The Future of Desalination in Texas

2010 Biennial Report on Seawater Desalination

Texas Water Development Board

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Texas Water Development Board

Section 16.060 of the Texas Water Code, directs the Texas Water Development Board to undertake or participate in research, feasibility and facility planning studies, investigations, and surveys as it considers necessary to further the development of cost-effective water supplies from seawater desalination in the state. The Texas Water Development Board shall prepare a biennial progress report on the implementation of seawater desalination activities in the state and shall submit it to the Governor, Lieutenant Governor, and Speaker of the House of Representatives not later than December 1 of each even-numbered year.

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TEXAS WATER DEVELOPMENT BOARD

December 1, 2010

To: The Honorable Rick Perry, Governor of Texas
The Honorable David Dewhurst, Lieutenant Governor of Texas
The Honorable Joe Straus, Speaker of the Texas House of Representatives

The Texas Water Development Board is pleased to present the fourth Biennial Report on Seawater Desalination, submitted to you in compliance with Texas Water Code §16.060. This report examines progress toward the goal of creating water supplies in Texas through seawater desalination.

The Texas Water Development Board has been directed to take all necessary actions to further the development of cost-effective water supplies from seawater desalination in the state. Currently, the greatest opportunity for Texas to begin large-scale development of seawater desalination is provided by the Brownsville Public Utilities Board.

The Brownsville Public Utilities Board proposes to install a 2.5 million-gallon-per-day production prototype on the south bank of the Brownsville Ship Channel at an estimated cost of $22.5 million. The Texas Water Development Board is requesting the 82nd Texas Legislature to consider appropriating $9.5 million to assist the Brownsville Public Utilities Board with implementing the seawater desalination project.

Additionally, the Brownsville Public Utilities Board is considering a $6 million investment in a renewable energy project to be implemented in conjunction with the seawater desalination project. If successful, this proposal could improve the fundability of the combined seawater desalination and renewable power generation project.

On behalf of the citizens of Texas, Texas Water Development Board respectfully submits to the Governor, the Lieutenant Governor, the Speaker of the House, and members of the 82nd Texas Legislature this document, including a progress report of and recommendations regarding the implementation of seawater desalination supplies in Texas.

James E. Herring
Chairman

J. Kevin Ward
Executive Administrator

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Executive Summary

With the population of Texas expected to nearly double in the next 50 years, Texans will be searching for new, sustainable, and drought-proof water resources. Although planners envision expanded use of existing fresh groundwater and surface water resources, these water resources face a variety of regulatory and implementation uncertainties. One resource that is new, sustainable and drought proof is just off of our coast: the seawater of the Gulf of Mexico.

The goal of the Seawater Desalination Initiative is to develop a water supply through seawater desalination. The initiative began in 2002 with the identification of possible sites for a seawater desalination project and subsequent feasibility studies of the best of these sites. The initiative was expanded in 2006 with the implementation of a comprehensive pilot plant study at the Brownsville ship channel by the Brownsville Public Utilities Board and a pilot plant study at South Padre Island by the Laguna Madre Water District. Both pilot plant studies have resulted in proposals for larger projects—a 1-million-gallon–per-day water supply project for South Padre Island and a 2.5-million-gallon-per-day water supply and demonstration project for the Brownsville ship channel.

Although both projects propose to desalt water from the Gulf, there are differences between the projects that will offer a broader spectrum of the desalination experience in Texas. One key difference pertains to the source water: the South Padre Island project proposes to treat open ocean water, and the Brownsville project proposes to treat bay seawater from Laguna Madre. The water quality of the latter is similar to many potential desalination sites along the Texas Gulf Coast. In addition, the Brownsville project includes research and demonstration components and has the potential to upgrade to a large-scale production facility.

A key commonality between these projects is the funding challenge: The Brownsville project requires a $9.5 million appropriation from the state for the $22.5 million project. A bond authorization of $13.7 million for the South Padre Island project failed to pass in the November 2010 elections, thus the immediate future of the project is uncertain.

The Brownsville Public Utilities Board, in its role as an electric power utility, is considering a $6 million investment in renewable energy to be developed in conjunction with the seawater desalination project. If implemented, this potential project could leverage the overall value of the project and open other potential sources of funding, such as the U.S. Department of Energy.

The cumulative efforts of the past eight years provide a robust foundation upon which to design, permit, and construct a demonstration seawater desalination facility. Completing a demonstration project will provide an invaluable reference point that will pioneer the future development of seawater desalination supplies in the state.

