Research Report

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Hold The Salt

The Promise Of Desalination For Texas

By
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ABOUT THE TEXAS PUBLIC POLICY FOUNDATION

The Texas Public Policy Foundation is a 501(c)3 non-profit, non-partisan research institute guided by the core principles of limited government, free enterprise, private property rights and individual responsibility.

The Foundation's mission is to improve Texas government by generating academically sound research and data on state issues, and by recommending the findings to opinion leaders, policy makers, the media and general public. The work of the Foundation is conducted by academics across Texas and the nation, and is funded by hundreds of individuals, corporations and charitable institutions.

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In 1989, a small group of civic-minded Texans created the Texas Public Policy Foundation to bring independent, market-based thinking to tackle problems facing state government. Through the years, the Foundation has championed solutions to the day's pressing issues, and won support for market-based policies that have made Texas a better place to live and work.

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EXECUTIVE SUMMARY

Water issues have been a part of the Texas scene since before the state joined the Union. Water rights have been bartered, litigated, fought over, bought and sold and are as contentious today as they have ever been. Study after study has forecast dire circumstances for Texas water futures.

One option to mitigate the water problems of the future that deserves consideration is desalination – producing drinking water from seawater or brackish groundwater. Desalination technologies have advanced rapidly in the last decades, bringing down costs and mitigating environmental consequences. Membrane technologies have evolved to make electrodialysis and reverse osmosis both promising desalination options for the future. The last decade has seen a doubling of the world's desalination plant capacity.

For many years public owners have designed, built and operated water supply facilities. Traditional project delivery systems have been used with much of the risk of a successful project being borne by the public owner. However, this traditional delivery system is not without problems, and the Texas legislature has begun to enable alternative project delivery systems where more of the responsibility and risk for public projects is being transferred to the private sector. Public private partnerships have evolved as a means to harvest the creativity and entrepreneurship of the private sector in partnership with public owners to integrate finance, planning, design, construction, operations and maintenance, and ownership in the delivery of complex projects.

Texas is embarked on a program of desalination demonstration projects at three locations – Corpus Christi, Freeport and Brownsville. The Texas Water Development Board has selected these three projects from 13 different proposals and intends to conduct further studies on each proposal. It is interesting to note that each of the proposals selected was some form of a public private partnership with substantial risk proposed to be handled by the private sector.

This paper makes two important points:

- Desalination clearly has a place as part of the solution to Texas' water dilemma. Desalination is a reliable water supply source and it is rapidly becoming cost competitive.
- The option to create public private partnerships to provide desalination facilities and operations is an option that should be made available to, and considered by public owners. Public owners should consider creative partnering arrangements that may include an enhanced role for the private sector in the design, construction, operations and maintenance, and financing of desalination facilities.

ABOUT THE AUTHOR

Dr. James C. Smith is a Professor in the Department of Construction Science at Texas A&M University.

He graduated from The Johns Hopkins University with a degree in Civil Engineering in 1961. In March 1962, he entered active duty with the U. S Army Corps of Engineers, serving as an officer until December 1974; his duty tours included two years in Vietnam and a tour in Japan.

In January 1975, he joined the professional staff of the U.S. Senate Committee on Armed Services where he was responsible for legislation involving military construction, intelligence, nuclear weapons programs, and procurement. He moved to the private sector in 1985, joining CRSS, one of the largest design and construction firms in the U.S., as President of the Commercial Group. In 1990, he moved to Brown and Root, a major construction firm, where he was Vice President of Business Development for the Civil Group.

In 1996, Dr. Smith was selected to be the Head of the Construction Science Department at Texas A&M University, and served in that capacity for eight years.

He has a Masters in Civil Engineering and a Doctorate in Construction Management from Texas A&M University. Dr Smith teaches undergraduate and graduate courses with emphasis on project delivery systems and business development. He is involved with many national organizations to include the Design-Build Institute of America and the National Council on Public Private Partnerships, where he serves as an Academic Advisor.

