	0	0	251	440	1,260
L	SS WSC	Wilson	Carrizo-Wilcox Aquifer	0	0	0	0	0	234
M	McAllen	Hidalgo	Gulf Coast Aquifer	2,688	2,688	2,688	2,688	2,688	2,688
M	North Alamo WSC - Delta Area WTP	Cameron Hidalgo Willacy	Gulf Coast Aquifer	0	0	0	0	2,240	2,240
M	North Alamo WSC - La Sara	Cameron Hidalgo Willacy	Gulf Coast Aquifer	0	0	0	0	0	1,120
M	Sharyland WSC WTP#2	Hidalgo	Gulf Coast Aquifer	900	900	900	900	900	900
M	Sharyland WSC WTP#3	Hidalgo	Gulf Coast Aquifer	900	900	900	900	900	900
M	Alamo	Hidalgo	Gulf Coast Aquifer	1,000	1,000	1,000	1,000	1,000	1,000
M	North Cameron Regional WTP	Cameron Hidalgo Willacy	Gulf Coast Aquifer	307	307	307	307	307	307
M	Hebronville	Jim Hogg	Gulf Coast Aquifer	560	560	560	560	560	560

RWPG	Water Management Strategy and/or Project Sponsor	Counties	Aquifer name	Water supply volume (acre-feet per year) in decade					
				2020	2030	2040	2050	2060	2070
M	La Feria	Cameron	Gulf Coast Aquifer	1,120	1,120	1,120	1,120	1,120	1,120
M	Laguna Madre	Cameron	Gulf Coast Aquifer	2,240	2,240	2,240	2,240	2,240	2,240
M	Lyford	Willacy	Gulf Coast Aquifer	1,120	1,120	1,120	1,120	1,120	1,120
M	Mission	Hidalgo	Gulf Coast Aquifer	2,688	2,688	2,688	2,688	2,688	2,688
M	Primera	Cameron	Gulf Coast Aquifer	1,120	1,120	1,120	1,120	1,120	1,120
M	San Juan	Hidalgo	Gulf Coast Aquifer	1,792	1,792	1,792	1,792	1,792	1,792
M	Union WSC	Starr	Gulf Coast Aquifer	560	560	560	560	560	560
M	El Jardin	Cameron	Gulf Coast Aquifer	560	560	560	560	560	560
N	Alice	Jim Wells	Gulf Coast Aquifer	3,363	3,363	3,363	3,363	3,363	3,363
O	Lubbock County	Lubbock	Dockum Aquifer	1,120	1,120	1,120	1,120	1,120	1,120
O	Abernathy	Lubbock	Dockum Aquifer	150	150	150	150	150	150
O	Seminole	Gaines	Dockum Aquifer	500	500	500	500	500	500
Total volume				70,137	72,944	86,337	91,906	99,706	110,773

Notes:

Volumes are cumulative from decade to decade.

- KBH = Kay Bailey Hutchison
- MUD = Municipal Utility District
- RWPG = Regional Water Planning Group
- SUD = Special Utility District
- WD = Water District
- WSC = Water Supply Corporation
- WTP = Water Treatment Plant
- WWTP = Waste Water Treatment Plant

APPENDIX B

Recommended Seawater Desalination Water Management Strategies and the Supplies They Are Projected to Provide to Water User Groups

Draft 2017 State Water Plan

RWPG	Water Management Strategy	County	2020	2030	2040	2050	2060	2070
H	Freeport Seawater Desalination	Brazoria	0	0	11,200	11,200	11,200	11,200
L	San Antonio Water System Seawater Desalination	Atascosa Bexar Comal Medina	0	0	18,019	29,037	43,064	53,978
L	Guadalupe-Blanco River Authority Integrated-Water Power Project	Calhoun Victoria DeWitt Gonzales	0	0	0	0	0	0
M	Brownsville Seawater Desalination	Cameron	2,800	2,800	2,800	2,800	28,000	28,000
N	Seawater Desalination	Nueces San Patricio	0	22,420	22,420	22,420	22,420	22,420
Total Volume			2,800	25,220	54,439	65,457	104,684	115,598

The Guadalupe-Blanco River Authority Integrated-Water Power Project is projected to produce 100,000 acre-feet per year; however, this table shows supplies of water to water user groups; the Project is not shown in the water plan to provide water to a water user group.

2012 State Water Plan

RWPG	Water Management Strategy	County	2010	2020	2030	2040	2050	2060
H	Freeport Desalination Plant	Brazoria	0	0	0	0	33,600	33,600
L	San Antonio Water System Seawater Desalination	Atascosa Bexar Comal Medina	0	0	0	0	0	23,463
L	Guadalupe-Blanco River Authority Integrated-Water Power Project	Calhoun Victoria DeWitt Gonzales	0	0	0	0	0	0
M	Brownsville Seawater Desalination	Cameron	0	0	0	5,600	5,600	7,013
M	Laguna Vista and Laguna Madre Seawater Desalination	Cameron	125	125	143	449	821	889
N	Seawater Desalination	Nueces San Patricio	0	28,000	28,000	28,000	28,000	28,000
Total volume			125	28,125	28,143	34,049	68,021	92,965

The Guadalupe-Blanco River Authority Integrated-Water Power Project is projected to produce 100,000 acre-feet per year; however, this table shows supplies of water to water user groups; the Project is not shown in the water plan to provide water to a water user group.

