LEARNING FROM DROUGHT

NEXT GENERATION WATER PLANNING FOR TEXAS

TCPS
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FOR POLICY STUDIES

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EXECUTIVE SUMMARY

Texas has been engaged in planning for future water needs for over 50 years. Beginning in 1961, the plans were developed at the state level, through various predecessor agencies to the Texas Water Development Board (TWDB) and the TWDB itself.

In 1997, the year of the last state-developed plan, the Texas legislature set up a new process, centered on "bottom-up" development of water plans across 16 regions of the state. The TWDB was tasked with managing, funding and providing rules for the new process, along with developing a state plan based on the regional plans. The process, repeated every five years, has produced three plans: 2002, 2007 and 2012. Another round is currently underway, scheduled for completion in 2017.

As the drought in Texas has intensified over the last several years, the water plan has taken on new prominence. In advance of the 2013 session of the Texas legislature, TWDB, advocates of new state funding for water projects, policy-makers and the press focused heavily on the two conclusions of the 2012 State Water Plan:

- Texas would face a demand/supply gap of 8.3 million acre-feet in 2060 and
- The price tag of meeting increased demand would be $ 53 billion.

With 15 years of regional water planning experience, a new emphasis on spending state and local funds to implement the plan, and the lessons that have been learned as Texas has managed its way through the current deep and persistent drought it is an appropriate time to examine whether Texas is really engaged in state-of-the-art water planning.

The goal of this report is to explore whether the planning process, as it has developed over the last 15 years, is producing a road map for a realistic and sustainable water future for Texas. If it is not, what changes might be needed to produce a plan that is cost-effective and prudently meets water needs for cities, industries and agriculture, while protecting our state's irreplaceable natural and cultural heritage?

HIGHLIGHTS OF FINDINGS AND RECOMMENDATIONS

Our analysis shows that the 2060 demand/supply gap of 8.3 million acre-feet/year projected by the 2012 State Water Plan is greatly over-stated.

On the demand side, Chapter 2 provides several examples of how the plan overstates how much water Texas will need. It shows that the projected 2060 demand could be reduced by 3.5 million acre-feet per year using reasonable municipal demand and conservation projections in Region C; appropriate irrigation demand projections in Region O; and the demand projections for steam electric generation statewide that the Bureau of Economic Geology has developed.

On the supply side, Chapter 4 has examples of how available supplies could be greatly extended or increased by: (1) reasonable drought contingency plan implementation (providing an estimated 1.5 million acre-feet/year); and (2) increased use of brackish water.

TABLE ES-1 summarizes the demand/supply findings of Chapters 2 and 4.

TABLE ES-1: Demand/Supply Findings Summary

AREA OF ANALYSIS	FINDING	COMMENT
Reduction in Region C municipal demand/supply gap.	Over 1 million acre-feet/yr of the projected demand/supply gap could be reduced with new projections and a 140 GPCD 2060 target for all municipal user groups.	Would eliminate the need for Marvin Nichols (at least). Marvin Nichols alone would cost at least $3.3 billion.
Eliminate over-inflation of Region O irrigation demand.	Eliminates 2.146 million acre-feet/yr of over-projected demand.	Demands in Region O should reflect reality of limitations on use of the Ogallala Aquifer.
More reasonable steam electric power generation demand projections.	Reduce SEPG demand projuction by at least 500,000 acre-feet/yr by 2060	Planning should be based on reasonable need for new electric generation, as scoped by the Bureau of Economic Geology, not on regional desires for attracting new coal-fired power plants.
Implement effective drought management plans for all major Texas reservoirs.	Extend existing supply by an estimated 1.5 million acre-feet/yr.	Estimated using reasonable drought triggers applied to all of Texas' major supply reservoirs.

Taken together, these four items would reduce the projected 2060 demand/supply gap from 8.3 million acre-feet per year (as projected in the 2012 State Water Plan) to about 3.3 million acre-feet per year.

The resulting reductions in demand-supply gap could significantly reduce the price tag for the state water plan.

In addition, making greater use of brackish groundwater desalination, better use of the existing supply for steam electric power generation and broader implementation of land stewardship to benefit streams and aquifers should lead to a more sustainable and affordable water plan for Texas.

A sustainable water plan for Texas should be based on demand scenarios that consider a range of possible futures, including a future in which conservation plays the significant role during drought that we now know it can, avoiding development of costly, and potentially environmentally damaging new water projects. Some local water suppliers already pay for existing infrastructure that was developed based on demand projections that have yet to materialize. This report does not seek to document the costs associated with these past mistakes. However, it does recommend that the planning process prioritize and advance the most cost efficient and environmentally reasonable options available.

Our recommendations for the planning process, detailed in Chapter 5, fall into six categories:

- Developing more realistic demand projections;
- Ensuring more effective use of existing supplies;
- Making healthy rivers and bays and vibrant economies co-equal goals to the other goals of the planning process;
- Moving away from the 50-year, single-scenario planning approach to examining a wide range of both demand and supply scenarios;
- Improving baseline data and modeling for all aspects of planning; and
- Making broader policy improvements in Texas water management that will benefit development of a sustainable water plan.

Planning a state's water future is a difficult and complex task, especially in a place as large and diverse as Texas. The current planning process reflects many years of extensive good-faith efforts from a wide range of policymakers and stakeholders. Nevertheless, the drought has provided new insights into both the vulnerability of communities whose short-term water needs have been ignored and into the willingness of Texans to adopt innovative and far-reaching water conservation practices, especially for the peak use periods during drought conditions. Combined with the developments in state water financing, a more active and prominent role for the Texas Water Development Board and heightened public interest in water, now is the time to examine whether we have a planning process that is up to the task.

INTRODUCTION

Texas has been engaged in planning for future water needs for over 50 years. Beginning in 1961, the plans were developed at the state level, through various predecessor agencies to the Texas Water Development Board (TWDB) and the TWDB itself.

In 1997, the year of the last state-developed plan, the Texas legislature set up a new process, centered on "bottom-up" development of water plans across 16 regions of the state. The TWDB was tasked with providing rules and guidance for the new process, along with developing a state plan based on the regional plans. The process, repeated every five years, has produced three plans: 2002, 2007 and 2012. Another round is currently underway, scheduled for completion in 2017.[1]

As the drought in Texas has intensified over the last several years, the water plan has taken on new prominence. In advance of the 2013 session of the Texas legislature, TWDB, advocates of new state funding for water projects, policy-makers and the press focused heavily on the two conclusions of the 2012 State Water Plan:

- Texas would face a demand/supply gap of 8.3 million acre-feet in 2060 and
- The price tag of meeting increased demand would be $53 billion.

This intensified focus led to the passage of House Bill 4 and the voters' November 2013 approval of Proposition 6, authorizing $2 billion for a new revolving loan fund to finance water projects.

Both House Bill 4 and Proposition 6 are closely tied to the 2012 State Water Plan. House Bill 4 requires regions and a re-organized Texas Water Development Board[2] to "prioritize" projects in that Plan, according to a complex set of criteria.[3] Only projects included in the State Water Plan will be eligible for state financing through Proposition 6.

With 15 years of regional water planning experience, a new emphasis on spending state and local funds to implement the Plan, and a deep and persistent drought that may represent a "new normal," it is an appropriate time to examine whether Texas is really engaged in state-of-the-art water planning. At this juncture, the critical questions this report addresses include:

- Do the water demand projections in the Plan represent a perspective informed by how Texans have actually been and will be using water (and conserving)?
- Do the projections of existing supply make the best use of flexible new water management alternatives and drought contingency planning?
- Does the planning process reflect, if not encourage, new technologies for alternatives sources, such as increased use of brackish groundwater?
- Do planners have the accurate information they need on actual uses and current supplies to project reasonable demand/supply gaps over the planning period?
- Is the planning process addressing the needs for water for healthy rivers and bays, rural agricultural economies, and Texas cultural values?
- Do the rules and guidance for the planning process ensure a state-of-the-art plan and a transparent process?
- Is the current planning process designed to highlight our choices about the future of water use in Texas in the short and long-term?
- Does the current process reflect an appropriate balance between "bottom-up" regional planning and over-arching state water policy interests?

This report examines these and related questions.

The goal of this report is to explore whether the planning process, as it has developed over the last 15 years, is producing a road map for a realistic and sustainable water future for Texas. If it is not, what changes might be needed to produce a plan that is cost-effective to implement, meets reasonable water needs for cities, industries and agriculture, and protects our state's irreplaceable natural heritage?

Chapter 2 of the report examines demand projections. Incorporating the water needs for healthy rivers and bays is discussed in Chapter 3. Water supply projection is the central topic of Chapter 4. Chapter 5 presents a summary of findings and policy recommendations.

Planning a state's water future is a difficult and complex task, especially in a place as large and diverse as Texas. The current planning process reflects many years of extensive good-faith efforts from a wide range of policy-makers and stakeholders. Nevertheless, the drought has provided new insights into both the vulnerability of communities whose short-term water needs have been ignored and into the willingness of Texans to adopt innovative and far-reaching water conservation practices, especially for the peak use periods during drought conditions. Combined with the developments in state water financing, a more active and prominent role for the Texas Water Development Board, and heightened public interest in water, now is the time to examine whether we have a planning process that is up to the task.

[1] See **www.twdb.state.tx.us/waterplanning/index.asp** for more details about the Texas water planning process.

[2] House Bill 4 replaced the six-member part-time board with three full-time members. The new board has significantly re-organized the agency.

[3] See Appendix A to this report for more detailed discussion of the HB 4 prioritization and implementation process. See also **www.twdb.state.tx.us/swift/index.asp**.

DEMAND FORECASTING

This chapter examines how the 2012 State Water Plan forecasts demand for municipal use, irrigation, steam electric power, and mining. It also discusses how demand might be more reasonably forecast and how that, in turn, would affect the 50-year projected demand/supply gap and the projected need for expensive water supply projects.

In the case of municipal demand, this analysis includes the use of conservation (increased water use efficiency) and drought management in the discussion of demand forecasting. While conservation and drought management are treated as "supply" strategies in the Texas water planning process, they are also integral to assessing future municipal demand which is highly dependent on and measured by individual behavior (i.e. gallons per capita per day, GPCD).

A. MUNICIPAL DEMAND, CONSERVATION AND DROUGHT MANAGEMENT

The 2012 Texas Water Plan projects that municipal demand will increase from about[1] 4.8 million acre-feet/year in 2010 to about 8.4 million acre-feet/year in 2060 **FIGURE 2.1**.[2] The projected increase is almost directly proportional to the increase in population, which was projected to grow from approximately 25.3 million people in 2010 to about 46.3 million people in 2060. Population was projected to increase by 80% by 2060, while municipal water demands were projected to increase by about 60%.

Projections for municipal water demands grow more slowly than the projections for population because individual, or per capita, use is assumed to decrease somewhat over time. Within the state water planning process this decrease in demand is the result of implementation of federally mandated water efficiency requirements for appliances. However, per capita water has declined and will decline more in response to other factors, including changing attitudes about water use, consumer responses to price, and other aggressive local initiatives to conserve water.

The state water planning process does not account for these decreasing trends in per capita water use as part of the demand projections. As demonstrated below, aggressive conservation strategies to reduce demands would substantially lower demands and eliminate or delay the need for costly and environmentally detrimental new water supply projects.

DALLAS SKYLINE AND SUBURBS PHOTO BY ANDREAS PRAEFCKE

A NOTE ABOUT WATER DEMAND FORECASTING

Water suppliers and government agencies have a long history of trying to project future water demand, a notoriously difficult task. While demand projections for the next ten or even twenty years may be reasonably reliable (depending on the quality of the underlying data about existing uses and recent trends in water use patterns), long-term forecasting often produces unreliable estimates. Some water planning approaches deal with this uncertainty by examining a range of scenarios and probabilities. The 1997 State Water Plan presented high, recommended and low demand scenarios, though it only used the "recommended" scenario for further analysis. The current Texas process, however, is based on projecting a single scenario of essentially peak water use during very dry periods. This approach has the advantage of producing an easily understood estimate (e.g. water demand will increase from 18 million acre-feet in 2010 to 22 million acre-feet in 2060). However, once policy-makers, the media, and the public see that single number, it tends to be taken as gospel. The single number approach also implies that there are no opportunities to shape future water use patterns by making deliberate management choices. A scenario approach, by contrast, draws attention to different paths to a more sustainable, affordable water future. For more on alternative approaches to water demand forecasting, see e.g., Pacific Institute, Water Rates: Water Demand Forecasting (in partnership with Alliance for Water Efficiency, **www.pacinst.org**) and the U.S. Bureau of Reclamations' Colorado River Basin Study, **www.usbr.gov/lc/region/programs/crbstudy.html.**

[1] In this report, we generally round demand and supply projections to just a few significant digits (e.g. 4.8 million acre-feet vs. 4,851,201 acre-feet). Neither the estimates of current use nor those for projections can be accurate to any the degree suggested in the plans.

[2] Note that 2010 estimated municipal use, according to the Texas Water Development Board, was about 4.16 million acre-feet. In 2011, a drier year, annual municipal use was estimated at about 4.87 million acre-feet.