The purpose of this report is to meet Texas Water Code requirements to (1) report on the results of the Texas Water Development Board's (TWDB’s) studies and activities relative to seawater desalination during the preceding biennium; (2) identify and evaluate research, regulatory,

technical, and financial impediments to implementing seawater desalination projects; (3) evaluate the role the state should play in furthering the development of large-scale seawater desalination projects in the state; and (4) identify the appropriation needed to continue investigating water desalination activities in the state during the next biennium.

Results of studies and activities

TWDB funded and participated in a number of studies and activities during the past two years, including outreach, partnership, and research activities. We awarded a $60,100 grant in June 2009 to the Brownsville Public Utilities Board to consult with regulators and environmental stakeholders to explore permitting strategies for seawater desalination facilities in Texas. This study is expected to be completed in June 2011, but the draft report submitted to us has identified the state and federal permits required to build a plant. We also received a final regional water facility plan and seawater desalination pilot plant study report from the Laguna Madre Water District for a 1-million-gallon-per-day seawater desalination plant for South Padre Island.

Based on collaboration between the U.S. Bureau of Reclamation and TWDB, the Bureau published a white paper describing the merits, theory, and practical alternatives for a variable salinity treatment process to be tested in Texas. This has resulted in the Bureau funding the next phase of this project: constructing a pilot plant and testing its performance at one or two sites in Texas.

We continued our outreach activities through our Web site, the Texas Innovative Water 2010 seminar, and involvement in various briefings, presentations, and white papers. In September 2010, the WateReuse Association awarded us with the 2010 WateReuse Project of the Year Award-Desalination.

Impediments to implementation

The high cost of seawater desalination relative to other potential water resources is the greatest challenge to implementing a large-scale demonstration seawater desalination facility in Texas. The Brownsville Public Utilities Board has indicated that without financial assistance in the form of a grant, it will not be able to build a seawater desalination plant. Because of the high cost of providing additional freshwater resources for South Padre Island, the desalination project proposed by the Laguna Madre Water District appears to be financially viable. However, in the November 2010 election, Laguna Madre Water District voters rejected a $13.2 million bond proposal to finance the 1-million-gallon-per-day seawater desalination project; therefore, the funding for this project is now uncertain.

For research, there is a need for studies to fill in knowledge gaps regarding potential environmental impacts and projected performance of desalination facilities. There is also a need to test the regulatory path with a demonstration facility to ensure we fully understand the permitting process and to propose any changes to the process if needed. The draft report of the environmental scoping study by the Brownsville Public Utilities Board identified 26 potential permits that would apply to their demonstration facility. There is a need to build a demonstration

project now while the pilot studies are relevant—in another few years new pilot studies will likely have to be undertaken.

The Role of the State

The state's leadership and support is needed to install a demonstration desalination facility and to identify and develop regional approaches to developing seawater desalination supplies in Texas. The state needs to (1) help install a demonstration seawater desalination facility in Brownsville, (2) monitor progress of the South Padre Island Project, and (3) pursue regional partnership opportunities.

Appropriations

TWDB has included a request for $9.5 million in our Legislative Appropriations Request for Fiscal Years 2012–2013 to assist the Brownsville Public Utilities Board with building a 2.5-million-gallon-per-day production and demonstration facility. This appropriation request reduces the financial requirements to begin implementing the demonstration project. Unlike the desalination proposal advanced in 2008, this plan excludes provisions for increased future capacity.

I. Introduction

As Texas grows, so grows its need for water. According to the 2007 State Water Plan, there will be almost twice as many Texans in 2060 as there are today. And more Texans means a need for new water, especially water that is sustainable and drought proof. The state water plan shows that much of our increased water demands will be met with conservation, reuse, and additional groundwater and surface water resources. The plan also shows desalination, including seawater desalination, becoming more important over the planning horizon. This is not surprising: after all, the Gulf of Mexico borders much of our state. Furthermore, seawater represents new water that is sustainable and drought proof.

Seawater desalination does have its issues: it's expensive, especially when compared to other sources of water, and is untested in Texas at a production scale. However, seawater desalination is becoming relatively more affordable. Costs have been coming down due to increased efficiencies in desalting membranes. In addition, the cost of freshwater supplies has been going up as demand for water and the distance that water has to travel increases. Furthermore, the availability of freshwater resources is in regulatory flux. It's unclear if planned groundwater and surface water projects will attain the permits they need to become reality. Environmental flow requirements and endangered species issues may further reduce surface water and groundwater availability. In addition, Texas has faced more severe droughts than the drought of record used in water planning. A more severe drought severely affects assumptions on water availability. For example, Australia recently experienced a new drought of record, a drought that caused it to build emergency seawater desalination plants at great cost. Texas could find itself in the same situation in the near future.

