Briefing Notes
on Desalination in Texas

Robert E. Mace, Ph.D., P.G.
Deputy Executive Administrator
and
Sanjeev Kalaswad, Ph.D., P.G.
Director
Conservation & Innovative Water Technologies Division

Water Science & Conservation
Texas Water Development Board

presented to the Joint Interim Committee to Study Desalination
June 16, 2014
Austin, Texas

Presentation outline:

I. Introduction
II. Current Capacity
III. Desalination in the State Water Plan
IV. Cost of Desalination
V. Recent 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).
    - Half of the plant's production was supplied to the City of Freeport and the other half was supplied 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 electrodialysis unit to desalt groundwater. That plant, since upgraded, still runs today.

II. Current Capacity

- There are currently more than 200 desalination plants in Texas.
- There are 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 14 years (Figure 1).
- Existing municipal desalination plants are distributed throughout the state (Figure 2).

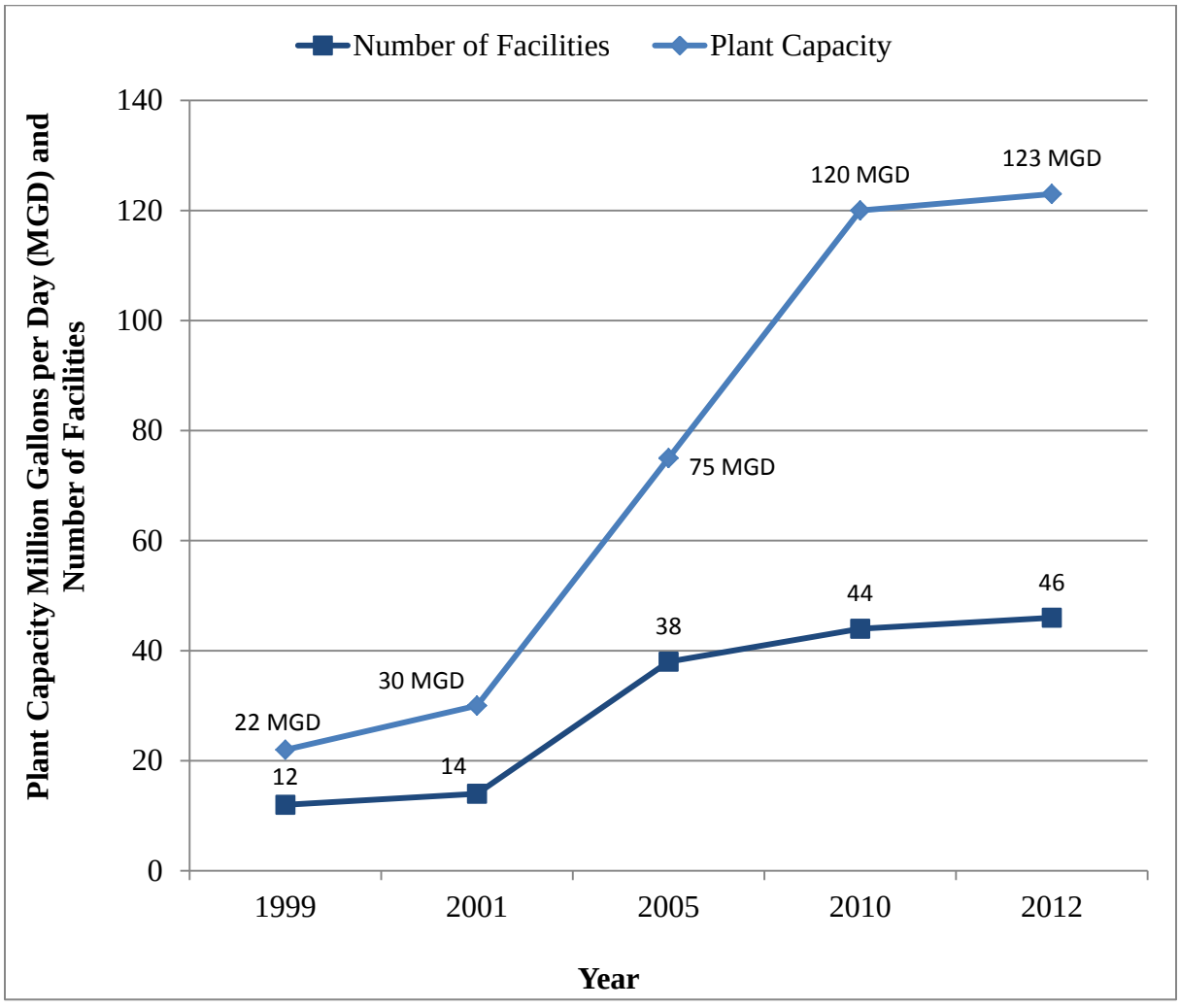

Figure 1. Number of facilities and installed design desalination capacity for municipal use in Texas in million gallons per day (MGD). Minimum plant capacity to be on this graph is 25,000 gallons per day. (1 MGD = 1,121 acre-feet per year).