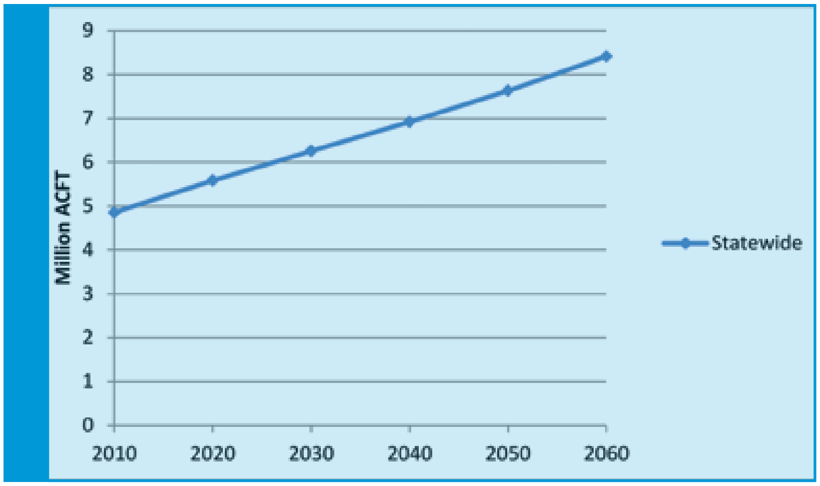

FIGURE 2.1 Municipal Demand Projections by Decade *2012 State Water Plan*

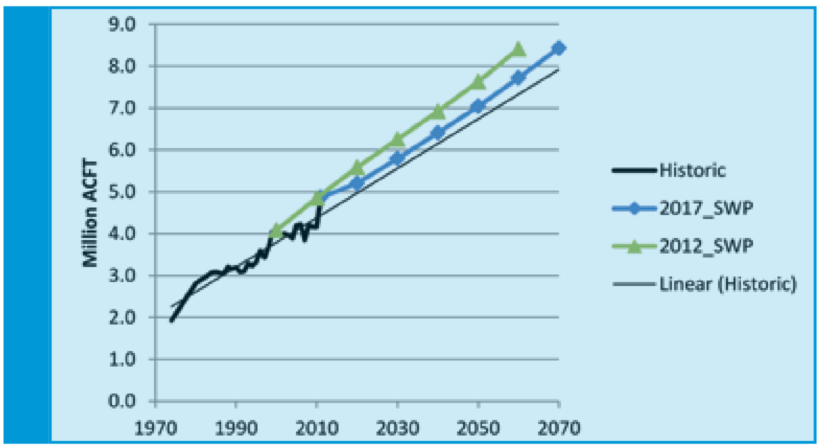

FIGURE 2.2 Municipal Demand Projections by Decade under the 2012 State Water Plan, current projections for the 2017 plan, and the trend in normal year demands

As shown in **FIGURE 2.2**, municipal demand estimates developed for use in the 2017 water planning process are lower than those used in the 2012 Plan. These lower demands will likely delay or eliminate the need for some new water development projects that are in the 2012 State Water Plan.

As also shown in **FIGURE 2.2**, the most recent demand projections are 200,000 to 500,000 acre-feet higher than the historic trends for municipal water use for normal years. Those higher projections result from the fact that demand forecasts are based on use during dry years. Municipal use goes up in dry years, to a large extent due to lawn watering. It is these peak uses during dry years that drive up the projections.

Municipal demands are calculated based on population forecasts supplied by the state demographer and on the gallons per capita per day (GPCD) water use estimates.[3]

The population forecast tends to become less accurate toward the end of the planning horizon, but a review of previous water plans indicates that population projections compare well with actual growth. For example, census results showed that the forecasts from 2006 overestimated 2010 population by only about 1 percent.

Developing accurate and agreed upon GPCD projections is substantially more complex and error-prone. The first complication is the data. Water use in much of Texas is self-reported by retail or wholesale water suppliers, and reports differ among different entities. The amount that users (buyers) report may not always match the amount that wholesalers (sellers) report. So, consultants who do much of the work of developing regional plans spend a good part of their effort trying to resolve these discrepancies.

[3] Texas Water Development Board, "Water Demand Projections," **www.twdb.state.tx.us/waterplanning/data/projections/2017/demandproj.asp**.

The more controversial issue, however, is setting the base year for the GPCD. The decision on which year to select for baseline GPCD is significant. The base year is important because, after making some adjustments for the build-out of more efficient plumbing fixtures, it defines GPCD for the demand projection over the 50-year water planning horizon.

Because water use varies significantly from year to year, selecting the appropriate base year is critical. In some cities, particularly where no drought management measures are applied, municipal use per capita may be much higher in dry years than in wet years, in large part because lawn watering accounts for a third or more of municipal water use. Drought management can significantly reduce municipal per capita use in dry years, even though it may still be somewhat higher than in normal years. Since the planning is based on providing water during these drought years, reduction in peaks during such times can be very important in reducing the demands and the projected need for new water supply projects. *See Sidebar on Drought Contingency Planning for further discussion.*

Water planners at the Texas Water Development Board selected a dry year to represent base year demands. For the 2012 plan, the base year was 2000. For the 2017 plan, the proposal for the base year is 2011, one of the worst drought years in decades.[4] Municipal use in 2011 was almost 4.9 million acre-feet, while in the ten years before 2011 municipal use was significantly lower, ranging between about 3.8 and 4.2 million acre-feet. Statewide, the 2011 municipal use was almost 15% greater than 2010.

DROUGHT CONTINGENCY PLANNING

One school of thought holds that drought contingency measures should be included in the water plan as "supply strategies" rather than being reflected in baseline demands. Proponents of this position argue that drought contingency plans will not be implemented unless they are budgeted and planned for, and thus they should be included as water supply strategies.

Some go even further, arguing that water savings from drought contingency plans should not be included at all. For example, according to the 2011 Region C Plan:

> Drought management and emergency response measures are important planning tools for all water suppliers. They provide protection in the event of water supply shortages, but they are not a reliable source of additional supplies to meet growing demands. They provide a backup plan in case a supplier experiences a drought worse than the drought of record or if a water management strategy is not fully implemented when it is needed. Therefore, drought management measures are not recommended as a water management strategy to provide additional supplies for Region C.

Yet, Texas Law does require public water supply systems to develop and implement drought contingency plans.[5] Thus, it can be argued that the reductions from mandatory drought contingency plans are similar to those that result from the mandatory plumbing code changes that are built into demand forecasts.

It is true that quantifying the reduced demand from implementation of drought contingency plans is not as easy as quantifying reduced demand from appliance efficiency standards. There are few standards for what is required for an adequate municipal drought contingency plan and there is little evidence of how they are actually being implemented across the state.

In this report, we primarily look at incorporating drought contingency measures into the water planning process as a supply strategy. *See Chapter 4.*

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[4] Cities and other suppliers of municipal water are allowed to show that they had higher uses in other years and develop their GPCD based on such higher use years.

[5] Texas Commission on Environmental Quality, "Drought Contingency Plans," **www.tceq.state.tx.us/permitting/water_rights/contingency.html**.

CASE STUDY: REGION C

Projects to supply future municipal demand across the state account for a significant portion of the estimated $53 billion cost of the 2012 State Water Plan. The majority of that price tag arises from projects that are said to be needed to supply growing municipal demand in the Dallas-Fort Worth metroplex area (Region C). In fact, the 2012 State Plan recommended a total of $21 billion in water supply projects for Region C (virtually all for municipal needs), or about 40% of the total projected $53 billion statewide plan cost. Many of these projects, especially the $3.3 billion proposed Marvin Nichols reservoir,[6] are not projected to be needed until near the end of the 50-year planning horizon and may not be needed well past that date, given the changes developing in the current planning cycle.

For the 2012 State Water Plan municipal demand projections, the GPCD for Region C[7] starts at 207 gallons for 2010 and declines to 198 GPCD in 2060. The decline is as a result of federally mandated plumbing fixture efficiencies. The Region C planning group also recommended basic and advanced water conservation strategies for individual water user groups. These strategies further reduced the projected per capita use to 201 GPCD in 2010 and to 178 GPCD in 2060. With a Region C population estimated at about 6.6 million people and growing to 13.0 million in 2060, this resulted in total municipal demands of approximately 1.5 million acre feet of water per year in 2010 growing to 2.9 million acre-feet per year in 2060.

As with previous regional water plans, 2017 municipal demand projections begin with estimates of base year GPCD for each water user group (WUG). The base year is intended to represent a current high use (dry year) amount of water. In most cases this high use year was 2011. Based on population projections and accounting for reductions in GPCD due to the implementation of federally mandated plumbing fixture efficiencies, forecasts are then developed for each decade from 2020 to 2070. TWDB first developed draft demand estimates and then the regions proposed refinements or corrections which were considered by the TWDB before approving the final projections. Significantly, the demand projections for the 2017 State Water Plan are substantially lower than those used for developing the 2012 State Water Plan. The base year GPCD for Region C of 186 GPCD is expected to be 176 GPCD in 2020 and will decline to 165 GPCD in 2060 due to plumbing code upgrades.

In addition to lower per capita use rates, population projections for the 2017 Region C Plan are about 3% lower at the beginning and end of the planning horizon (2020 and 2060) and about 6% lower in the middle decades as compared with the estimates developed in the last round of planning.

Although it is too soon in the planning process to know what Region C or other regions will do with respect to water conservation strategies, if we assume that Region C will propose a level of savings comparable to the savings it used to develop the 2012 plan, the GPCD used to calculate demand for the 2017 plan could be revised down to about 163 gallons in 2020 and 145 in 2060. Combined with the new population estimates, the 163/145 GPCD values would result in total municipal demands of approximately 2.3 million acre-feet of water per year in 2060. This is over 575,000 acre-feet less in 2060 than the 2012 plan, or about 100,000 acre-feet more than the firm annual yield of the proposed Marvin Nichols Reservoir (472,000 acre-feet per year).

Such a reduction in projected per capita water use in the 2017 process in Region C represents an important step in the right direction and should be applauded. It is consistent with the well-documented broader trends in decreased per capita water use across the country, suggesting that this type of decreasing per capita use trend should be incorporated in long term projections.[8]

That said, it is worth asking whether these lower per capita use rates reflect sufficiently ambitious goals for municipal water use in age of limited supply over the next 50 years.

The Texas Water Conservation Implementation Task Force (WCITF) recommended a goal of 140 GPCD for potable water supplied to municipal retail customers.[9] The discussion above suggests that Region C could be on course towards that goal. There are several nuances to the WCITF target that are worth considering, however. For example, it should be noted that the WCITF 140 GPCD goal explicitly includes credits for indirect reuse towards meeting the 140 GPCD goal. This means that before calculating the GPCD, demand should be reduced by the amount of supply that is projected to be met through indirect reuse of existing supply. There is a significant amount of existing and planned indirect reuse in Region C, and if it were used to reduce the demand figures, the projected GPCD for Region C would be even lower.

Moreover, the WCITF goal may not even be the target the regional and state plans should use. It was developed as a result of a long negotiation that reached a broad consensus among water suppliers, state agency representatives, and public and environmental advocacy groups. For some participants in that process it does not necessarily represent a particularly aggressive approach to conservation, nor is it reflective of the best we can do with technological innovation, funding, and education. According to the WCITF report, "A major study of the potential for urban water conservation in California released by the Pacific Institute for Studies in Development, Environment, and Security in late 2003 estimated that California's urban water use could

[6] The Marvin Nichols reservoir is used as the example here and elsewhere since it is the most expensive of the proposed strategies in the 2012 water plan.

[7] See 2011 Region C Water Plan, Vol. 1, Table 6.8, p. 6.38.

[8] Alliance for Water Efficiency, "Declining Water Sales and Utility Revenues: A Framework for Understanding and Adapting," **www.allianceforwaterefficiency.org/Declining-Sales-and-Revenues.aspx**.

[9] The Texas Water Conservation Implementation Task Force, Report to the 79th Legislature, November 2004, which can be found at **www.savetexaswater.org/.**

WHOLESALE WATER PROVIDER	WUG CUSTOMER	GPCD	POPULATION
Dallas City of	COPPELL	230	41,817
Dallas City of	DENTON COUNTY FWSD #1A	231	30,000
Dallas City of	FARMERS BRANCH	255	38,625
Dallas City of	FLOWER MOUND	220	92,730
Dallas City of	GRAPEVINE	307	60,000
North Texas MWD	FRISCO	214	168,000
North Texas MWD	PLANO	223	284,656
North Texas MWD	PROSPER	227	35,058
North Texas MWD	RICHARDSON	215	34,000
Tarrant Regional WD	GRAPVINE	307	60,000
Tarrant Regional WD	KELLER	224	51,310
Tarrant Regional WD	MANSFIELD	240	149,065
Tarrant Regional WD	MIDLOTHIAN	203	43,871
Tarrant Regional WD	SOUTHLAKE	364	45,000

TABLE 2.1 Large Water User Groups (Population > 30K) Supplied by Wholesalers Proposing Large Reservoir Projects With High GPCDs

	2020	2030	2040	2050	2060
2012 SWP	1,833,670	2,087,596	2,344,114	2,612,175	2,924,156
2017 SWP	1,478,145	1,671,728	1,890,949	2,116,039	2,349,043
Reduction in projections between 2012 and 2017 plans	355,525	415,868	453,165	496,136	575,113
2017 Alternative SWP assuming maximum 140 GPCD by WUG	1,134,126	1,301,388	1,485,271	1,677,334	1,880,486
Reduction projections in 2017 SWP due to 140 GCD cap	344,019	370,340	405,678	438,705	468,557
Total reduction from 2012 SWP to 2017 alternative SWP	699,544	786,208	858,843	934,841	1,043,670

TABLE 2.2 Potential Reductions in Demands from 2012 to 2017

be reduced from around 185 GPCD to 123 GPCD through the implementation of readily available technologies." The WCITF considered a recommendation for a 125 GPDC target, but a majority voted for the 140 GPCD.