DESALINATION, THE STATE OF THE ART

INTRODUCTION. Many people are surprised to learn of the long history of desalination and the extent to which many nations depend on seawater for their water supply needs. According to Tom Pankratz, who serves on the Board of Directors of the International Desalination Association:

> "Technological advancements in the past ten years have led to a dramatic increase in the installed desalination capacity. Seawater desalination facilities are now being proposed or constructed in places where they were never before economically feasible."

This section is an abbreviated summary of the state of the art with respect to desalination; readers are invited to read Mr. Pankratz' book, "desalination.com", or "The ABCs of Desalting" by Mr. O.K. Buros, for a more comprehensive treatment of the subject.

TECHNOLOGY. There are two fundamental processes for desalination – thermal and membrane.

- **Thermal** processes are more than 50 years old and produce half the world's desalted water. These processes involve heating the salty water, producing water vapor that can be distilled to produce fresh water, leaving a brine residue to be disposed of.
- **Membrane** technologies, as the name suggests, use membranes to separate the salts from fresh water. There are two membrane technologies. *Electrodialysis* uses an electrical potential to move salts through a membrane, leaving behind the fresh water. *Reverse osmosis* uses pressure to drive fresh water through a membrane leaving the salts behind for disposal.

There are a number of other desalination processes, but they are rarely used except in special circumstances.

CAPACITY. The capacity of desalination facilities is typically given in millions of cubic meters per day or in millions of US gallons per day (mgd). In 1993 global capacity from all desalination facilities was about 3800 mgd with more than 2000 mgd coming from Middle East plants. In 2003, just ten years later, global capacity had more than doubled to nearly 8000 mgd with slightly less than 4000 mgd from Middle East plants. Individual plant sizes vary greatly, but new technology suggests plant capacities in excess of 20 mgd are necessary to achieve cost effectiveness.

COST. Discussion of the cost of a desalination facility typically focuses on the cost of fresh water produced by the facility, as compared to the prevailing cost of water from conventional sources. The usual measure is in dollars per thousand gallons [$/1000 gal]. As might be imagined there are wide ranges in costs, depending not only on the costs of desalination facilities, but on the cost of conveyance facilities and environmental mitigation. Cost data provided on desalination plants, recently completed or in planning stages, show a cost range of $1.89-$2.76 per 1000 gallons [Pankratz, 2004]. For seawater, reverse osmosis plants, costs have fallen from almost $6.00 per 1000 gallons in a Santa

Barbara facility built in 1991 to less than $2.00 per 1000 gallons in a Singapore facility built in 2003 [Pankratz, 2004].

LOCATIONS. A 1998 inventory of desalination plants [Wangnick] reported desalting equipment in over 100 countries with about half the total capacity in the Middle East and North Africa. Saudi Arabia has nearly a fourth of the world's capacity, using primarily thermal distraction plants. The United States ranks second in the world in desalting capacity; most of the U.S. capacity is in reverse osmosis plants to treat brackish groundwater.

ENVIRONMENTAL CONSIDERATIONS. In addition to the normal environmental concerns associated with any large water supply project, desalination facilities have issues of special environmental concern that require consideration and mitigation. Foremost among these issues is the disposal of the briny residue that results from the desalination process. In coastal areas where the source material is seawater, disposal is normally accomplished by returning the brine to the sea which is usually an acceptable disposal method. Inland facilities, however, may have to dispose of the brine in injection wells or provide transport to the nearest seawater site. Brine disposal issues often add substantial cost to desalination facilities and should be considered early in any feasibility study.

HARNESSING THE PRIVATE SECTOR

INTRODUCTION. Providing water, like providing power or waste collection and treatment, has traditionally been a predominantly public responsibility. Municipalities have felt an obligation to the public at large to provide these utilities via a government-conceived, government-executed plan, largely with government ownership and government operation, with cost reimbursement by a system of user fees which may or may not have been adequate to cover the capital and operating costs.

The private sector has played a traditional role in utility system designs with construction normally done by a private contractor who was low bidder.

DELIVERY OPTIONS. The private sector began to play a more involved project delivery role in the production of power in the 1980’s. The traditional design-bid-build delivery system began to give way to more integrated project delivery systems where the private electrical power industry began to have a more comprehensive role in project delivery. In the 1990’s the concepts of integrated project delivery strategies began to find its way into other utility systems as well as other public infrastructure like roads, airfields, and rail systems.