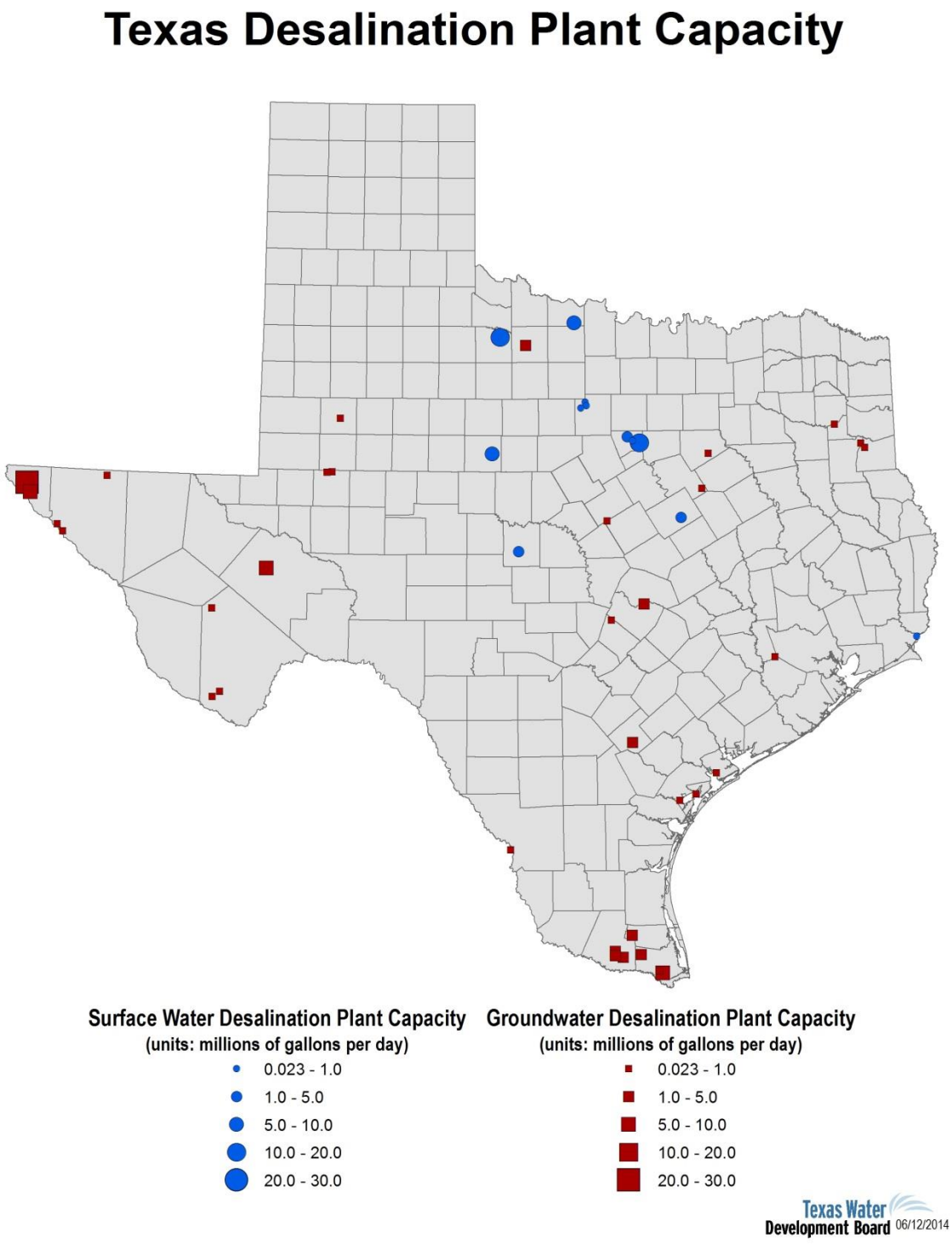

Figure 2. Distribution, size, and source water of existing municipal desalination facilities in Texas with design capacity of more than 25,000 gallons per day.

III. Desalination in the State Water Plan

- Recommended water management strategies in the 2012 State Water Plan would increase the total installed capacity by about 310,000 acre-feet per year by 2060 (Table 1), about 3.4 percent of new supplies. Approximate locations of these proposed plants are shown in Figure 3.
  - Regions E, F, L, M, and O include brackish groundwater desalination strategies.
  - Region E includes a surface-water desalination strategy.
  - Regions H, L, and M include seawater desalination as a strategy.
  - Water user groups with groundwater desalination strategies are listed in the appendix.

Table 2. Desalination strategies in the 2012 State Water Plan. New volumes of supply added each decade are shown with a total in the last column. Volumes are in acre-feet per year.

Water management strategies	Decade						Total
	2010	2020	2030	2040	2050	2060	
Brackish groundwater	56,553	24,603	22,279	29,843	29,805	18,485	181,568
Brackish surface water	0	2,700	0	0	0	0	2,700
Seawater	125	0	18	5,906	33,972	85,493	125,514
Total	**56,678**	**27,303**	**22,297**	**35,749**	**63,777**	**103,978**	**309,782**