Finally, even if the 140 GPCD estimate does represent a reasonable goal, it should be the target for all individual water user groups. As shown in **TABLE 2.1**, many of the Region C water user groups still project GPCDs well above 200 in 2060. The demands from some of those groups are used justify some of the expensive new projects in the Region C Plan, including large new reservoirs.

If these water user groups were able to get their individual use down to the 140 GPCD value in 2060, an ***additional*** reduction of 468,000 acre-feet/year could be made in the 2060 demand projection. It would lead to an overall GPCD for the region of about 130 gallons **TABLE 2.2**.

This 468,000 acre-foot reduction, when added to the 575,000 acre-feet reduction already included in the approved 2017 projections, means that municipal demand in 2060 could be over 1 million acre-feet less than they were projected to be when the 2012 State Water Plan was developed.

The controversial Marvin Nichols Reservoir is projected to provide up to 472,000 acre-feet of raw, untreated water at a capital cost (not including operations and maintenance, electricity, or debt service) of $3.4 billion dollars. Even the official projections for the 2017 Plan, which assume that many of the entities that would be using water from Marvin Nichols would still be using more than 200 GPCD in 2060, suggest that the supply provided by Marvin Nichols would not be needed. In fact much more than this could be saved by achieving the negotiated goals approved by the Texas WCITF, much less the 125 GPCD target supported by a large scale study and advocated in a WCITF minority report.

This kind of aggressive goal would make Region C a leader in the state (and possibly the nation). It would not only create great savings for Region C, but, if then used as the model for other regions, the overall demand projections in the State Water Plan could be further reduced. Other expensive and controversial strategies could then also be delayed if not abandoned.

B. AGRICULTURAL IRRIGATION DEMAND[10]

According to the 2012 Plan, irrigation of agricultural crops was projected to account for about 10 million acre-feet/year in 2010, or about 56% of total statewide water use.[11] Ground water supplied over 80% of irrigation water.

The 2012 Plan projects that irrigation demand will be 8.37 million acre-feet/year in 2060, or a 17% decrease.

About two-thirds of the state's total irrigation demand occurs in the Panhandle, Regions A and O, and the Rio Grande Valley, Region M, with Region O alone accounting for almost 40% of statewide irrigation demand. Region O includes the Southern High Plains over the Ogallala Aquifer **FIGURE 2.3**.

As with municipal demand, the regional plans (and, thus, the State Plan) make only a single-scenario projection for irrigation demand based on drought of record use. Clearly, basing future irrigation demand projections on drought years can have very significant effects. **FIGURE 2.4** shows estimated annual statewide historic use for irrigation from 1974 to 2011. The large spike in 2011 was due to both low rainfall and high temperatures. Regions A, M and O accounted for the vast majority of the increased use in 2011.

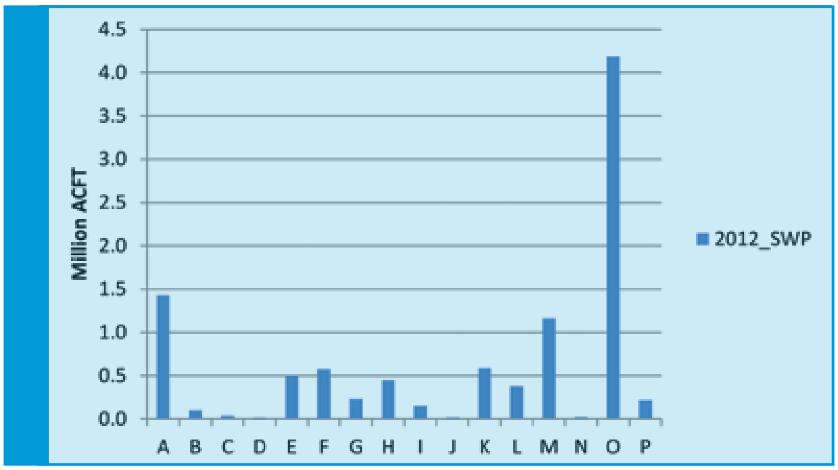


FIGURE 2.3 Irrigation Demand by Region from 2012 State Water Plan

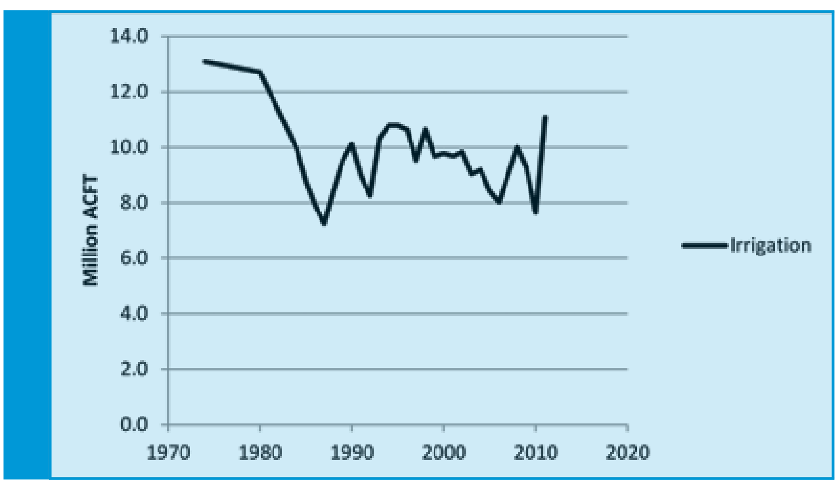


FIGURE 2.4 Estimated Statewide Irrigation Use: Historical Trends

[10] Adapted from TCPS blog post, which has several additional references via embedded links: **www.texascenterforpolicystudies.blogspot.com/2013/09/region-o-reverses-course-on-irrigation.html**.

[11] TWDB estimates actual irrigation use for 2010 at 7.8 million acre-feet, and 11.1 million acre-feet for 2011, a very dry year. The increase of 3.3 million acre feet was about 75% of the increase in total water use in 2011 over 2010. Most of the remaining increase was due to municipal use.

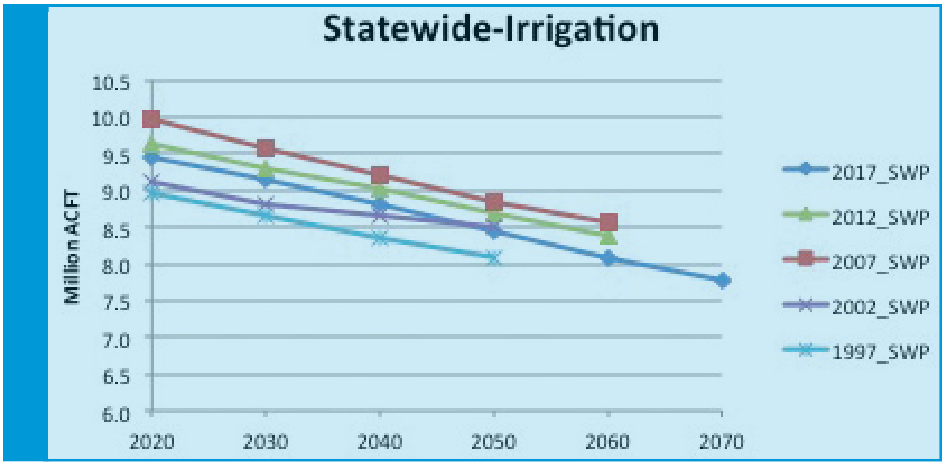


FIGURE 2.5 Irrigation Demand Projections from Various Water Plans

By contrast, previous years had shown a general decline in irrigation water use, due in part to extensive efficiency efforts by growers and irrigation districts.

In reviewing these trends, it is important to consider that reported irrigation use is only an estimate, not actual measured use data. Very few groundwater districts require metering of irrigation use, and most surface water use is based on self-reported data (some metered, some not). Instead, estimated water use for any year is derived from agricultural surveys on crop acreage, crop mix and evapotranspiration models. It does not appear to account for situations where the water needed to meet irrigation goals was not available or became too expensive to pump after planting because of fuel costs or limits imposed on pumping by a groundwater district.

Thus, there are substantial uncertainties in the base "dry year" estimate on which future demand projections are based. The TWDB indicates that estimates are reviewed by local and regional officials, and the TWDB itself bases the initial projected demands it supplies to regions on an average period, not a single year. But, the regions are free to use a different base year[12] (even a single dry year or peak use year) for developing their projections.

Other factors important in projecting future irrigation demand include changing crop mix and the amount of land in agricultural production. Crop land is generally declining across the state as suburbs expand into farmland. Crop mix is highly dependent on national and international commodity prices, federal farm bill subsidies and related programs, and other factors that do not stay consistent, particularly over the 50-year planning horizon.

FIGURE 2.5 shows irrigation demand projections for the various planning cycles (1997 being the last statewide plan), including regionally-adjusted projections for the current round of planning. While the various plans are consistent in projecting declining irrigation use, the rates of change vary significantly among the different planning cycles. Moreover, the absolute amount of water projected to be used for irrigation varies greatly among the different plans. Because irrigation accounts for such a large share of statewide water demand (and thus affects the perceived demand/supply gap), it is worth looking at these projections in more detail. We focus on Region O, which has by far the largest irrigation use in the state.

CASE STUDY: REGION O

The State Water Plan projects a total statewide demand/supply gap ("needs") of 8.325 million acre-feet/year by 2060. That number is often presented as the reason the state needs to fund implementation of the State Water Plan.

But, a breakdown of that number shows three regions together accounting for two-thirds of the demand-supply gap:

- Region C (Dallas/Fort Worth area) with 1.588 million acre-feet/year;
- Region H (Houston area) with 1.236 million acre-feet/year; and
- Region O (Llano Estacado) with 2.366 million acre-feet/year.[13]

The over-inflated Region C demand projections are discussed above. This case study takes a closer look at the 2.366 million acre-feet annual gap projected for Region O, which is over 28% of the total projected statewide gap for 2060.[14] Not surprisingly, it's all about the sustainability of irrigation water from the High Plains Ogallala Aquifer.

[12] For example, in the current round of planning, the board used an average of the 2005 to 2009 irrigation estimated use as the "base year." Memo from Dan Hardin to TWDB Board of Directors, Oct. 12, 2011.

[13] See Table 6.1 in the 2012 State Water Plan.

[14] It should be noted that most of this gap is not projected to be filled by strategies for new water in the regional plan. There is probably no economic way to meet the gap. As a result, the projected demand does not reflect what the demand will actually be, but what the regional group wishes it could have. That approach, especially with no explicit explanation where the state gap is discussed, adds to the sense in the State Water Plan that Texas is running out of water, when it is not.

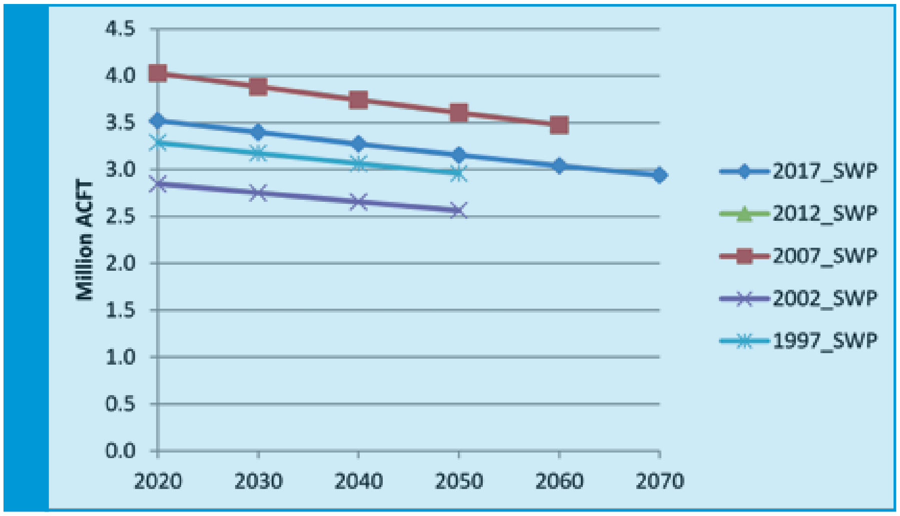


FIGURE 2.6 Irrigation Demand Projections for Region O

The figures for the 2012 Plan are hidden behind those for 2007 Plan because they are the same.

Irrigation dominates, accounting for 95% of the total regional use in 2010, or 4.186 million acre-feet/year. Virtually all of this irrigation water is supplied by the Ogallala Aquifer.

FIGURE 2.6 shows the various irrigation demand projections for Region O for the current (2017) and past planning cycles. While these projected demands do decline over time, as discussed below, they do not reflect the constraints on availability of Ogallala water that would be in place with implementation of management systems designed to preserve some aquifer capacity for the future. The decreasing trend in these demand projections is "due to declining well yields and increased irrigation efficiencies."[15]

Instead, the effect of water management goals on ground water availability is incorporated into the supply side of the planning process. For example, the 2011 Region O Plan projected that water supply will decline 56% between 2010 and 2060 "due to the managed depletion of the Ogallala Aquifer," with ground water availability decreasing from 3.076 million acre-feet in 2010 to 1.337 million acre-feet in 2060.