For discussion purposes it is useful to differentiate between several project delivery systems. However, it should be made clear that this differentiation is an artificial one, since the range of delivery systems for capital projects is essentially infinite and limited only by the imagination of the parties and the tolerance that each has for risk. In fact, it is the sharing of risk that most clearly defines the differences between project delivery systems.

<u>The Traditional Project Delivery System.</u> This is the standard or conventional delivery system that became the dominant delivery system early in the last century. In this system, sometimes called the design-bid-build system, under contract with the owner a designer produces a design which is in the form of plans and specifications suitable for a builder to analyze and cost. The builder, following specific instructions for bidders, submits his bid in competition with other builders. A selection is made, usually on the basis of the lowest responsible and responsive bid, and the builder proceeds to build the facility. The process is essentially linear, a step-by-step process that has dominated capital project acquisition for the last 50 years. Most projects today continue to be delivered via this process or some variation of this process, and in fact the Federal Procurement rules and regulations specified this traditional delivery process for most government facilities and most states followed suit.

For the most part, the owner takes a major share of the overall project risk. The designer takes risk for the design competence and protects himself with insurance in case of errors and/or omissions. The builder takes construction risk using a combination of warranties and insurance to mitigate the construction risk. The owner takes overall project risk, including the risk of design and construction in the overall completed facility.

Alternative Delivery Systems. In an attempt to further mitigate project risk and to reduce the rising tide of litigation, in the 1980's owners began to experiment with alternative project delivery systems. The Federal Government amended procurement rules to relax previous requirements for the traditional system and many states began to enact similar legislation to permit "Alternative Delivery Systems" (ADS). In Texas, Senate Bill 1 in 1995 opened up procurement options to a menu of delivery procedures for school districts and universities. Subsequently the 75th Legislature enacted Senate Bill 583, broadening the application to other public owners, including cities and counties, general services, and Port authorities. This menu of delivery systems included:

- **The Traditional System** is described above.
- **Competitive Sealed Proposals.** In this process the owner solicits sealed proposals after design is complete and the contractor selection is made based, not only on price, but also on other factors (e.g., past experience, proposed management team, schedule, etc.) in a "best value" selection process. Unlike the traditional system, the owner may negotiate with proposers in deciding which offer provides "best value".
- **Design-Build.** In this delivery process, the owner enters into a single contract to provide both design and construction services. This process requires the owner to have a high quality statement of work required and a comprehensive set of project performance specifications. The contractor takes both design and construction risk, eliminating the necessity for the owner to manage the interface between the parties. The design-build delivery process is used when the project has a tight time horizon and when the owner has qualified in-house professionals to manage the fast-paced delivery process.
- **Construction Manager at Risk.** Involving the constructor earlier in the design process is achieved with this delivery strategy. The construction manager is usually selected based on credentials early in the process and is available to the owner to assist with materials and methods selection during the design process. Once the design is sufficiently complete, the constructor agrees to take the construction risk, usually negotiating a guaranteed maximum price (GMP), and delivers the project via competitively selected subcontractors. The owner typically has access to the constructor's books in this delivery method.
- **Construction Manager-Agency.** Many times the owner needs to have construction "experts" assist in the delivery of a project. Under the construction manager-agency process, the owner employs construction professionals to act as the "eyes and ears" of the owner, delegating authority to the construction manager for construction administration on behalf of the owner. In this role the construction manager does not take construction risk.
- **Job Order Contracting.** Job order contracting, sometimes called the indefinite quantity delivery method, grew out of military processes to provide repair and maintenance projects at military bases. This process facilitates the delivery of many small projects, using pre-approved material and labor prices, by a single contractor. This method is

especially useful for large facilities – a university campus – or an owner with multiple sites – a school district.

Public-Private Partnerships. Public-Private Partnerships (PPP) are complex agreements to deliver capital projects, and/or the products and services that flow from capital projects, in a unique manner with a non-traditional sharing of risk between the parties. The Partnerships generally involve multi-year commitments by both parties and usually go well beyond the design and build activities of traditional as well as alternative project delivery systems. There is often a commitment by the parties with regard to project financing and post-construction operations and maintenance.