Texas needs to be ready. And the best way for Texas to be ready is to build demonstration and production facilities to test the permitting pathway (and modify it if needed) and the technology at a production scale. Pilot projects show seawater desalination from the Gulf of Mexico to be technically viable. And for the first time in Texas, based on one of the pilot studies, a community is seriously considering seawater desalination as an economically viable source of water. However, more work—and state funding—is needed to ensure Texas is ready for seawater desalination.

Since April 2002, TWDB has engaged in a collaborative, purposeful approach to identify sites with the greatest potential for seawater desalination, worked with potential project developers in evaluating the feasibility of such projects, completed comprehensive pilot plant studies in Brownsville and South Padre Island and, during the current biennium, initiated an environmental scoping study to determine the specific permitting needs to install a demonstration production facility in Brownsville.

These efforts, and the manner in which they have been implemented, won the recognition in 2006 of Global Water Intelligence and more recently of the WateReuse Association with its Desalination Project of the Year 2010 award to TWDB.

However, the cumulative accomplishments to date (and the recognitions) would be diminished and the momentum lost if an actual production demonstration seawater desalination facility is not installed in the near future.

This progress report provides a summary of the work completed to date and the challenges ahead. The report is prepared in response to Texas Water Code, Section 16.060(b), which directs TWDB to prepare a biennial progress report on the implementation of seawater desalination activities in the state and to submit it to the Governor, Lieutenant Governor, and Speaker of the House of Representatives no later than December 1 of each even-numbered year. The report is required to include

(1) “results of the board's studies and activities relative to seawater desalination during the preceding biennium;

(2) identification and evaluation of research, regulatory, technical, and financial impediments to the implementation of seawater desalination projects;

(3) evaluation of the role the state should play in furthering the development of large-scale seawater desalination projects in the state; and

(4) the anticipated appropriation from general revenues necessary to continue investigating water desalination activities in the state during the next biennium” (Texas Water Code, Section 16.060 [b]).

II. Results of Studies and Activities

This section reports on the results of TWDB's studies and activities to advance the seawater desalination demonstration strategy and other efforts including outreach, partnership, and research activities.

A. Seawater Desalination Initiative—demonstration project activities

Since the launching of this program in April 2002, TWDB has awarded about $3.3 million to fund eight studies directly related to advancing seawater desalination in Texas (Table 1).

Table 1 - TWDB-funded studies on seawater desalination

Study	TWDB Grant ($)	Match ($)	Total Cost ($)
Seawater Desalination Feasibility Study—Brazos River Authority (2004)	500,000	-	500,000
Seawater Desalination Feasibility Study—Corpus Christi (2004)	500,000	-	500,000
Seawater Desalination Feasibility Study—Brownsville Public Utilities Board (2004)	500,000	-	500,000
Guidance Manual for Permitting Requirements in Texas for Desalination Facilities—R.W. Beck Inc. (2004)	50,000	-	50,000
Minimum Requirements for Seawater Desalination Projects in Texas—REI Inc. (2005)	118,025	-	118,025
Seawater Desalination Pilot Plant Study—Brownsville Public Utilities Board (2008)	1,340,000	1,885,057	3,225,057
Regional Water Facility Plan Update and Seawater Desalination Pilot Plant Study—Laguna Madre Water District (2009)	231,000	548,000	779,000
Research and Develop Permitting Process Strategies for Seawater Desalination Projects in Texas—Brownsville Public Utilities Board (2009, on-going)	60,100	8,000	68,100
TOTAL	3,299,125	2,441,057	5,740,182

The most recent of these awards was authorized in June 2009, consisting of a $60,100 grant to the Brownsville Public Utilities Board to consult with regulators and environmental stakeholders to explore permitting strategies for seawater desalination facilities in Texas. This environmental scoping study is the only state grant during the reporting biennium that is directly related to the seawater desalination project at the Brownville ship channel.

The anticipated deliverables from the environmental scoping study include a comprehensive list of permits and compliance documents necessary for constructing and operating the proposed seawater desalination plant; projected timelines and costs to complete permits and compliance requirements; and if needed, a public meeting to comply with the National Environmental Policy Act requirements for preparing an Environmental Impact Statement.

As part of this contract, on December 3–4, 2009, the Brownsville Public Utilities Board held a stakeholders' workshop in South Padre Island. The workshop included presentations and roundtable discussions on key environmental and permitting issues. Participants were asked to identify their permitting or regulatory responsibilities regarding development of a seawater desalination project; provide references to relevant data, studies, and research; and provide guidance to facilitate the permitting of seawater desalination projects.