This approach results in the large demand/supply gap, or "need", which is theoretically to be addressed with water supply strategies. But, the 2011 Region O Plan projects that advanced irrigation conservation will only be able to provide about 480,000 acre-feet/year of water at a capital cost of $346 million.

As the 2011 planning process was coming to a conclusion, the regional groundwater conservation districts in Groundwater Management Area 2 were finalizing their desired future conditions (DFCs) for the Ogallala Aquifer and beginning to adopt rules to ensure those DFCs could be met. For the portion of the Ogallala covered by Region O, the chief DFC is a 50% depletion of the aquifer over 50 years, also known as the "50/50" goal.

If the Ogallala is, in fact, to be managed to meet the desired future conditions set by the regional groundwater conservation districts, the projected "demands" should reflect that management and reduced availability of water for irrigation. Doing so could significantly decrease the statewide projected demand/supply gap that generates so much attention. Put another way, doesn't showing a huge demand that can never realistically be met undermine the integrity of the planning process?

Region O initially seemed poised to address this important issue in the current round of planning. In early 2013, Region O consultants worked with irrigators throughout the region to review the 2017 irrigation demand projections from the Texas Water Development Board. While the 2017 projections were on average about 500,000 acre-feet/year less than the projections from the 2011/2012 planning period, they were still far beyond the groundwater availability under the managed depletion scenario reflected through DFC implementation.

[15] State Water Plan, p. 118, Region O Summary.

According to the consultant's July 2013 report:[16]

> The revision to the demand estimates that is proposed here is an attempt to apply the limitations set forth in the DFC process to the demands previously estimated[…]
>
> Subcommittee meetings with irrigation interests discussed current and future needs of producers and what measures would be required in order to implement the DFC. The general concern was over the best way to account for real unmet needs, particularly for irrigation, and to continue to show irrigation water shortages. Under the proposed methodology, the irrigation demand would be set equal to the volume of water that is available in the policy sense for irrigators to use. This would incorrectly show no unmet needs for the region's irrigators.
>
> Unmet needs are the impetus for development of a particular water management strategy. Advanced irrigation conservation, beyond the conservation measures currently being taken, is a water management strategy that would need to be pursued for the region to meet their groundwater conservation goals. To account for increased conservation, an estimate of conservation volumes was added back into the irrigation demand: Total irrigation demand = Baseline for irrigation demand + advanced conservation.

Thus, the proposed approach was to base the projected irrigation demand on water available under the DFC plus an amount that could be achieved via advanced conservation (and then translate that advanced conservation to the water supply strategy side of the Plan).

Under this approach, 2060 total projected irrigation demand for Region O would have been **1.328 million acre-feet/year for 2060**[17] versus the 2011/2012 Plan's projected 2060 demand of **3.474 million acre-feet/year**. And the 2070 projected demand under the consultant's approach would have been 1.273 million acre-feet/year.

For perspective, this proposed approach would have meant that the 2017 projected demand would be less by over 2 million acre-feet per year than that projected in the 2011 Region O Plan, or nearly one-quarter of the projected 2060 statewide demand/supply gap from the 2012 State Water Plan.

However, between July and the August 1, 2013 meeting of Region O, the Region O planning group decided instead to request no changes in the TWDB irrigation demand projections.[18]

What changed? That requires a look behind the scenes at development in groundwater management in Region O, particularly in the High Plains Underground Water Conservation District (HPWD), which covers 16 of the 21 counties in Region O and accounts for the vast majority of irrigation use from the Ogallala.

Established in 1951, the HPWD has been working for decades to conserve and protect the basically non-renewable reserves of the Ogallala. In recent years, as aquifer levels have begun to drop even more steeply than in the past, HPWD sought to enact phased-in metering requirements and pumping limits generally to 1.5 acre-feet/acre. While not free from controversy, the new rules enacted in July 2011 were approved 4-0 by the board as necessary to meet the 50/50 goal for the Southern High Plains portion of the Ogallala.

Two factors appear to have combined to generate resistance to the HPWD's efforts to sustainably manage the Ogallala for both current and future generations: commodity prices and the Edwards Aquifer v. Day case.

Corn, along with cotton and wheat, is one of the major irrigated crops in the High Plains, from Texas up through Kansas. As shown in the recent report of results from the Texas Alliance for Water Conservation work in the Southern High Plains, crop choices fluctuate with "anticipated prices, weather conditions, and water availability."[19] When corn prices are high, there is an incentive for growers to irrigate as much as possible in order to take advantage of the market. Under that perspective, pumping limitations can be a barrier to short-term profits.[20] Cropping fluctuations for the 4,700 irrigated acres involved in the TAWC project are shown in **FIGURE 2.7**. These thirty voluntarily-enrolled sites represent only a tiny portion of the over 2 million irrigated acres in the Southern High Plains, but may be somewhat indicative of overall trends.

[16] Available here as part of the background materials for the Region O August 1, 2013 meeting, pp. 9-12 of draft non-municipal demand Technical Memorandum from Daniel B. Stephens & Associates, dated July 26, 2013.
www.llanoplan.org/Downloads/Region%20O%20Meeting%20Packet%20-%20August%201,%202013.pdf.

[17] Figure 5 in the July 2013 consultants' report.

[18] The revised consultant report and adoption of the TWDB projections can be found at
www.llanoplan.org/Downloads/Region%20O%20-%20Non-Municipal%20Demand%20Projections.pdf.

[19] Texas Water Development Board, "An Integrated Approach to Water Conservation for Agriculture in the Texas Southern High Plans," available at
www.twdb.state.tx.us/conservation/agriculture/demonstration/doc/TAWC_Project_Summary.pdf.

[20] New York Times, "Wells Dry, Fertile Plains Turn to Dust," available at
www.nytimes.com/2013/05/20/us/high-plains-aquifer-dwindles-hurting-farmers.html.

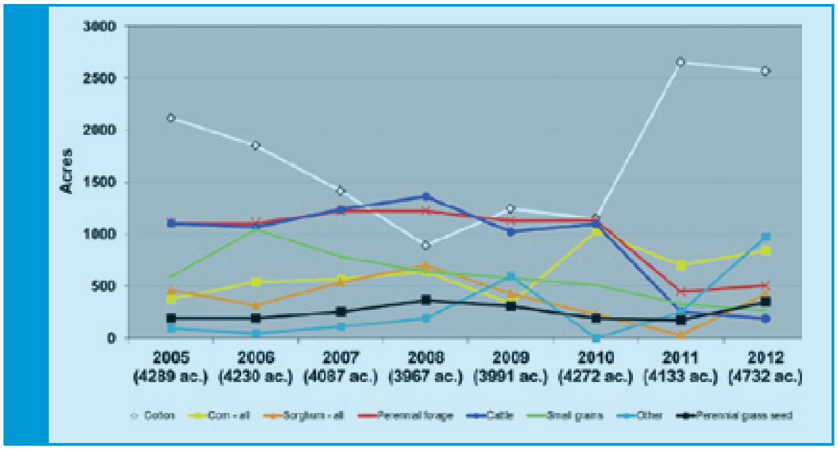


FIGURE 2.7 Irrigated Crop Trends on TAWC Research-Sites

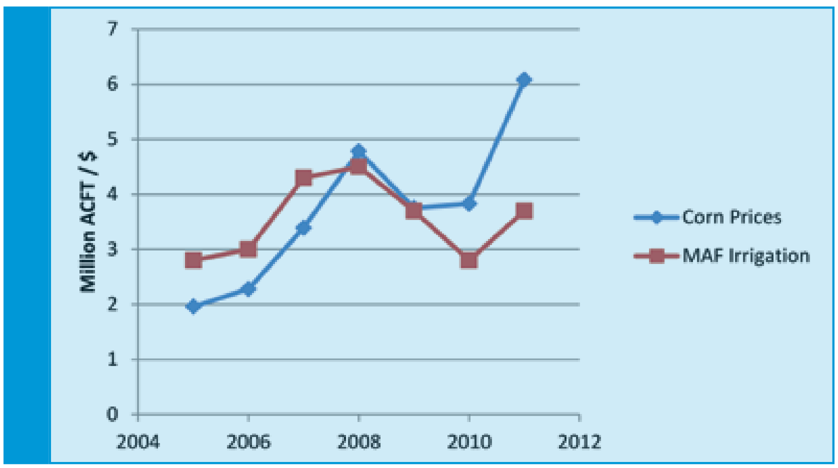


FIGURE 2.8 Region O Irrigation Use in million acre-feet/year versus National Calendar Year Average Corn Prices

Sources: Texas Water Development Board and Farmdoc.illinois.edu

FIGURE 2.8 shows irrigation use in Region O as compared to national average corn prices for the last five years. Both 2009 and 2011 were years of severe drought in the region, requiring additional irrigation.

Adding to these higher commodity price-related incentives, in February 2012, the Texas Supreme Court held in the Day case that groundwater is owned in place by the overlying landowner. The ruling added fuel to a small group of High Plains farmers arguing against pumping limits on constitutional grounds. The Protect Water Rights Coalition has opposed HPWD's efforts to enact measurement and pumping limits at every turn, often finding support from the Texas Corn Producers.

In November 2012, two HPWD board incumbents were defeated and two more resigned in early 2013. The 12-year director of HPWD, James Conkwright, resigned in July 2013. Mr. Conkwright also stepped down from his position representing HPWD on the Region O planning group.

As noted above, the TWDB projections adopted by the Region fail to reflect the aquifer management goal. But, because these demand projections were initially supplied to the Region by TWDB, there is no clear step to change them at this point. Thus, the unrealistic demand figures from the 2012 Plan will likely be included in the 2016 Region O Plan.

In the next step of revising its Plan, Region O will look at the demand/supply gap and water management strategies. The Region is required per TWDB rules to apply the current DFC to determine available supply.[21] With the application of the DFC/managed available groundwater standard, the demand/supply gap will be as large, if not larger than, that shown in the 2011/2012 Plan, again distorting the total statewide gap significantly. While advanced conservation can be used to help reduce irrigation demand, the over-stated gap and some completely unrealistic figure of "unmet needs" will likely remain.

It is unfortunate that Region O (and TWDB) missed a golden opportunity to help improve the overall integrity of the state planning process and focus instead on what is really needed to achieve sustainable management of the High Plains portion of the Ogallala Aquifer, which continues to decline at alarming rates.

C. STEAM ELECTRIC POWER GENERATION DEMAND

The 2012 State Water Plan projections for steam electric power generation (SEPG) provide another stark example of the demand forecasting problems with the current planning process.

A number of regions have simply ignored reasonable guidance from the TWDB that would have resulted in substantially lower projected SEPG demand, and thus total projected demands for water, over the 50-year planning horizon. Many of the regional planning groups have included unsubstantiated projections for future water demand by steam electric plants.

More troubling, TWDB has failed to push back against these inappropriate projections and failed to adopt rules that would direct the regions to substantiate the SEPG water demand. Finally, the process for developing SEPG water demand projections is essentially disconnected from the reality of how many new power plants Texas might actually need or expect over the next 50 years and where those plants should be located from an available water supply perspective. It appears that TWDB would, for example, allow each of the 16 regions to include a new reservoir in the hopes of encouraging the siting of a new power plant in the region, even if demand projections for electricity did not show a need for 16 new power plants in Texas.

According to the 2012 State Water Plan, SEPG water use in 2010 made up less than 4% of total state water use. The 2012 Plan projects that SEPG will make up about 7.5% of total water demand in 2060, increasing from 730,000 acre-feet/year in 2010 to 1,620,000 acre-feet/year in 2060. This additional 890,000 acre-feet of water, however, accounts for over 10% of the total of 8,325,000 acre-feet of additional statewide demand/supply gap projected for 2060. Like the demand projections for municipal and agricultural water, SEPG demand appears to be far over-projected.

Part of the problems with these projections is the starting point. The 2012 Plan projected a demand of 730,000 acre-feet in 2010, yet actual estimated water use for SEPG was 449,000 acre-feet in 2010 and 482,000 acre-feet in 2011.

Moreover, for the current round of planning, TWDB has provided estimated projections for SEPG use that adopt and, in some case, increase the 2012 Plan's projections when all indications are that future demand is likely to be far less. For example, TWDB now projects 2020 statewide SEPG demand at 1,010,000 acre-feet/year, more than double the 482,000 acre-feet/year of water TWDB says was used for SEPG in 2011, which was a very hot, dry, high-use year. With the boom in natural gas and renewable energy, and with the few new coal or gas and no new nuclear plant units now being proposed for Texas in the next seven years, one can reasonably question whether these projections reflect reality. The exercise in projecting demand is based on outdated assumptions about what type and where new electric generating plants will be built in Texas and significant errors in projection methodology.

As a 2008 report from the Bureau of Economic Geology (BEG) pointed out, past water plans projections for SEPG use, upon which most of the current projections are based, have been significantly overstated in most basins.[22] The BEG reports explains that the projections in the 2007 State Plan were too high because they were based on a 2003 report which has a major error.

> There is one major factor that describes why the previous steam-electric demand is much higher than the [BEG] estimate[...]. This discrepancy is based upon using too large of an average water consumption rate for existing steam-electric power plants.