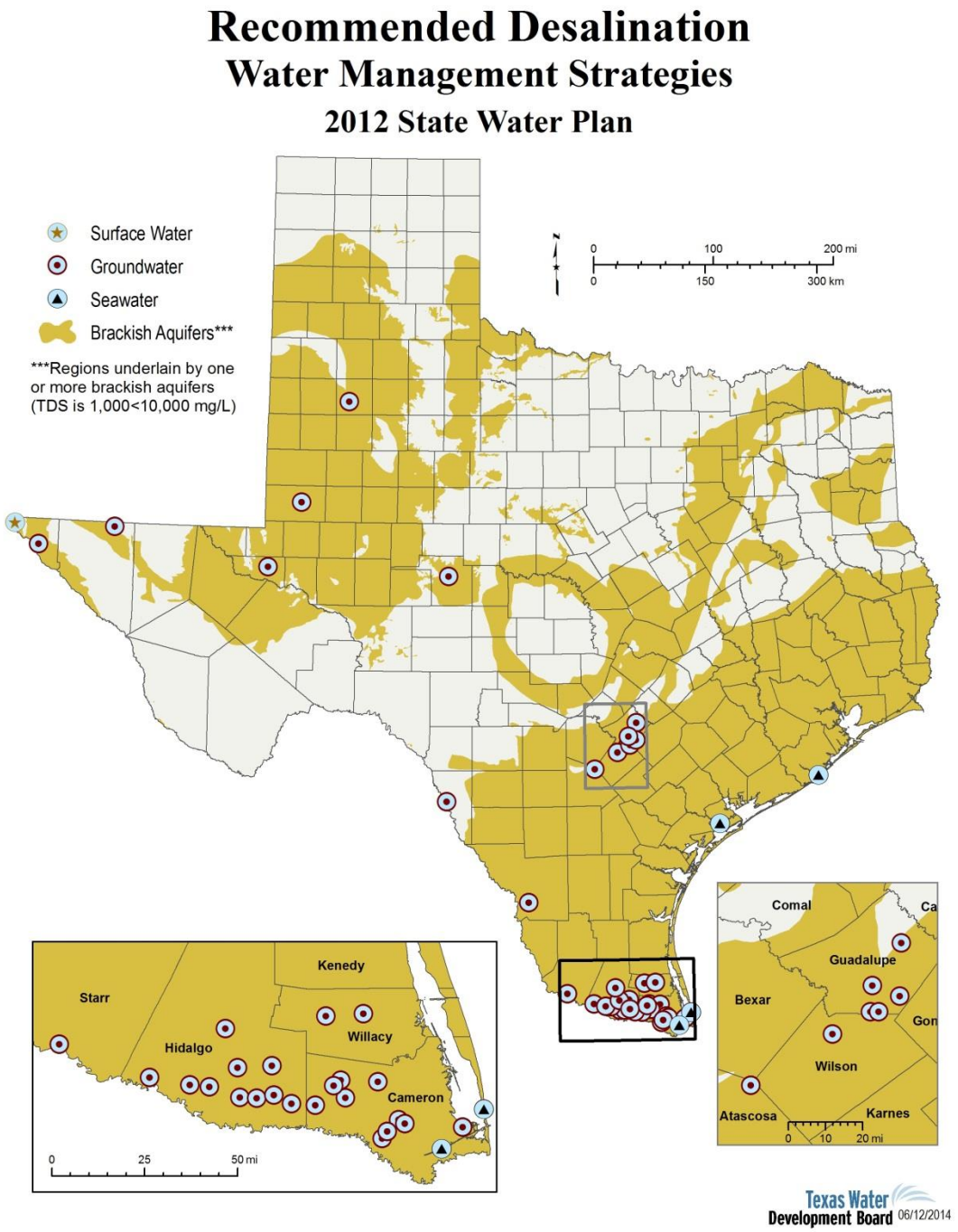

Figure 3. Approximate location of the recommended desalination water management strategies in the 2012 State Water Plan.

IV. Cost of Desalination

- The cost of desalination plants varies from project to project depending on a variety of factors. Cost drivers include:
  - Complexity of facility
  - Funding and procurement method
  - Quality and location of source water
  - Cost of energy
  - Disposal of waste product (concentrate)
  - Operations (blending)
  - Distance from where the supply is needed
- Production costs:
  - Brackish groundwater: $1.26 to $2.60 per 1,000 gallons ($410 to $847 per acre-foot; at the fence)
  - Seawater: $3.5 to $5 per 1,000 gallons ($1,140 to $1,629 per acre-foot; at the fence)
- Energy use (in addition to other energy used in the water treatment process):
  - Brackish groundwater: 517 to 735 kilowatt-hours per acre-foot
  - Seawater: 813 to 1,138 kilowatt-hours per acre-foot

V. Recent 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, 2014.
    - 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:
        - Assessing the feasibility of variable salinity processes
    - Due to the drought, there is greater interest in seawater desalination. We continue to monitor various discussions and potential projects and provide assistance as needed.

- 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.
  - 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. The legislature expanded funding to this program in 2013.
  - 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.
- Financing Desalination Plants
    - We've financed 29 desalination projects since 1982
    - 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.