In April 2010 the Brownsville Public Utilities Board submitted a partial draft report to TWDB describing the results of the environmental scoping effort and identifying research needs and the permits that will need to be processed for the Brownsville Seawater Desalination Project. The draft report identified 26 potential permits that would apply to the demonstration facility proposed at the Brownsville ship channel location. The permits, along with estimates of the time required to process these permits and the range of costs, are shown in Table 2.

Of the permits listed, the most complex is the issuance and approval of an Environmental Impact Statement for compliance with the National Environmental Policy Act. If required, this permit could take up to three years to secure at an estimated cost of up to $3 million. An Environmental Impact Statement will be required if federal funds are used to build the project. The Brownsville Public Utilities Board is in discussions with the U.S. Bureau of Reclamation to determine the viability of funding a 2.5-million-gallon-per-day demonstration seawater desalination under existing federal authorizations for technology demonstration projects[1]. If this potential funding source is pursued, then an Environmental Impact Statement could be required, and the hearing described in the TWDB contract with Brownsville Public Utilities Board will be scheduled.

The contract for the environmental scoping study was extended to June 2011 to allow for dialogue between the Brownsville Public Utilities Board and the U.S. Bureau of Reclamation, as well as to account for additional funding guidance or possible appropriations from the 82nd Texas Legislature.

Participants in the stakeholder workshop also identified research needs pertaining to development of seawater desalination projects in the Texas Gulf Coast:

- characterizing benthic fauna in areas to be affected by concentrate discharges
- determining the salinity tolerance of key aquatic species along the Texas Gulf Coast potentially affected by desalination concentrate discharges
- modeling currents and tides to determine impact on concentrate dispersion
- improving thin-layer mixing models as part of far-field plume modeling
- integrating desalinated seawater into existing drinking water distribution networks
- revising regulatory bacteria and virus removal credits for reverse-osmosis membranes

Some of these issues will need to be addressed as part of the design and permitting of the Brownsville project and will add to the general body of knowledge for future seawater desalination projects located in areas with similar source characteristics along the Texas Gulf Coast.

[1] United States Congress Title XVI of Public Law 102-575

Table 2 - Potential permits for a seawater desalination facility at the Brownsville ship channel

Permit/Approval	Agency	Schedule (months)	Cost ($1,000)
Section 10/404 Nationwide Permit	U.S. Army Corps of Engineers	4–8	20–35
Section 10/404 Individual Permit		6–18	45–85
National Environmental Policy Act–Environmental Assessment (excludes other permit costs)		6–18	50–250
National Environmental Policy Act–Environmental Impact Statement		12–36	500–3,000
Endangered Species Act	U.S. Fish and Wildlife Service	2–12	30–60
Endangered Species Act /Essential Fish Habitat	U.S. National Marine Fisheries Service	2–12	35–70
Navigable Airspace Hazard Determination	Federal Aviation Agency	2–4	<1
Section 401 Certification	Texas Commission on Environmental Quality	4–18	2–5
Texas Pollutant Discharge Elimination System–Industrial Wastewater Discharge Permit		13–18	20–75
Texas Land Application Permit		13–18	20–75
Texas Pollutant Discharge Elimination System–Hydrostatic Test Water Discharge Permit		1–2	5–15
Texas Pollutant Discharge Elimination System–Construction Discharge Permit		1–2	5–15
Land Application for Water Treatment Sludge		1–2	5–10
Water Rights Permit		8–24	10–50
Public Water System Registration		3–8	10–15
Petroleum Storage Tanks Registration		1–2	<1–2
Air Permit by Rule		1–2	<1–2
New Source Review Air Permit		12–18	6–12
Protected Species Consultation	Texas Parks and Wildlife Department	2–6	10–20
Sand and Gravel Permit		2–6	5–10
Antiquities Permit	Texas Historical Commission	1–2	<1
National Historic Preservation Act Section 106 Review and Compliance		3–8	20–150
Coastal Management Program	Texas General Land Office	4–18	5–10
Miscellaneous Easement		3–6	5–10
Utility Line Request	Texas Department of Transportation	1–3	1–4
Local Permits and Easements	Cameron County, Brownsville Navigation District, Railroad Companies	1–12	5–20

B. Other studies and activities

1. Laguna Madre Water District

In August 2010, the Laguna Madre Water District submitted a final regional water facility plan and seawater desalination pilot plant study report to TWDB[2]. The study recommends installing a 1-million-gallon-per-day seawater desalination plant on South Padre Island at an approximate cost of $12 million. The projected operation and maintenance cost for this facility is $1.96 per 1,000 gallons. The life-cycle cost of the facility, that is, operation and maintenance plus capital recovery cost, is estimated at $4.79 per 1,000 gallons (Laguna Madre Water District, 2010).