Comparing projections and actual use **FIGURE 2.9** over the last 15 years shows the extent to which the planning process has over-estimated demands for this sector.

---

[21] Tex. Admin. Code Section 357.32(d).

[22] Texas Water Development Board, "Power Generation Water Use in Texas for the Years 2000 through 2060," prepared by Representatives of Investor-Owned Utility Companies of Texas (January 2003), available at **www.twdb.texas.gov/publications/reports/contracted_reports/doc/2001483396.pdf**.

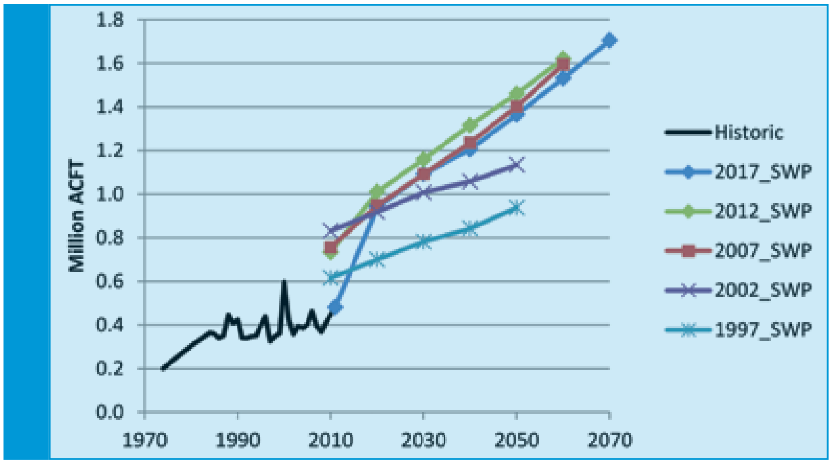


FIGURE 2.9 Historical and Projected SEPG Water Demand

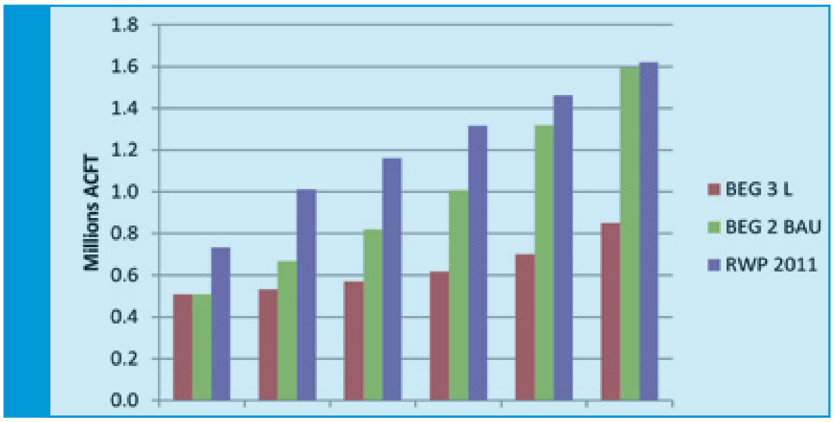


FIGURE 2.10 BEG 3L is the BEG Report's Lowest Demand Scenario, While BEG 2 BAU is the Highest Demand Scenario

Every past plan since 1997 predicted significantly greater SEPG water use in 2010 and 2011 than actually occurred.

A look at the history of how SEPG demand projections were developed provides some insight into how this situation arose. As shown above, SEPG projected demand increased substantially between the 2002 and 2007 State Water Plans, especially after 2030. The increase appears to be tied to a 2003 report[23] prepared by a group of investor-owned electric power utilities which predicted that water demand for SEPG would be higher than the demands projected in the 2002 Water Plan after 2030.[24]

This report had three scenarios for projected SEPG demand: high, medium and low. The SEPG projections in the 2007 State Plan generally track the recommended medium range scenario in this report.

For development of the 2012 State Water Plan, TWDB provided the regional groups with the new 2008 BEG report, "Water Demand Projections for Power Generation in Texas," mentioned above.

The 2008 report projected SEPG water demands for eight different scenarios, for each region and for each decade. Under the BEG's analysis, any of its scenarios, except the very highest demand scenario for the year 2060, resulted in lower projected demands for SEPG than in the 2012 regional and state plans. The BEG's highest demand scenario projected use of 1.6 million acre-feet for 2060, but this was the only year that BEG's projections were higher than the 2012 projections. As shown in Figure 2.10, BEG's other projections are all lower, and the low scenarios ranged from 800,000 to 900,000 acre-feet for 2060.

If the 2030 demand figures are compared, the total demand in the 2012 State Plan is over 1,000,000 acre-feet. That is also true for the 2007 Plan. The highest demand scenario projected by BEG, however, is 820,000 acre-feet/year. The low demand figure for 2030 is 570,000 acre-feet/year.

[23] Texas Water Development Board, "Power Generation Water Use in Texas for the Years 2000 through 2060," prepared by Representatives of Investor-Owned Utility Companies of Texas (January 2003), available at **www.twdb.texas.gov/publications/reports/contracted_reports/doc/2001483396.pdf**.

[24] Id., Appendix D.

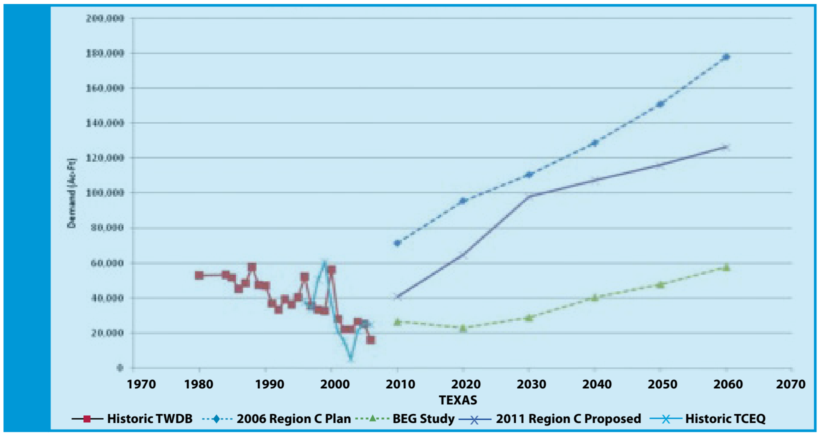


FIGURE 2.11 Region C Steam Electric Actual Use and Projected Demands[26]

It is important to note also that BEG's highest demand scenario is based on a number of factors that, taken together, would not appear to reflect current or likely future reality, including:

1. Texas continues business as usual for power generation and does not put in place any measures to significantly reduce electricity consumption,
2. new and existing power plants do not adopt the type of more efficient new technologies for cooling,
3. natural gas prices go much higher than they are now compared to other fuels and coal again is the major source of new SEPG, and
4. carbon dioxide capture is required for power plants.

Despite the availability of these BEG projections in 2008, most regional plans developed for the 2012 State Plan started with the figures from the 2007 Plan and in many cases increased the demands, rather taking even the lower numbers in the BEG's highest use scenario.[25]

The projections for Region C, shown in Figure 2.11, illustrate the variability in the use figures and provide a good example of the high projections for SEPG demand in the 2012 Plan.

Unfortunately, TWDB has adopted the high SEPG demands from the 2011/2012 regional and state plans as the starting point for the 2016/2017 planning process. Moreover, TWDB rules and guidance for regions do not require a hard look at such starting numbers.

CASE STUDY: REGION G

Region G[27] provides one example of why this approach is a significant problem. The 2011 Region G Plan (developed for the 2012 State Plan), projected a need for more than 145,000 acre-feet of new water for SEPG in the region. It projected an increase in SEPG annual demand from about 170,000 acre-feet per year in 2010 to about 315,000 acre-feet per year in 2060. That is approximately 40% of the 370,000 acre-feet of water projected for new demands for all water uses for 2060 in Region G. For 2030, the Region G Plan projected a demand of 254,000 acre-feet for SEPG, compared to the BEG low scenario of 141,000 acre-feet and a high scenario of just 219,000 acre-feet that year.

Among the reasons that the 2030 and 2060 demand projections are high is the inclusion of a proposal for a new power plant in Nolan County. The 2011 Region G Plan included a proposal for the Cedar Ridge reservoir, a new reservoir in the Brazos River Basin, to supply 20,000 acre-feet per year of water for that power plant by 2020.

The new steam electric power plant at the time of the 2011 regional planning was one proposed by Tenaska. In its comments on the draft 2011 Region G Plan, Tenaska stated:

> Current design calls for the […] use [of] air cooled condenser technology with an anticipated maximum water demand of 2000 acre-feet/year. However, the […] design could shift to more efficient and less expensive wet cooling if sufficient water supply can be secured […]. Under the wet cooling case, water usage on the order of 12,000 acre-feet/year would be anticipated. Although Tenaska currently has no plans to expand [… it] might expand at some point […]. Consequently the 20,000 acre-feet/year earmarked for steam-electric demand in Nolan County […] seems reasonable.
>
> (Appendix Q to Region G Plan, Attachment D)

Tenaska subsequently announced that it was abandoning its proposed plant in Nolan County.

[25] For an evaluation of the water use at specific coal-fired power plants in Texas, see Lone Star Chapter of the Sierra Club, "Water for Coal-Fired Power Generation in Texas: Current and Future Demands," available at **http://texas.sierraclub.org/press/WaterForCoal20120229.pdf**.

[26] 2011 Region C Plan, Volume 2, p. E.43 (344). The BEG figures in Figure 2.11 are for its highest demand scenario.

[27] All regional plans can be found at **www.twdb.texas.gov/waterplanning/rwp/plans/2011/index.asp**.

Thus, the Region G's projected demand for this power plant was at a minimum very conservative, at ten times what a dry cooling plant would have required. It is hard to see how the 20,000 acre-feet figure used to justify the new reservoir could be accepted in the 2012 Plan if TWDB rules required a serious justification of new water demands. The rules at the time did not. They do now.

Worse, however, TWDB has now recommended that the Region G 2016 Plan include the water demand figure that is based, in part, on this Nolan County power plant demand, despite the Tenaska cancellation. That is so, because, under TWDB newer rules and guidance for the 2016 regional planning, Region G can now retain that 20,000 acre-foot projected demand, despite Tenaska's announcement, and without providing any justification for the projected 20,000 acre-feet demand for that project.

TWDB rules only require that a regional planning group provide a justification for a new project if that project has not been included in the past plan. Thus, the 20,000 acre-feet projected demand figure was included by TWDB provide to the region as a basis for the SEPG demands, and the region does not have to remove that demand even if there is no current projected use of the water.

TWDB RULES AND GUIDANCE FOR SEPG PROJECTIONS

The high demand projections for SEPG are not just a result of desires of regional planning groups or utilities for significant expansion of SEPG or some other such incentives. They also result from a failure of the TWDB to provide a reasonable set of rules or guidelines to regional groups to require or even encourage a serious evaluation of projected water demands for SEPG or many other sectors. The fact that many regional planning groups simply adopted or raised their 2006 projections for their 2011 regional plans despite the BEG finding of significant errors also suggests the rules and guidance did nothing to bring projections back to reality for the 2011-12 planning process. They will not likely do so for the 2016 planning period either.

The TWDB rules and guidance for the 2006 and 2011 rounds of regional planning did not require the regional groups to justify their projected water demands or proposed new SEPG capacity.[28]

While the TWDB guidelines for 2016 have some good language that might suggest a harder look at projections is required of regions, the rules and guidelines for the 2016-17 planning process are not likely to help, especially since TWDB essentially recommended using the 2012 projections as the starting point for this next round of planning.

The agency's new guidance[29] provides some indication that TWDB understands that projections should be based on reality, not dreams. It requires that the regions desiring to increase projected demands above those provided by the board provide:

> Documentation of plans for an industrial facility [including a steam electric power plant] to locate in a county at some future date will include the following data:
>
> **a.** Confirmation of land purchased for the facility or lease arrangements for the facility[…].
>
> **c.** The proposed construction schedule for the facility including the date the facility will become operational […].

The guidance does not, however, require such information from any regional planning groups that is satisfied with the figures TWDB provides at the start of the planning process. In this case, TWDB basically provided the 2012 projections. No justification is required for those figures. Thus, the errors in the 2006 regional plans that were identified in 2008 by the BEG, but nevertheless carried over to the 2011 regional plans, can just continue to be ignored in the 2016 regional plans. Likewise, water demands that could be justified in the 2012 Plan but not in 2017 Plan can remain.

In fact, even if the PUC or the electric power industry were to conclude that the entire state needs only a few new power plants, TWDB would apparently accept sixteen, or even more, if each of the sixteen regional planning groups projected at least one new steam electric power plant in its region. There does not appear to be a serious effort to develop rules or enforce them to bring the planning process for SEPG back to reality. That is also true for mining and other industries.

Moreover, neither TWDB's rules or guidance create any incentives for regional planning groups to consider or move toward better conservation of water in the steam electric power sector.

D. MINING DEMAND

For the state and regional water planning process, the mining industry is defined to include oil and gas exploration, development, and production, as well as mining for rock, coal, uranium and other materials.[30] The Bureau of Economic Geology (BEG) predicts that oil and gas activities will account for the majority of increase in water demand for mining over the next 15 years, shifting to water for aggregate mining in the long term.[31]

[28] See Appendix B for a more detailed discussion of the TWDB rules and guidelines.