APPENDIX A

Recommended Groundwater Desalination Water Management Strategies
2012 State Water Plan

RWPG	Water User Group	County	Aquifer name	Water supply volume (acre-feet per year) in decade					
				2010	2020	2030	2040	2050	2060
E	Horizon Regional MUD	El Paso	Other Aquifer	0	1,607	3,304	4,764	6,245	7,726
E	El Paso	El Paso	Bone Spring-Victorio Peak Aquifer	0	0	0	0	10,000	20,000
F	Andrews	Andrews	Dockum Aquifer	0	950	950	950	950	950
F	San Angelo	Tom Green	Other Aquifer	0	0	0	5,600	5,600	5,600
F	County-Other	Howard	Capitan Reef Aquifer	0	0	0	9,500	9,500	9,500
L	S.S. WSC	Wilson	Carrizo-Wilcox Aquifer	0	0	0	1,120	1,120	1,120
L	County-Other	Guadalupe	Carrizo-Wilcox Aquifer	0	0	2,004	2,004	2,004	2,004
L	Crystal Clear WSC	Comal	Carrizo-Wilcox Aquifer	0	0	130	130	259	259
L	Crystal Clear WSC	Comal	Carrizo-Wilcox Aquifer	0	0	0	0	0	0
L	Crystal Clear WSC	Guadalupe	Carrizo-Wilcox Aquifer	0	0	130	130	259	259
L	Crystal Clear WSC	Guadalupe	Carrizo-Wilcox Aquifer	0	0	0	0	938	938
L	Crystal Clear WSC	Hays	Carrizo-Wilcox Aquifer	0	0	130	130	259	259
L	Crystal Clear WSC	Hays	Carrizo-Wilcox Aquifer	0	0	206	206	1,469	1,469
L	Green Valley SUD	Bexar	Carrizo-Wilcox Aquifer	0	0	112	112	225	225
L	Green Valley SUD	Bexar	Carrizo-Wilcox Aquifer	0	0	638	638	1,278	1,278
L	Green Valley SUD	Comal	Carrizo-Wilcox Aquifer	0	0	112	112	225	225
L	Green Valley SUD	Comal	Carrizo-Wilcox Aquifer	0	0	638	638	1,278	1,278
L	Green Valley SUD	Guadalupe	Carrizo-Wilcox Aquifer	0	0	112	112	225	225
L	Green Valley SUD	Guadalupe	Carrizo-Wilcox Aquifer	0	0	638	638	1,278	1,278
L	Green Valley SUD	Guadalupe	Carrizo-Wilcox Aquifer	0	0	112	112	225	225
L	Green Valley SUD	Guadalupe	Carrizo-Wilcox Aquifer	0	0	638	638	1,278	1,278
L	San Antonio	Bexar	Carrizo-Wilcox Aquifer	0	12,000	21,000	26,400	26,400	26,400
L	Schertz	Guadalupe	Carrizo-Wilcox Aquifer	0	0	2,000	2,000	2,000	2,000
L	Springs Hill WSC	Guadalupe	Carrizo-Wilcox Aquifer	0	0	0	0	0	1,500
M	Alamo	Hidalgo	Gulf Coast Aquifer	0	83	288	469	882	1,304
M	Brownsville	Cameron	Gulf Coast Aquifer	8,291	8,235	8,173	8,108	16,446	16,680
M	Brownsville	Cameron	Gulf Coast Aquifer	123	182	247	316	382	449
M	Combes	Cameron	Gulf Coast Aquifer	0	25	25	25	25	25
M	Donna	Hidalgo	Gulf Coast Aquifer	0	50	50	50	50	50
M	Eagle Pass	Maverick	Carrizo-Wilcox Aquifer	0	260	260	260	272	641
M	East Rio Hondo WSC	Cameron	Gulf Coast Aquifer	100	100	100	100	177	906
M	Elsa	Hidalgo	Gulf Coast Aquifer	0	100	100	100	100	100
M	Harlingen	Cameron	Gulf Coast Aquifer	0	25	25	25	586	1,923
M	Indian Lake	Cameron	Gulf Coast Aquifer	18	27	36	46	54	64