At its regular meeting of July 14, 2010, the Laguna Madre Water District Board of Directors approved a motion to include in its next bond issue an allowance for $13.7 million for a 1-million-gallon-per-day seawater desalination plant to be located on South Padre Island. The bond authorization was included in the November 2010 ballot but failed to pass thus forcing the District to seek other funding options.

Pending funding for the Brownsville and South Padre Island desalination projects, these two projects could potentially be implemented at nearly the same time, providing Texas planners with the permitting and design knowledge of both a ship channel intake for a large project (Brownsville) and an open ocean intake for a small project (South Padre Island).

2. Regional water plans

Based on the initially prepared plans, four regional water planning groups considered seawater desalination in the current cycle of regional water planning leading to the adoption and approval of the 2011 regional water plans.

The South Central Texas Regional Water Planning Group (Region L) included seawater desalination as a recommended water management strategy for Bexar County (South Central Texas Regional Water Planning Group, 2010). Related to this strategy is the stakeholder outreach efforts initiated in 2009 by the San Antonio Water System as part of its exploration of seawater desalination. The 2009 Water Management Plan of the San Antonio Water System includes a seawater desalination supply project as a potential long-term strategy for implementation in the 2035 to 2060 time frame (San Antonio Water System, 2010).

The Rio Grande Regional Water Planning Group (Region M) included seawater desalination as a recommended water management strategy for South Padre Island (1 million gallons per day) and for Cameron County (5 million gallons per day) (Rio Grande Regional Water Planning Group, 2010).

The Coastal Bend Regional Water Planning Group (Region N) and Region H Regional Water Planning Group included seawater desalination as an alternative water management strategy in both of these regions' initially prepared plans (Region H Water Planning Group, 2010; Coastal Bend Regional Water Planning Group, 2010).

[2] TWDB awarded $231,000 for this study in July 2006 to the Laguna Madre Water District to update its regional water facility plan and conduct a seawater pilot plant study.

3. Variable salinity source desalination

In 2008, TWDB staff conducted research at the Variable Salinity Plant operated by the Singapore Public Utilities Board as part of its NeWater Program (Reuse) in the Republic of Singapore. The plant treats stormwater runoff stored in drainage canals and, when this source is exhausted, the plant automatically shifts to seawater. Variable source desalination is a potential means to gain the drought-proofing benefits of seawater while reducing the cost of a desalination operation by designing the facility to also treat lower salinity sources.

In Texas, this approach could be useful in areas subject to seasonal availability of fresh or moderately saline sources that could be supplemented with more saline sources, such as brackish groundwater or even seawater, to ensure the required production yield of the facility.

In 2009, TWDB and the U.S. Bureau of Reclamation staff discussed possible collaborative efforts to assess variable salinity applications in Texas. These discussions resulted in the authorization of a U.S. Bureau of Reclamation Science and Technology Program study to pilot and assess variable desalination and the potential for conjunctive—fresh and saline sources—applications at up to two locations in Texas: the Brownsville ship channel (in partnership with the Brownsville Public Utilities Board) and Corpus Christi (in partnership with the San Patricio Municipal Water District). The Singapore Public Utilities Board has also pledged its support for this study.

On July 1, 2010, the U.S. Bureau of Reclamation produced a white paper (U.S. Bureau of Reclamation, 2010) describing the merits, theory, and practical alternatives for a variable salinity treatment process to be tested in Texas. As part of its Science and Technology Program, the Bureau has approved funding for the next phase of the project: constructing a pilot plant and testing its performance at one or two sites in Texas— Brownsville or Ingleside.

4. Outreach activities

TWDB, as part of its Innovative Water Technology Program, maintains a Web site with educational information about desalination, as well as downloadable copies of all TWDB-funded desalination study reports (Texas Water Development Board, 2010a).

Staff participates in technical conferences to provide briefings, presentations, and white papers about desalination and other innovative water technology programs.

Our outreach efforts and continued programmatic support to advance the development of seawater desalination supplies in Texas were recognized by the WateReuse Association at its annual symposium in Washington, D.C., in September 2010 with the 2010 WateReuse Desalination Project of the Year award.

5. Texas Innovative Water 2010 seminar

On October 11–12, 2010, TWDB hosted a seminar in San Antonio, Texas Innovative Water 2010, to advance the development and management of innovative water supplies in Texas. The seminar included a panel on seawater desalination in which recognized desalination experts, key regional water planners, and stakeholders considered the state of seawater desalination in Texas and discussed successful examples and costs of seawater desalination as well as the need to

expedite development of seawater desalination in Texas (Texas Water Development Board, 2010b).