- **The Public Partner.** In a PPP, the public partner may take many forms. It may be an existing public entity – a city, a state, an agency of the government. The public partner may be an entity created solely for the purpose of the PPP; a toll road authority, a municipal utility district, etc. The public entity has a need for a product or service provided by the private partner and is willing to enter into a partnership agreement to provide that need.
- **The Private Partner.** The private partner in a PPP may be an existing company, a conglomeration of companies, or a special private entity created solely for the purpose of providing the need of the public partner. Usually the private partner will create itself to be able to best respond to the public need, pulling together the resources of several private companies and forming a unique private entity.
- **The Partnership.** Many people expect to find a document that sets forth the PPP terms and conditions – a traditional "contract". However, most PPP's are the product of many documents and agreements, which may number in the tens or even the hundreds, of different understandings and agreements between the parties. This is especially true when there is a financing dimension involved in the PPP. Given the complexity of a PPP, it is important that the Partners involve subject matter "experts" to assist in the creation of the PPP concepts and subsequent documentation.

The Partnership typically flows from the product or service produced by a capital project. If the project product or service has a value, then a revenue stream can be forecast and this revenue stream becomes the basis for financing the project. For example, a power plant produces a quantity of electrical power which has a dollar value when it is provided to the distribution system; a highway project will handle traffic which can be tolled to produce a revenue stream; a water treatment plant produces potable water which has a market value. If the product can be quantified and/or forecast with sufficient certainty and a value in the market place can be computed to enable a reasonably accurate revenue projection, then a PPP is possible.

PPP's are characterized by long term commitments by the Public Partner to assure the revenue stream for a significant time period, coupled with long term commitments by the Private Partner to "guarantee" the delivery of a product or service.

There are many excellent examples of PPPs in water supply. A contemporary example is the Northeast Water Treatment Plant in Houston, TX [Taylor, 2004]. In this project:

- The Public Partner is a local government corporation, the Houston Area Water Corporation (HAWC), created by the City of Houston to deliver the project using a Design-Build-Operate scenario and to facilitate bond financing.
- HAWC selected the Private Partner using a “best value” selection process which considered the credentials of the three proposers as well as the proposed cost of the water produced. Montgomery-Watson-Harza [MWH] was chosen as the Private Partner.
- MWH designed and built the 40 mgd water supply facility and will sell the water produced to HAWC at the negotiated rate.

THE FUTURE OF DESALINATION IN TEXAS

Many people are surprised to learn that Texas is already a major participant in desalination. The State has over 100 plants with an installed capacity of approximately 40 mgd. All of these plants treat brackish surface or groundwater; none use seawater [TWDB, Dec 2002].

The State of Texas is embarked on a path to make desalination a cornerstone of its water future. In April 2002, Governor Perry charged the Texas Water Development Board (TWDB) to develop a recommendation for a large-scale seawater desalination project. The TWBD broadcast a call for interest and considered 10 industry proposals together with three in-house proposals. After screening all proposals, the TWDB selected three for further consideration. The selected projects are in Freeport, Corpus Christi and Brownsville. A more detailed discussion of this process is found in the TWDB report to the Governor, dated December 2002 [TWDB, Dec 2002]. It is interesting to note that all three proposals selected for further consideration involved some form of public-private partnership.

Texas is not the only state looking seriously at desalination as a partial solution to its water problems. In Tampa, Florida, a 25 mgd plant is expected to go on line shortly [Schiller, August 2004]. The Florida owner, the Southwest Florida Water Management District, has used a public private partnership approach to delivery that has not been without some startup problems as reported by Engineering News Record [Wright, 2004]. In March 2004 the California Coastal Commission released a comprehensive report on desalination in California [California Coastal Commission, March 2004]; although the report "neither supports or opposes" desalination projects, it is a detailed review of the current desalination issues in California. The Metropolitan Water District of Southern California is considering five proposals for major desalination plants [MWDSC] and is offering a subsidy of $250 per acre-foot to enhance the financial viability of the proposals.