RWPG	Water User Group	County	Aquifer name	Water supply volume (acre-feet per year) in decade					
				2010	2020	2030	2040	2050	2060
M	La Feria	Cameron	Gulf Coast Aquifer	0	180	180	180	180	180
M	La Joya	Hidalgo	Gulf Coast Aquifer	50	48	75	69	40	7
M	La Joya	Hidalgo	Gulf Coast Aquifer	0	2	25	51	80	113
M	Laguna Madre WD	Cameron	Gulf Coast Aquifer	100	100	400	1,000	1,500	2,000
M	Laredo	Webb	Carrizo-Wilcox Aquifer	0	0	0	0	0	0
M	Laredo	Webb	Gulf Coast Aquifer	0	1,577	1,577	5,100	5,100	5,100
M	Laredo	Webb	Yegua-Jackson Aquifer	0	1,523	1,523	2,500	2,500	2,500
M	Laredo	Webb	Yegua-Jackson Aquifer	1,120	2,500	2,500	2,500	2,500	2,500
M	Los Fresnos	Cameron	Gulf Coast Aquifer	0	0	206	474	740	997
M	McAllen	Hidalgo	Gulf Coast Aquifer	3,360	3,360	6,139	6,600	8,121	8,821
M	Mercedes	Hidalgo	Gulf Coast Aquifer	560	560	560	560	560	560
M	Mission	Hidalgo	Gulf Coast Aquifer	560	560	560	560	560	560
M	North Alamo WSC	Hidalgo	Gulf Coast Aquifer	11,201	11,201	11,201	11,201	11,201	11,201
M	North Alamo WSC	Willacy	Gulf Coast Aquifer	11,201	11,201	11,201	11,201	11,201	11,201
M	Port Isabel	Cameron	Gulf Coast Aquifer	944	1,045	1,149	1,249	1,357	1,463
M	Primera	Cameron	Gulf Coast Aquifer	51	70	95	111	124	113
M	Raymondville	Willacy	Gulf Coast Aquifer	0	100	100	100	100	100
M	Rio Grande City	Starr	Other Aquifer	560	1,120	1,120	1,123	1,314	1,498
M	San Perlita	Willacy	Gulf Coast Aquifer	25	25	25	25	25	25
M	Valley MUD #2	Cameron	Gulf Coast Aquifer	0	268	269	269	269	269
M	Weslaco	Hidalgo	Gulf Coast Aquifer	100	100	100	100	250	350
M	Eagle Pass	Maverick	Other Aquifer	0	130	130	130	130	130
M	Harlingen	Cameron	Gulf Coast Aquifer	0	25	25	25	25	25
M	Laguna Madre WD	Cameron	Gulf Coast Aquifer	100	100	400	1,000	1,500	2,000
M	County-Other	Hidalgo	Gulf Coast Aquifer	11,201	11,201	11,201	11,201	11,201	11,201
M	Brownsville	Cameron	Gulf Coast Aquifer	1,000	1,000	1,000	1,000	1,000	1,000
M	Brownsville	Cameron	Gulf Coast Aquifer	2,903	2,903	2,903	2,903	2,903	2,903
M	Indian Lake	Cameron	Gulf Coast Aquifer	10	10	10	10	10	10
M	Indian Lake	Cameron	Gulf Coast Aquifer	6	6	6	6	6	6
M	Los Fresnos	Cameron	Gulf Coast Aquifer	1,000	1,000	1,000	1,000	1,000	1,000
M	Los Fresnos	Cameron	Gulf Coast Aquifer	915	915	915	915	915	915
M	Valley MUD #2	Cameron	Gulf Coast Aquifer	527	527	527	527	527	527
M	Valley MUD #2	Cameron	Gulf Coast Aquifer	527	527	527	527	527	527
M	Combes	Cameron	Gulf Coast Aquifer	0	268	268	268	268	268
O	Lubbock	Lubbock	Edwards-Trinity-High Plains Aquifer	**0**	**3,360**	**3,360**	**3,360**	**3,360**	**3,360**
Total Brackish Groundwater Desalination Strategies									**181,568**

Notes:

RWPG = Regional Water Planning Group
WSC = Water Supply Corporation
MUD = Municipal Utility District
WD = Water District
SUD = Special Utility District