At the seminar, Nikolay Voutchkov of Water Globe Consulting Inc. noted that a recent sample of large-scale seawater desalination projects indicates that production costs range from approximately $2 to $11 per thousand gallons. Three factors help explain the wide range: procrastination, size, and location. Projects that have to be implemented under more critical time requirements edge on the higher end of the cost bracket; economies of scale favor projects of up to a 50-million-gallon-per-day capacity; and the proximity of the project to the demand center as well as the specific intake and discharge characteristics of the site are highly variable but quite relevant in terms of the cost of a project. Voutchkov also reported that the project methods for implementing all large-scale projects are variations of the design-bid-build delivery.

Tom Pankratz, editor of the Water Desalination Report, an industry-recognized periodical that tracks water desalination developments around the world, provided insights into factors that lead to the success of seawater desalination programs. Catalysts to the successful implementation of large-scale seawater desalination projects are the need for water, a well-defined and efficient permitting process, competitive water pricing, and a transparent project development process.

Genoveva Gomez, Brownsville Public Utilities Board, discussed the benefits to the state from implementing a seawater desalination project as currently proposed. First, because of the well-documented vulnerability to drought and over-allocation of the Rio Grande, Brownsville has a critical need for water supply diversification to gain water supply reliability. Second, the Brownsville Public Utilities Board has the unique advantage of being a water and power utility, which gives it the ability to manage the large power needs of a seawater desalination facility in a more efficient manner. Third, citing the example of the Southmost Regional Water Authority Brackish Groundwater Desalination project and the seawater desalination pilot plant study, the Brownsville Public Utilities Board has demonstrated its commitment and ability to successfully implement desalination technology projects.

Bill West, Guadalupe-Blanco River Authority, remarked on the difficulties the state faces in implementing new reservoirs and/or long-distance transfers of water. He stated that seawater desalination is a substantive alternative to reduce the pressures on senior water rights and to provide relief to environmentally driven water needs affecting the Edwards Aquifer. West discussed the water demands that will result from the growing need for power plants to be located along the Texas Gulf Coast and how those new and substantial water demands can best be met by seawater desalination. West concluded by expressing the need for the state to aid in permitting and funding to expedite seawater desalination supplies.

Robert Puente, San Antonio Water System, discussed strategies the state should consider to advance the development of seawater desalination supplies. First, it is important for the state to support and assist with funding the installation the Brownsville demonstration project. According to Puente, there is great value to the state in completing this project to gain a reference point for the permitting, design, construction, and operation of a large-scale seawater desalination facility. Puente commented that the state should also lead in technical support and research and hold educational outreach seminars such as the Texas Innovative Water 2010 seminar. Puente

strongly encouraged outreach and partnerships with diverse interests—cities, industries, power generators, and environmentalists—to formulate seawater desalination projects with a regional scope. He estimates that such approaches could more easily gain a broader support for funding and implementation.

6. Other activities

TWDB staff monitors national and international desalination research efforts in search of opportunities that may benefit seawater desalination activities in Texas.

An important desalination research program in the United States is that of the U.S. Bureau of Reclamation. In 2003 the Bureau and Sandia National Laboratories led the formation of a national desalination research agenda as a means to guide national research efforts (U.S. Bureau of Reclamation and Sandia National Laboratories, 2003). Similarly, in 2009 the WateReuse Research Foundation published a white paper with recommendations for needed desalination research (Vouthckov, 2009). TWDB staff participates in these national processes through membership in key organizations such as the Desalination Committee of the WateReuse Association and through continued collaboration with the U.S. Bureau of Reclamation desalination researchers.

An example of how we participate in this broader research community is the variable salinity process described in the previous section. Another example is the invitation our staff received and accepted to comment on the draft of the Water Research Foundation report *Guidelines for Implementing Seawater and Brackish Water Desalination Facilities* (Water Research Foundation, 2010).

TWDB staff prepared a white paper entitled *Cost of Water Desalination in Texas*. The paper documents the production cost of systems completed in the last five years (brackish groundwater desalination) or in the planning stage (seawater desalination) (Texas Water Development Board, 2010c).

III. Impediments to Implementation

In just one decade, 2000 to 2010, global seawater desalination by reverse-osmosis increased five-fold, from 681 to 3,615 million gallons per day of installed capacity (Global Water Intelligence, 2010). This staggering growth is a combined result of increased need for new water supplies, growing scarcity of freshwater sources, and the significant advances in membrane desalination technology that have resulted in lower costs to desalt water.

In spite of the many improvements and increased cost-competitiveness of reverse-osmosis desalination, creating a new water supply from seawater is comparatively more expensive than developing supplies from existing fresh sources, if available.