Notes:

Volumes are cumulative from decade to decade.

Volumes shown include strategies supplying water to a water user group.

RWPG = Regional Water Planning Group

APPENDIX C

TWDB-Funded Desalination Projects

No.	Entity	Funding Program	Funding Amount	Funding Date	Project Name
1	Seymour	DWSRF	\$4,140,476.00	04/11/2016	Water system improvements
2	Loop WSC	DWSRF	\$170,000.00	12/14/2015	WTP improvements
3	Brazosport Water Authority	SWIFT	\$28,300,000.00	07/23/2015	Brackish groundwater RO WTP and water wells
4	Guadalupe Blanco River Authority	SWIFT	\$2,000,000.00	07/23/2015	Integrated Water and Power Plant project
5	Granbury	DWSRF	\$16,430,000.00	03/26/2015	City of Granbury WTP
6	Baylor WSC	DWSRF	\$500,000.00	02/25/2015	Urgent need - Bufkin well field development
7	San Antonio Water System	DWSRF	\$75,920,000.00	11/06/2014	Water Resources Integration pipeline
8	Raymondville	DWSRF	\$3,800,000.00	09/19/2013	Emergency well & RO system
9	Dell City	DWSRF	\$244,450.00	05/16/2013	RO treatment plant
10	San Juan	DWSRF	\$8,410,000.00	01/31/2013	WTP #2 transfer line
11	Andrews	SAAP	\$388,000.00	01/19/2012	Water treatment system
12	Montgomery Co MUD # 8	WDF	\$5,450,000.00	09/22/2011	Walden conjunctive use WTP design
13	Montgomery Co MUD # 9	WDF	\$5,450,000.00	09/22/2011	Walden conjunctive use WTP design
14	Roscoe	DWSRF	\$1,765,000.00	05/04/2011	RO WTP
15	Fort Hancock WCID	EDAP	\$3,012,989.88	04/22/2010	Water well and RO treatment facility
16	Fort Griffin SUD	DWSRF	\$2,355,000.00	10/15/2009	Throckmorton County water lines
17	Millersview-Doole WSC	DWSRF	\$10,857,148.00	10/15/2009	SWTP and distribution lines
18	San Antonio Water System	WIF	\$109,550,000.00	07/16/2009	Brackish groundwater desalination
19	Stephens Regional SUD	DWSRF;WDF	\$11,800,000.00	05/21/2009	WTP and transmission lines
20	Possum Kingdom WSC	DWSRF	\$1,625,000.00	07/18/2006	WTP expansion
21	East Rio Hondo WSC	RWAF	\$4,150,000.00	11/15/2005	North RO plant transmission line
22	Clarksville City	WDF	\$1,530,000.00	02/15/2005	George Richey Road water wells
23	Ballinger	DWSRF	\$3,865,000.00	06/16/2004	Lake Ballinger water line
24	El Paso	WAF;SAAP	\$1,240,000.00	03/20/2002	Eastside desalination plan
25	Horizon Regional MUD	WDF	\$7,780,000.00	11/14/2001	Reverse osmosis treatment plant
26	Burleson Co MUD # 1	DWSRF	\$1,560,000.00	09/19/2001	Reverse osmosis treatment facility
27	Holiday Beach WSC	WDF	\$470,000.00	11/15/2000	Reverse osmosis water plant
28	Harlingen	CWSRF	\$1,845,000.00	04/19/2000	WWTP # 2 sludge process
29	Brady	DWSRF	\$9,405,000.00	03/09/2000	New SWTP and storage tank
30	Palmer	DWSRF	\$1,405,000.00	07/14/1999	RO plant
31	Possum Kingdom WSC	DWSRF	\$4,700,000.00	12/17/1998	Regional water system
32	Lorena	WDF	\$3,335,000.00	10/16/1997	Robinson transmission line
33	Haciendas del Norte WID	WDF	\$1,725,000.00	08/20/1997	East Montana transmission and RO unit
34	Harlingen	WAF	\$2,000,000.00	04/20/1989	WWTP # 2 expansion

Notes:

CWSRF = Clean Water State Revolving Fund
DWSRF = Drinking Water State Revolving Fund
EDAP = Economically Distressed Areas Program
MUD = Municipal Utility District
RO = Reverse Osmosis
RWAF = Rural Water Assistance Fund
SAAP = Special Appropriation Act Program
SUD = Special Utility District

SWIFT = State Water Implementation Fund for Texas
WAF = Water Assistance Fund
WCID = Water Control Improvement District
WDF = Water Development Fund
WID = Water Improvement District
WIF = Water Infrastructure Fund
WSC = Water Supply Corporation
WTP = Water Treatment Plant
WWTP = Wastewater Treatment Plant