[29] Section 2.3 page 12 of TWDB First Amended General Guidelines for Regional Water Plan Development for the 2016-17 planning process (See Appendix B).

[30] "Current and Projected Water Use in Texas Mining and Oil and Gas Industry," Bureau of Economic Geology, June 2011, Prepared for the Texas Water Development Board, (BEG 2011) page 2. See also "Oil & Gas Water Use in Texas: Update to the 2011 Mining Water Use Report," Bureau of Economic Geology 2012 (BEG 2012).

[31] Id., BEG 2011, page 3.

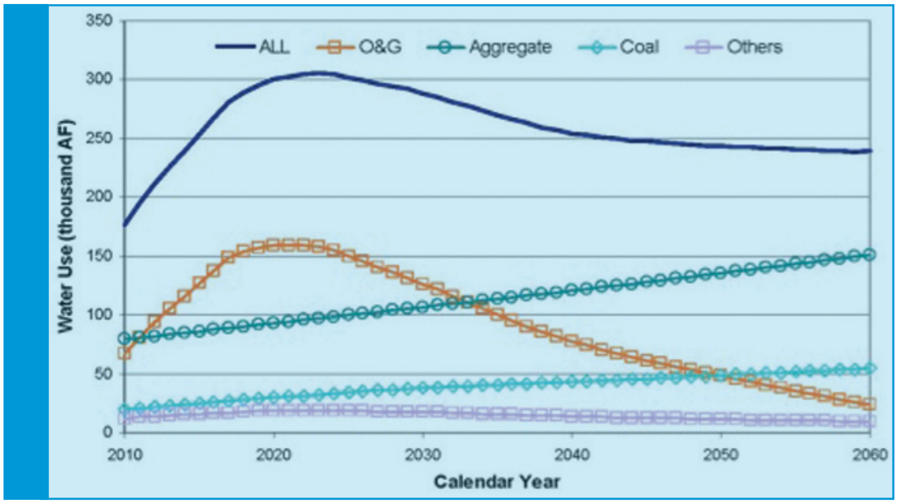


FIGURE 2.12 Water Use Projections for Mining from BEG 2011 Report

Even with the increase water use for fracking, the total water demand for the entire mining industry is still very small in comparison to other sectors that are included in the water planning process. Water used in mining in 2010 is estimated at about 2% of the total water used in the state that year.[32] It is projected to be about 2% by 2060, rising to 3% in between 2010 and 2030 before falling back by 2040.[33] The predicted expansion of fracking is the reason for a rise in demands in the next 20 years.[34]

Water is used in various ways within the mining industry. In the oil and gas industry, water is used to stimulate regular wells, it is injected for fracking, and it is used in secondary and other enhanced recovery processes. In aggregate mining, water is used mainly for washing rock, with a small amount for dust control. In surface coal mining, much of the water "used" is groundwater pumped to relieve pressure or dewater the coal mines.

BEG estimated that in 2010, 56% of the total water withdrawn for mining was groundwater and 44% was surface water; with consumption of about 70% of the water withdrawals.[35] BEG's 2011 projections for water use by type of mining are shown below in **FIGURE 2.12.**[36] Its 2012 update revised the oil and gas projections somewhat to lower the peak figures in the 2020 to 2030 period and increase use after 2030, to 10,000–20,000 acre-feet per year for oil and gas and, thus, for the totals for all uses.[37] The overall figures are, however, about the same as those for 2011.

Although the amount of water used for mining is not large compared to other uses on a statewide basis, the amount used or that is projected to be used at a county or regional level can be significant due to concentrations of mining activities in particular areas of the state.

For example, the 2012 State Plan projects that water use for mining in Wise County will rise from 4.5% in 2010 to 50% of that county's total water demand by 2060.[38]

Moreover, for several of the sixteen planning regions, the 2012 Water Plan projects significant water needs (the demands minus the supplies) for mining. It is the needs or the demand/supply gaps that drive the development of new supply strategies and, thus, increase the price tag of the Water Plan.

In Region I, for example, the projected demand/supply gap in 2020 for water for mining is about 30,000 acre-feet per year. That is more than one-third of the 83,000 acre-feet per year of total needs projected for that year.[39] In Region N, the projected needs of 3,000 acre-feet per year of water for mining in 2020 makes up over 21% of total needs in that region that year.[40]

[32] 2012 Texas Water Plan, page 137.

[33] Id.

[34] See note 30, BEG 2012.

[35] See note 30, BEG 2011, page 3.

[36] See note 30, BEG 2011, page 3.

[37] See note 30, BEG 2011, page ii.

[38] 2011 Region C Water Plan, page 2.21.

[39] Texas Water Plan 2012, page 180.

[40] Id.

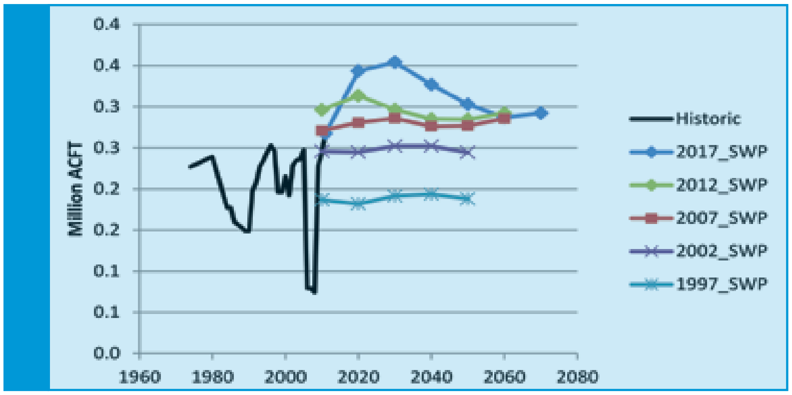
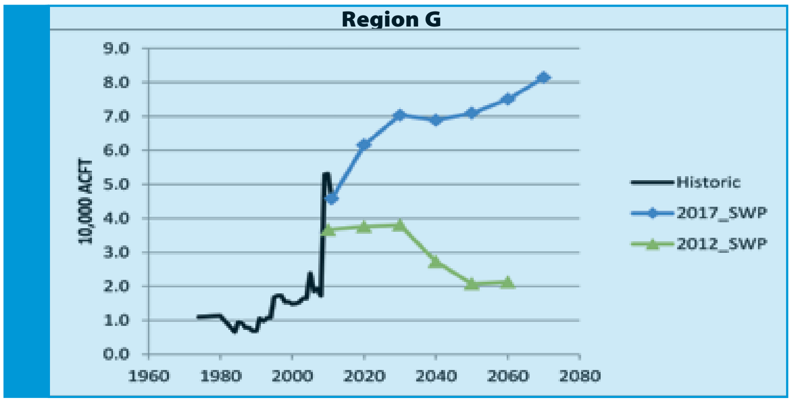


FIGURE 2.13 Historic Use and Projected Mining Demand in Past Water Plans.[41]



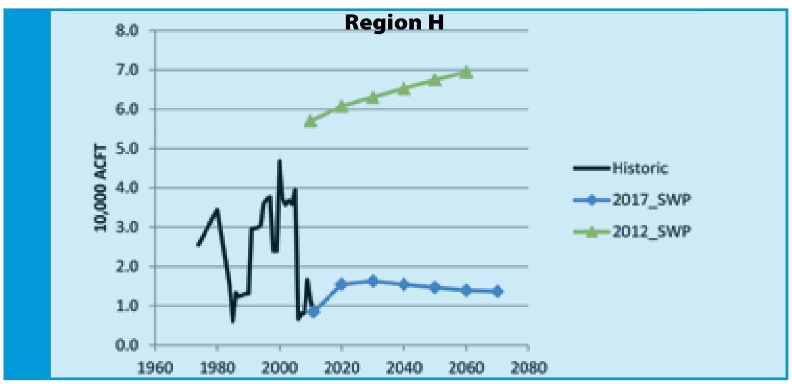


FIGURE 2.14 Historic Water Use Data for Mining and Projections for Mining Use in the 2011 and 2016 Regional Plans

The state's efforts to collect data on past or present use of water and projected use in the future for mining and, thus, its ability to project the demands for water for mining in the future is of very limited value in the overall water planning process and for funding decisions. **FIGURE 2.13** shows the state's data on historic water use for mining since 1975 and the projections for such use in the state water plans since 1997. The chart raises serious questions about the reliability of any of these projections.

First, the figures on past use do not appear to provide any solid basis to project future demands. Moreover, the variations in projected demands do not even appear to have much relation to past use. For example, the 2012 Plan projection starts well above any year's historic use.

The projected water demand for mining in some of the regional plans shows similar problems **FIGURE 2.14**.

[41] The data used to create this figure and those in Figure 2.14 was obtained from the TWDB website for historic use data (**www.twdb.state.tx.us/waterplanning/waterusesurvey/estimates/index.asp**) and demands (**www.twdb.state.tx.us/waterplanning/data/projections/index.asp**). Since both sets of data change from year to year, the current data may not agree exactly with the data available in the fall of 2013 when theses charts were created.

These two regional planning efforts show significant changes from the 2011 regional (and, thus, the 2012 state projections) in green to the more recent 2017 initial projections for the State Plan in blue. For Region G, the 2012 water projections are about 50% of the new projections, while in Region H the TWDB new projections of about 10,000 acre-feet per year are well below the 60,000 to 70,000 acre-feet per year projected in the 2012 State Plan. These wildly different projections were made within five years of each other.

This variability might suggest that the State does not have the ability to collect the data it needs on past and current uses and for projected mining activities that it needs to provide a basis for reasonable projections. However, that is not the case.

Texas laws provide the Texas Water Development Board and other state and regional agencies the authority needed to collect data on past and present water use and to survey industries on projected production and related water use. These existing laws appear adequate, but the data that results, at least for mining, does not appear to be to be a valid basis for overall planning and financing purposes.

The Texas Water Code and the Texas Natural Resources Code include authority for state agencies and certain water districts to require **1)** reporting of uses and **2)** responding to surveys on such uses and projected uses.[42]

As a recent report of the Bureau of Economic Geology stated, however, the use of survey authority by the Texas Water Development Board has not been used effectively in the past.

> This study emphasized the difficulties in gathering information on water use and the disappointing limitations of voluntary surveys, in particular whether the surveyed entities are representative of their respective mining segment as a whole. In other words, our survey sampling is likely biased. The somewhat low response rate may reflect the general reluctance of the mining industry to provide competitively sensitive information that is not required or to divert staff resources to obtain and submit data that is not routinely kept for business purposes.
>
> The uncertainty […] is relatively high as only figures from the coal industry […] are relatively well known because of legal requirements.[…] Water use projections could be improved if the starting point, current water use, was better known.[43]

TWDB staff states that the agency is in the process of improving its use of its survey authority, but the improvements were not in place for the 2012 planning process and they do not appear to be providing improved data for the 2017 Plan, at least for the mining sector.

Moreover, Texas Commission on Environmental Quality (TCEQ), the Railroad Commission of Texas (RRC), and many regional water districts have also failed to use their authority to assist in filing the data gaps on past uses. For example, there does not appear to be any significant effort to improve the quantity or quality of data that is required to be reported to TCEQ on use of surface water uses under water right permits.

Part of the problem is likely a lack of funding for state, regional and local data collection efforts. From a review of past legislative appropriation requests, it does not appear that TCEQ or RRC have asked for additional funds to assist with data collection needed for water planning. Ground water districts are also limited by funding and no significant funding for data collection has been provided by TWDB for such districts. Of course, without significant incentives, these agencies are not likely to spend their limited funding data collection that does not advance their main purposes.

As the BEG statements above indicate, TWDB has not used its law to require accurate reporting of projected production, water use, and other such data needed for planning. TWDB is authorized to collect data for water planning through surveys of industries. Texas law requires that the surveys must be filled out accurately and returned. The failure to do so can result in criminal penalties, disqualification for TCEQ water right permits, and denial of state funding assistance by TWDB.[44] Neither TWDB nor TCEQ has, however, used such penalties even though many TWDB surveys for mining and many other uses are never returned. The BEG report for 2011 indicated that less than 50% of its surveys to groundwater conservation districts for water use data on mining were even returned.[45]

There is also no process to check on accuracy of those surveys that are returned. The threat of penalties, without more, does not appear to create a sufficient incentive to report. The survey process is, thus, the voluntary process complained of by BEG in its report cited above. This problem is true for all sectors, not just the mining sector.

The frequency of surveys is a related problem. TWDB sends out surveys for mining use once every 5 years. Thus, the regional and state water plan for the next round will likely have to rely on the 2011 BEG report using the very limited surveys done before 2011 for water use in mining.[46]

[42] A survey of these laws is provided in Appendix C to this paper.

[43] See note 30, BEG 2011, page 245.

[44] Section 16.012(m), Texas Water Code.

[45] See note 30, BEG 2011, page 304.

[46] The report on the use of water by the oil and gas industry was supplemented in 2012, with BEG using informal surveys with trade associations and a limited set of members of the industry.

As mentioned above, Texas law also requires annual reporting on use of surface water for all permitted water right uses.[47] With no program to monitor or enforce this reporting requirement, TCEQ cannot verify the accuracy of the reports it receives.[48] TCEQ does not take enforcement action for failure to report or the failure to report accurately.