The relative high cost of desalination, which has been described as the Achilles' heel of seawater desalination (U.S. Bureau of Reclamation and Sandia National Laboratories, 2003), is the greatest challenge to implementing a large-scale demonstration seawater desalination facility in Texas.

The current proposal by the Brownsville Public Utilities Board to limit the initial phase of the demonstration project to a 2.5 million-gallon-per-day facility lessens the financial demands of the project while allowing the state to support the Seawater Desalination Initiative. The Brownsville Public Utilities Board has indicated that without grants it will not be able to execute the project.

Regarding research gaps and regulatory issues, the Brownsville Public Utilities Board's environmental scoping study has identified project-specific studies related to project permitting and design. Some of these studies will have wider implications toward developing seawater desalination in the Texas Gulf Coast.

> *"In the second half of the 1990s, the typical 8-inch SWRO [seawater reverse-osmosis] membrane element had a standard productivity of 5,000 to 6,000 gallons per day (gpd) at salt rejection of 99.6%. In 2003, several membrane manufacturers introduced high-productivity seawater membrane elements that are capable of producing 7,500 gpd at salt rejection of 99.75%. Just one year later, even higher productivity (9,000 gpd at 99.7% rejection) seawater membrane elements were released on the market. Over the past three years SWRO membrane elements combining productivity of 10,000 to 12,000 gpd and high-salinity rejection have become commercially available and are now gaining wider project implementation."*
>
> Nikolay Voutchkov
> *Seawater Desalination:*
> *Current Status and Challenges*
>
> (Voutchkov, 2010)

A. Research

Seawater desalination projects are notably driven by site-specific conditions. In regions where there is a lack of experience or precedent, such as the case in the Texas Gulf Coast, there is a need for studies to fill in knowledge gaps regarding potential environmental effects and projected performance of desalination facilities.

As part of the Brownsville Public Utilities Board's environmental scoping study, representatives of regulatory agencies and other stakeholders participated in a workshop to consider currently proposed seawater desalination facilities and discuss potential impacts to natural resources. This group identified a list of research needs that will need to be addressed (page 7).

Stakeholders also discussed more general desalination research needs, such as

- using alternative energy sources;
- funding mechanisms for large-scale desalination projects;
- reducing energy requirements of desalination;
- improving membranes to reduce fouling;
- understanding, testing, and demonstrating new technologies; and
- assessing and recommending pilot plant regulatory guidance.

B. Regulatory

The draft report of the environmental scoping study by the Brownsville Public Utilities Board identified 26 potential permits that would apply to the demonstration facility proposed at the Brownsville ship channel location. Although the report lists these permits, the actual need and length of some of these permitting processes will not be known until one or two permitting cycles are completed. As reported in 2008, a practical goal of the Seawater Desalination Initiative is to produce a complete and fully operational seawater desalination project to serve as a reference in the permitting processes. A large-scale project that completes the full project development cycle from the idea phase through the operational phase would set an example and provide guidance on key regulatory issues.

C. Technical

In August 2008, the Brownsville Public Utilities Board completed a comprehensive 18-month seawater desalination pilot plant study on the banks of the Brownsville ship channel. The study documented relatively high levels of organic contaminants that generate biological fouling of reverse-osmosis membranes. This is not an uncommon challenge in reverse-osmosis desalination and the focus of many research studies. Some of the more promising solutions include the use of more robust pre-treatment membrane systems and/or use of chlorine-resistant membranes.

As new technological advances come on line, the results of the 2008 pilot plant study will become dated and may necessitate additional piloting to ensure that the most cost-effective technology will be used. Although additional piloting costs might be borne by the technology manufacturer, it would certainly add more time to the process of getting a production facility in the ground.

D. Financial

The feasibility and pilot plant studies conducted by the Brownsville Public Utilities Board in 2004 and 2008, respectively, provided sufficient data to prepare a preliminary design for a 25-million-gallon-per-day plant to be installed at the Brownsville ship channel. The estimated cost for that project was $182.4 million.

In 2008, having completed a pilot plant study to better determine the treatment needs and related costs to install a desalination plant, the Brownsville Public Utilities Board proposed to install an initial phase of a 2.5-million-gallon-per-day plant with some of the facilities sized for the project's ultimate capacity. This option was estimated to cost $67.5 million with $31.1 million of that cost corresponding to future capacity**.** TWDB requested an appropriation of $28.2 million from the 81st Texas Legislature to assist with implementing this initial phase; that request was unsuccessful.