Declining water resources, coupled with inexorable population growth, demand that the State find alternative solutions for its future water supply needs. Desalination is an option with a long history around the world and it deserves a good look as an option for the future in Texas. However, desalination is not without its problems. Although costs have come down, there is still a premium to pay for desalination. Perhaps more challenging are the environmental issues, primarily those associated with the disposal of the briny by-product of the desalination process; this disposal must be handled prudently often resulting in costly infrastructure if disposed of properly to insure there is no resultant environmental damage.

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ADDITIONAL RESOURCES

1. For more on Public Private Partnerships, visit the web site of the National Council on Public Private Partnerships: http://ncppp.org/.
2. For more on alternative delivery systems, visit the web site of the Design Build Institute of America: http://dbia.org/**.**
3. For more on desalination, visit the web site of the International Desalination Association: http://www.idadesal.org/home.asp?Flash=ok.
4. For information from the Texas Water Development Board: http://www.twdb.state.tx.us/home/index.asp.

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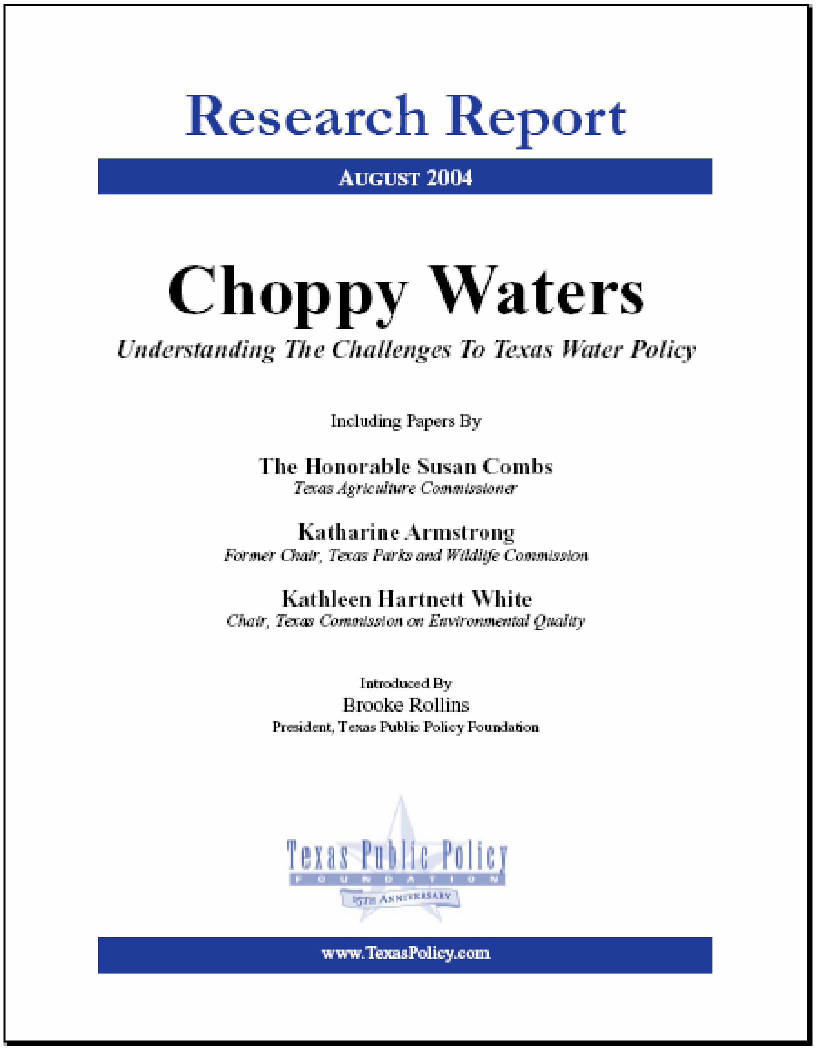

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August 2004

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This is collection of three original papers on state water policy by Agriculture Commissioner Susan Combs, Texas Commission on Environmental Quality Chairman Kathleen Hartnett White, and Katharine Armstrong, former Chairman of the Texas Parks and Wildlife Commission. The papers explore the history of the state's water policy while examining how the market can better meet the ever increasing – and contentious – demands for water.

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