Requirements for reporting on water use come from other sources as well. For example, certain water use for uranium mining water must be reported to the RRC and TCEQ under Section 131.354 of the Texas Natural Resources Code and Section 27.024 of the Texas Water Code. Again, there is little, if any, verification of the accuracy of such reports and the reports are apparently not used for water planning purposes.[49] Even when BEG did its own surveys of the industry, BEG agreed to withhold some of the production data from public release and treat the data as confidential.[50]

Moreover, under Chapter 36 of the Texas Water Code, groundwater conservation districts (GCDs) are given broad authority to collect data on ground water usage by type of use. There are exceptions, but almost all mining entities are required to report on groundwater withdrawals from wells for water used during mining activities. GCDs can require metering as well as reporting ground water uses for most mining activities and most other uses.

Some GCDs require meters for water wells, but most allow other methods for monitoring the quantity of water withdrawn from a well. BEG, however, found the GCDs' data collection to be of little help in filling data gaps for water use for mining.[51]

GCDs could help fill the gap on groundwater data. For that to happen, however, the TWDB will likely have to provide additional guidance, if not rules and funding, to assist with data collection. It will also likely have to impose quality control and consistency requirements for the data collection if it is to be used in water planning.

For state or regional entities, the costs of data collection will be an issue, but targeted efforts for areas of greatest use, in a particular county or region, should make it possible for the state to limit those costs. There does not, however, appear to be any plan to determine how state resources should be used to provide the best data for the planning process.

Given the small percentage of water used by the mining sector and the questions about the accuracy of the data used to project future demands, it could be argued that the state should ignore this sector in developing its water plan. It could then use the money saved to improve data collection or other planning activities.

There are certainly a number of regions where mining water use is almost insignificant. There are, of course, other regions and counties where water use in mining is significant and ignoring it in those areas would not be wise.

Since water use in the mining sector is likely to be a part of the water planning process in future rounds, there are clearly ways to improve the results. Focus on areas of significant use makes sense. A commitment to collecting more accurate data is clearly also needed, although again a focused effort on some regions or some mining industries may be appropriate.

With the availability of new technologies and capacities for most members of the mining industry for online reporting of data, better use reporting for surface and groundwater should be possible at low costs. TWDB, TCEQ, RRC and GCDs would still have to create incentives to report accurately.

E. CONCLUSION

The 2012 State Water Plan projects future water demands that exceed reasonable projections both in the short and long-term. The examples above provide just some of the areas of over-projection in demands for water for municipal, steam electric power generation, mining, and agricultural uses. The analysis of mining demands highlights data collection problems for those uses, problems which probably exist for other uses.

If regional and state plans are intended to guide decisions by the legislature and state agencies, they should be based on good data and should provide the best estimates of demands that can be provided. One way to do so would be to use scenarios to highlight different paths to the future, especially for long-term forecasting. Knowing what conservation can do if significant reductions in per capita use are attained would allow state policy makers to decide if and how to encourage or possibly require some steps toward reductions as an alternative to increasing supplies with new projects. Better cost comparisons for different ways to reduce the demand-supply gap can then be made.

[47] Section 11.031, Texas Water Code.
[48] See note 30, BEG 2011, pages 145-6.
[49] See note 30, BEG 2011, page 35.
[50] See note 30, BEG 2011, page 14.
[51] See note 30, BEG 2011, page 148.

This approach is also valid for other user groups, such as steam electric power generation and agriculture. While the bottom up approach provides many benefits, it needs to be done within limits to avoid excessive demand projections that do not reflect the range of likely future conditions. Limiting the number of new power plants to reasonable projections for the state's future power needs is one clear example. Limiting future demands to realistic ranges of supplies is another.

TWDB can and should require justification for major projects and major large sources of demands. The regional and state plans should be revised to reflect changes in projected new or expanded power plants, oil and gas and other mining activities, and manufacturing facilities. Building new plans on outdated information, without taking a hard look at the assumptions in the old plans, continues to result in significant projections of demands that are in excess of the likely future demands.

A good balance between bottom up projections and top down guidance is needed to develop demand projections that reflect both the local and regional goals and the realities of overall state growth and state interests. Without such a balance, demand projections can become more like wish lists than valid projections and large urban regions are likely to dominate rural interests.

INCORPORATING ENVIRONMENTAL FLOWS IN THE REGIONAL PLANNING PROCESS

BRAZOS RIVER DOWNSTREAM OF POSSUM KINGDOM LAKE (PALO PINTO COUNTY, TEXAS) WIKIPEDIA

Since 1997, the Senate Bill 1 (SB 1) water planning process has required protection of natural resources as the state determines how to meet needs for water for the future. For example, the basic directive of the legislature in SB 1 is:

> The state water plan **shall** provide for the **orderly development, management and conservation of water resources** and preparation for and response to drought conditions, in order that sufficient water will be available at a reasonable cost **to ensure** public health, safety and welfare, **further economic development and protection of agricultural and natural resources** of the entire state.
> (Texas Water Code, Section 16.051, emphasis added)

One of the "Guiding Principles" as adopted by the Texas Water Development Board (TWBD) for the 2017 State Water Plan is:

> (23) Consideration of **environmental water needs, including instream flows** and bay and estuary inflows, including adjustments by the [Regional Water Planning Groups] to water management strategies to provide for environmental water needs including instream flows and bay and estuary needs[…] (TWDB rule at 31 Texas Admin. Code Section 358.3, emphasis added)

This guiding principle makes sense not only because of the language in SB 1, but also because the legislature has enacted two other laws that focus on protecting environmental water needs: Senate Bill 2 (SB 2) in 2001 and Senate Bill 3 (SB 3) in 2007. These laws recognized that water left in rivers and available to flow to bays and estuaries plays important roles in conserving fish and wildlife habitat, protecting healthy timber and agricultural lands, providing recreational opportunities, and sustaining economic and cultural values. Even the value of private property along a river and associated riparian rights can vary significantly with the flow conditions in the river.

Yet, to date, the results of work done under SB 2 and SB 3 have played a very limited role in determining how Texas will use its water resources over the next 50 years. The work of these bills has not been fully integrated into the SB 1 water planning process. This next round of regional planning provides an important opportunity to help provide for environmental water needs.

For those regions that want to do more to protect environmental water needs, the question is how to use the water planning process. The most straightforward approach would be to treat environmental water needs like other water needs. Healthy river and bay systems need flows that mimic natural conditions, but not necessarily all the water that has historically flowed in them. Once the healthy flow needs are identified, the regional planning groups could develop strategies to meet those needs over time. In many cases, strategies to meet environmental flow needs can work in combination with strategies to provide water for municipal, agricultural or industrial needs.

Current TWDB rules and guidance do not treat environmental water needs in the same fashion as other needs, however. Instead, the rules and guidance focus on evaluating the water supply strategies for other needs and then identifying the effects of these strategies on environmental water needs. The rules and guidance suggest only that regional water plans and the State Water Plan adjust their strategies for obtaining new water supplies with considerations of the existing environmental conditions, not the real needs of rivers and bays. Thus, if we have already created unhealthy rivers and bays, there is no process to try to reverse that situation over the next 50 years or more.

The current state approach gives environmental water needs a very limited role in the regional planning process. TWDB rules and guidance do not promote the idea that regional planning groups should find strategies to ensure healthy rivers and bays or actually develop comprehensive plans that "protect natural resources."

While TWDB encourages the use of TCEQ "environmental flow standards" under SB 3, TWDB fails to acknowledge that such standards are very limited. They do not reflect the types of flows that scientists and stakeholders in the SB 2 and SB 3 processes determined are needed to sustain a sound ecological environment in our rivers and bays. TCEQ's standards apply only to surface water rights permit applications that seek new appropriations of state water. That is a very different process from one that is seeking to develop strategies to fill water needs for the future.

TWDB rules do, however, allow regional water planning groups to use a different process to develop strategies for meeting environmental water needs in the future. Regional groups wanting to do so simply have to develop their own approach.

There are a number of options for regional planning groups that want to protect and enhance environmental water needs while not limiting the growth of cities, industries or agriculture.

For example, the Brazos River Authority (BRA) sends large amounts of water from Possum Kingdom Lake downstream to Lake Granbury for transfer to Squaw Creek Lake and use there by Luminant as cooling water for the Comanche Peak Nuclear Power Plant. That water could be delivered in different ways from Possum Kingdom Lake. It could be released in one large pulse once a day or once a week, leaving the river mostly dry the rest of the time. It could be released at a constant low flow. Or BRA could send the water down in a fashion that meets some, possibly all, of the SB 3 recommendations for environmental water needs in the segment of the river between the two lakes.

Thus, the Region G planning group could, with the assistance of BRA and Luminant, develop strategies for meeting all or some of the recommendations of scientists and stakeholders who worked to quantify the environmental flow regime for that segment of the river under SB 3. Those strategies could be based on releasing water needed for existing and new uses in a fashion that also helps meet the environmental flow needs.

As discussed in detail below, while such an approach is not encouraged by the TWDB rules and guidelines, it is not prohibited. It will, unfortunately, be up to the regional planning groups to take the initiative in the 2016 round of planning.

A. LEGAL FRAMEWORK FOR REGIONAL PLANNING AND ENVIRONMENTAL WATER NEEDS

Texas law and TWDB's Guiding Principle 23 provide ample legal authority for regional water planning groups to focus some of their work on "environmental water needs." While the Guiding Principle makes clear that the term environmental water needs includes "instream flows and bays and estuaries inflows," TWDB planning rules and guidance do not otherwise define the term.

Elsewhere, TWDB defines "environmental flows" as the flow of water (both quantity and timing of flow) needed to maintain ecologically healthy streams and rivers, as well as the bays and estuaries that they feed.

In SB 3, the term "environmental flows" is used in the definition of several key terms:[1]

> (15) "Environmental flow analysis" means the application of a scientifically derived process for predicting the response of an ecosystem to changes in instream flows or freshwater inflow [to bays and estuaries].
>
> (16) "Environmental flow regime" means a schedule of flow quantities that reflects seasonal and yearly fluctuations that typically would vary geographically, by specific location in a watershed, and that are shown to be adequate to support a sound ecological environment and to maintain the productivity, extent, and persistence of key aquatic habitats in and along the affected water bodies. (Texas Water Code, Section 11.002)

In addition, TWDB has provided excellent guidance on the value and role of environmental flows on its website.[2]

TWDB rules for the 2011 regional plans did not require regional planning groups to determine environmental water needs in the step-wise process that applies to projecting water needs for municipal, agricultural, industrial, steam-electric, mining, and livestock uses. The TWDB rules for 2016 do not either. They do not include environmental water needs in the process for developing new supply strategies over the 50-year planning horizon. 31 Tex. Admin. Code 357.33 & 34.

Given Texas law and TWDB rules, however, regional planning groups have a range of ways to bring environmental water needs into the regional water planning process. That can be done outside of the process for other water needs.

[1] Texas Water Development Board, "Environmental Flows," available at **www.twdb.state.tx.us/surfacewater/flows/**.

[2] Texas Water Development Board, "Environmental Flows FAQ," available at **www.twdb.state.tx.us/surfacewater/flows/faqs/index.asp**.

B. IDENTIFYING ENVIRONMENTAL WATER NEEDS

Environmental water needs have some characteristics that make them different from other water needs evaluated by the regional planning groups. The major unique feature, as the Brazos River example above indicates, is that some environmental water needs can be satisfied with water that is filling or can fill other needs.

Most of the needs addressed in the regional plans and State Water Plan are for "consumptive uses," that is, water diverted from a river, stream or lake and used for drinking water, irrigation and manufacturing. Some of that water may be returned to the river. Most is not. It is consumed or used up. It might, for example, be taken up by crops or lawns. It might end up in soft drinks or beer. It might be evaporated during the cooling process in power plants.

In contrast, most environmental water needs are non-consumptive, such as flows in the river to provide for fish and wildlife. Some environmental flows, like those needed for bays and estuaries to support commercial fisheries, are more like the consumptive needs. They cannot be used for other fresh water supplies once they are in the bays or estuaries. Of course, the inflows to bays and estuaries may be made up, in part, of return flows from other upstream uses.

To do more than the minimum that TWDB requires, a regional planning group will first have to identify their environmental flow needs. TWDB does not now provide this information to the planning groups as part of the other data needed for water planning.

Fortunately, scientists and stakeholders have worked under the SB 3 process to develop a good first cut at what those needs are for most river basin and bay systems. In a few basins, studies under SB 2 are providing an even better basis for identifying some environmental flow needs.

Moreover, some environmental water needs were identified well before the passage of SB 2 and SB 3. For example, some state and federal permits for new dams required releases for downstream fish and wildlife, public health, and other instream benefits. In most cases, these requirements were set in terms of constant releases from dams, rather than the more complex release patterns that are now recognized as better protecting the health of the river, stream, lake or bay.

For purposes of illustration, assume a constant release of 20 cubic feet per second (cfs) was set as the requirement for a release from a dam. That is reflected in **FIGURE 3.1** as the blue line.

More recently, such constant flows have not been favored. Instead, as indicated in SB 2 and SB 3, environmental flows are defined as "flow regimes" that mimic historic flow conditions. Thus, like historic flows, environmental flows usually vary from month to month and year to year. Senate Bill 3 requires such environmental flow regimes be set with the goal of assuring a "sound ecological environment."