The current proposal by the Brownsville Public Utilities Board consists of a less expensive option that would allow for the continued advancement of the Seawater Desalination Initiative. The proposal is to implement a 2.5-million-gallon-per-day production plant at the Brownsville ship channel without provisions for future expansion. The estimated cost for this plant is $22.5 million (Table 3). Implementing this first phase would facilitate testing seawater desalination in a production setting while providing a uniquely advantageous site for researching desalination technology and conducting studies to determine sound environmental approaches to implement large-scale seawater desalination projects.

Additionally, the Brownsville Public Utilities Board, in its role as an electric power utility, is considering a $6 million investment in renewable energy to be developed in conjunction with the seawater desalination project. If implemented, this potential project could leverage the overall value of the project and open other potential sources of funding, such as the U.S. Department of Energy.

Table 3 - Projected cost of the proposed 2.5-million-gallon-per-day seawater desalination demonstration project

Item	Estimated Cost
Design Determination Studies	$990,000
Environmental Review and Permitting	$360,000
Final Design and Specifications	$1,970,000
Construction Support Services	$900,000
Startup Support Services	$360,000
Construction	$17,920,000
Total	$22,500,000.00

As noted previously in this report, Brownsville Public Utilities Board is in discussions with the U.S. Bureau of Reclamation to map a process to secure federal funding for a demonstration plan.

The Brownsville Public Utilities Board is particularly encouraged by the TWDB Legislative Appropriations Request for seawater desalination.

On October 13, 2010, the Brownsville Public Utilities Board convened a meeting with representatives from the U.S. Bureau of Reclamation and TWDB to discuss possible funding options for the proposed seawater desalination demonstration project coupled with a renewable energy component. U.S. Bureau of Reclamation staff reacted positively to the concept and discussed different funding options that could provide between 25 to 50 percent of the cost of a demonstration project. U.S. Bureau of Reclamation staff also noted that as a matter of policy the Bureau, if asked, would testify that the project is not currently included in the President's request. Although, federal appropriations may and have been awarded outside of the President's request, a more robust request would include a federal appropriation that gets added to the current budgetary request (Irlbeck, 2010).

IV. The Role of the State

The state's leadership and support is needed to install a demonstration desalination facility and to identify and develop regional approaches to developing seawater desalination supplies in Texas.

A. Installing a demonstration seawater desalination facility in Brownsville

The current proposal from the Brownsville Public Utilities Board is the best practical option to install a demonstration seawater desalination facility in Texas. By implementing that proposal, the state would gain a full test of the permitting of seawater desalination facilities in a setting that has great relevancy to the rest of the Texas Gulf Coast; also, the demonstration facility will provide researchers with access to a site for testing new technologies.

The state's role is to continue supporting the development of the Brownsville Seawater Desalination Project, as it will serve as a prototype to guide the development of other large-scale seawater desalination projects along the Texas Gulf Coast. With the support of the state, the Brownsville Public Utilities Board may begin design and permitting of the facility immediately after funding is secured.

TWDB should continue the educational approach to the Seawater Desalination Initiative to maximize the benefit to the state by closely monitoring and assisting in the implementation of the Brownsville Demonstration Project.

B. Monitoring progress of the South Padre Island Project

The Laguna Madre Water District plans to install a 1-million-gallon-per-day facility on South Padre Island, which could potentially provide Texas its very first seawater desalination production facility. Even though the proposed project lacks the research and development aspects of the Brownsville project and it is a simpler concept with a different source (open ocean seawater), it provides a valuable reference point for the permitting and eventual operation of a seawater desalination facility in Texas. In coordination with the Laguna Madre Water District, TWDB should monitor progress of the project, collect and analyze project implementation data, and report the data to the public as part of its educational and outreach efforts.

C. Regional partnering opportunities

Assessing the economic benefits of regional-scale seawater desalination supplies and developing—or clarifying—financial mechanisms to pay for excess capacity are activities that need to be implemented under the state's leadership. Similarly, the current study of variable salinity processes by the U.S. Bureau of Reclamation, in partnership with the Brownsville Public Utilities Board, TWDB, San Patricio Municipal Water District, and the Singapore Public Utilities Board, is an opportunity to engage a broader base of regional stakeholders, such as the San Antonio Water System and river authorities, with interest in seawater desalination. Spearheading those efforts to maximize the benefits of the variable salinity study is an appropriate role for the state.

V. Appropriations

The TWDB Legislative Appropriations Request for Fiscal Years 2012–2013 includes an exceptional item request for $9.5 million for seawater desalination. This request will enable the state through TWDB to continue the state's Seawater Desalination Initiative by funding research studies and assisting the Brownsville Public Utilities Board with the installation of a proposed $22.5 million, 2.5-million-gallon-per-day demonstration production facility at the Brownsville ship channel (Texas Water Development Board, 2010d).

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