Thus, for purposes of comparison with the type of constant release discussed above, a flow regime that mimics historic flows is represented as the red line on **FIGURE 3.1.**

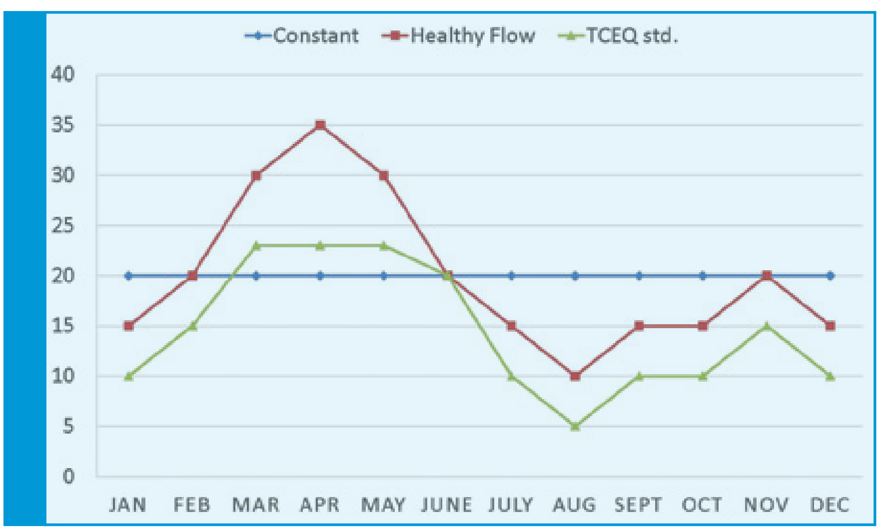


FIGURE 3.1 Different Types of Environmental Flows

In this hypothetical case, the constant release pattern – the blue line – satisfies this SB 3 type environmental flow recommendation at times, but it also provides more water at times and less at times. Thus, if this were the case in a river segment downstream of a dam, the operator of the dam might be able to use the same amount of water to provide the red line flows as it did for the blue line and do so in a way that meets the type of healthy environmental flows needed to provide for a "sound ecological environment." Such an approach would, of course, be voluntary and may require permit amendments, but there is nothing that prohibits exploration of or even recommendations for such strategies through the regional planning process.

There is a third type of environmental flow, reflected in the green line on **FIGURE 3.1**. Under SB 3, TCEQ is required to adopt "environmental flow **standards**" based on the environmental flow regimes recommended by the scientists and stakeholders participating in the process. Again, that type of recommended flow regime is represented by the red line.

The TCEQ flow standard is, however, more limited in most cases. TCEQ's standard can only include those aspects of the recommended flow regime that can be obtained with the available water. That means the flow standard is limited to the unappropriated water at the time the standard is set. The standard cannot include water already in a water right, whether it is being used or not. TCEQ assumes full use of all consumptive water rights. Thus, in rivers that are fully appropriated, there may be no water for an environmental standard during many months. In other river segments, the appropriated water in water rights may limit the standard to a fraction of the recommended flow regimes.[3]

Thus, the TCEQ standard does not reflect the recommended flow regime or the environmental water needs as defined by scientist and stakeholders. It reflects what is possible given that much, if not all, of the water in a river has already been allocated in water right permits.

In those basins with red line type recommendations from the SB 3 process, SB 2 studies or other scientifically credible sources, the regional planning groups have the information they need to identify much of their environmental water needs.

While TWDB planning rules do require protection of the green line water needs, the rules and TWDB guidance or assistance do not provide for or encourage better protection of environmental water needs over the next 50 years. Nevertheless, regional groups do not have to limit their plan to the green line approach. They can develop ways to achieve the red line goal for healthy flows through strategies that the groups recommend in the regional water plans. The plan can provide for such strategies over the 50 year planning period.

C. OPTIONS FOR INTEGRATING ENVIRONMENTAL WATER NEEDS INTO THE WATER PLANNING PROCESS

A basic requirement of the planning process authorized by SB 1 is to "ensure protection of […] natural resources." That requirement, however, has not been a priority to date for water or other natural resources. For example, TWDB's decision to approve the 2011 Region C plan was reversed by Texas courts because TWDB did not treat the protection of natural resources as an equal responsibility with the development of water strategies.[4]

There are, however, a number of options that would allow a regional planning group to develop proposals that ensure that water resources, including environmental water needs, are protected, while also providing strategies for other water needs over the entire planning horizon.

In most Texas river basins the green-line approach – the environmental flows standard – is well below what the scientists and stakeholders have recommended as the environmental water need. Thus, regional planning groups would have to do more to develop a plan to assure the type of "sound ecological environment" that SB 3 seeks for all rivers, streams, and bays.

In the 2011 regional process, only one region made efforts to look at environmental water needs beyond the limited approach that TWDB proposed at that time and now proposes for the 2016 planning process.[5] In its 2011 plan, the Region D group explicitly indicated that it was looking to protect the red line type environmental water needs for several basins. Excerpts from the 2011 Region D regional water plan are provided in Appendix D.

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[3] The green line approach is used by TCEQ in issuing permits. It need not be used for regional planning. TCEQ limits environmental flow standards unnecessarily to the green line approach. It will not issue new water right permit that would result in flows below the green line, once set. The permitting process is not, however, intended to create environmental flows where they do not meet the red line approach. It will take the water planning process to do so in most basins.

[4] TWDB found no conflict between the Region C and Region D plans even though a reservoir proposed in the Region C plan was identified in the Region D plan as a conflict with that region's goal of protecting certain natural resources at the site of the proposed reservoir. *TWDB v Ward Timber*, et al. No. 11–12–00030–CV, (Tex. App.— Eastland, May 23, 2013, no pet.).

[5] Several regions made significant efforts to analyze the effects of potential water supply strategies on environmental water needs, but even these regions did not consider the environmental water needs in a fashion comparable to other needs. Region L, for example, had two special studies prepared, but both were designed to help with the basic evaluations TWDB requires for proposed water supply strategies. **www.twdb.texas.gov/publications/reports/contracted_reports/doc/0704830697_RegionL/2011%20Region%20L%20Study%204%20Report%20(Final)**, and **www.twdb.texas.gov/publications/reports/contracted_reports/doc/0704830697_RegionL/2011%20Region%20L%20Study%205%20Report%20(Final).pdf**.

One of Region D's priorities was environmental water needs for Caddo Lake and a segment of Big Cypress Bayou above the Lake. Lake O' the Pines was constructed in 1960 on Big Cypress, 35 miles by river upstream of Caddo Lake. Over the past 7 years, environmental studies have been completed to help define environmental flow needs for Caddo Lake and the segment of Big Cypress below Lake O' the Pines. The work was done under the Sustainable Rivers Project, a national joint effort by the Nature Conservancy and the U.S. Army Corps of Engineers.

One of the reasons it was done is that the federal permit for Lake O' the Pines requires only a blue line or minimum constant release type requirement set at a constant 5 cfs from the lake. Greater releases, generally 25 cfs, have generally been made, but neither the 5 cfs release nor the higher releases were tied to any scientific analysis or set of stakeholder goals for an environmental flow regime.

Over the past few years, a voluntary approach by scientists and stakeholders has developed such a recommendation.[6] Recently, both the Corps of Engineers and the Northeast Texas Municipal Water District agreed to help provide releases from Lake O' the Pines to meet some aspects of the recommended environmental flow regimes. Thus, in this region, not only has a healthy environmental water need been identified, but also at least one strategy for meeting that need has been developed. It is currently being tested.

Thus, the Region D planning group can add environmental water needs in the Cypress basin, as well as at least one strategy to meet those needs to the regional plan. Like all other projected needs and strategies (for municipal, agricultural, etc.), those needs and strategies for environmental flows will be subject to periodic revision. If new information or analysis shows that changes should be made, they can be. Water planning in Texas is a continuing process that allows for improvements every 5 years, and even more often if an amendment to a plan is justified.

Other regional planning groups could take similar steps based on SB 3 recommendations of scientists and stakeholders. They may not be able to identify strategies for all the environmental water needs that are not satisfied with available water, but they could and should begin the process.

One obvious place to start would be any stream segment recommended as an "ecologically unique stream segment" in a regional plan. For these segments, historic flows and other factors could be evaluated to determine the environmental water needs and the planning groups could develop recommended strategies for meeting those needs, if they are not now met. If such needs are not well defined now or the strategies for meeting them are not obvious, the regional planning group could request TWDB funds for a special study.

There are also studies that can assist regional planning groups in identifying strategies to restore or protect environmental water needs. The Science Advisory Commission, which was first created by statute[7] in 2003, published a report in 2004 with a discussion of a number of options for protecting and restoring environmental flows.[8] The relevant text of that report is provided as Appendix E to this report.

D. CONCLUSION

In 2001 and 2007, the Legislature passed SB 2 and SB 3 as the next big steps in water planning. Those laws began a process of identifying and protecting environmental water needs. Those laws have not, however, been effectively integrated into the SB 1 water planning process.

TWDB's current rules do require some protection for environmental water needs. TWDB has not, however, developed a process or provided the basic information needed by regional planning groups to identify, protect, and enhance environmental water needs. These environmental water needs are not treated the same as other water needs.

If any regional planning group wants to integrate environmental water needs into the regional planning process to enhance and protect the environmental water needs, there is, in most river basins, sufficient information to do so for the 2016 regional plans.

Full integration of SB 2 and SB 3 can and should be a priority for the SB 1 planning process. Rules for the next planning cycle should be developed that make sure the three bills work in harmony.

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[6] Senate Bill 3 provided a schedule for all river basins except the Cypress, Sulphur, Red and Canadian River basins. The legislature provided schedules for the other basins, and required that TCEQ adopt environmental standards for all by 2014. State funds were used to pay for the development of the recommendations for environmental flow regimes by scientist and stakeholders, which were then used by TCEQ to develop the flow standards. In the basins without a schedule, the law provided that a "voluntary consensus-building process" could be used. See, Section 11.02362(e), Tex. Water Code. This voluntary approach has been used in the Cypress basin to develop the recommended environmental flow regimes.

[7] This commission, as well as the Study Commission on Water for Environmental Flows, was created by Senate Bill 1639 in 2003. That law, like SB 2 in 2001 and SB 3 in 2007, found, "Maintaining the biological soundness of the state's rivers, lakes, bays, and estuaries is of great importance to the public's economic health and general well-being." It directed, "In evaluating the options for providing adequate environmental flows, the study commission shall take notice of the strong public policy imperative that exists in this state, recognizing that environmental flows are important to the biological health of our parks, game preserves, and bay and estuary systems."

[8] Currently there is a Scientific Advisory Commission, but this one was established in 2007 by SB 3. It has worked with scientists and stakeholders across the state to set the green line type of environmental flow regimes. It could also be called by regional planning groups for advice and assistance on flow recommendations and possibly additional strategies that the SAC may have identified.

EXISTING WATER SUPPLY AND FUTURE PROJECTIONS

This chapter focuses on the issues related to assessing existing and future water supply availability in the planning process. Existing water supplies are those supplies that can be produced with current permits, current contracts, and existing infrastructure during periods of drought. Historically, our major supply sources have been surface water diverted from reservoirs and rivers and groundwater pumped from aquifers.

Like projecting future water demand, assessing water supply for planning purposes is fraught with uncertainty. The estimates of existing and future supply are only as good as the data, the predictive models, and the policy assumptions made about availability. The water planning process does not have adequate data to determine the amount of groundwater that can serve as a dependable supply in times of drought for many aquifers. Groundwater availability models (GAMS) provide only rough estimates. Moreover, Texas lacks detailed information on the extent to which surface rights are dependent upon groundwater flow from springs and how pumping of groundwater could affect spring flows.

There are also significant questions about surface water supplies. Available supplies may be underestimated because the location of intake structures and political pressures to maintain lake levels for recreation.

Moreover, as discussed in detail below, the assumptions embedded in water availability modeling and decisions not to incorporate drought contingency planning as a supply strategy have significant effect on the projected supply available to meet demand, especially over the next few decades.

In general, several assumptions used in the state water planning process—assumptions that are not always obvious—result in very conservative estimates of future water supply availability (at least for surface water). When combined with the over-projection of demand discussed in Chapter 2, this tends to make the demand/supply gap (or "need") look unduly dire, and leads to proposals for potentially damaging and expensive new reservoirs and long-distance groundwater exports.

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There are other ways to extend our existing supplies without causing further damage to our springs, rivers and bays. Indeed, the 2012 State Water Plan includes some steps in the right direction, including proposals for increased reliance on conservation, as well as voluntary market transfers of water rights from agriculture to municipal use, particularly in the Lower Rio Grande Valley. This chapter, however, focuses on supply alternatives that have not been thoroughly examined in the Texas water planning process.

The first section below focuses on how the current planning process results in excessively conservative estimates of the availability of existing surface water supplies from reservoirs, especially over the next 15 to 20 years. The section also explains how effective programs for reduction of peak uses during drought could shrink the demand/supply gap significantly.

The second section uses the Steam Electric Power Generation sector as an example of how current excess supplies should be evaluated and used more efficiently to meet future water demands.

The third section discusses the direct use of brackish groundwater in place of fresh water and the use of brackish groundwater desalination to provide new supplies.

A. EXISTING SUPPLIES AND EXTENDING SUPPLIES WITH REDUCED USE DURING PERIODS OF DROUGHT

Texas relies on approximately 200 large reservoirs to supply much of its water. Many of these reservoirs provide municipal water supply, flood control, cooling water for steam electric power generation and opportunities for fishing and other recreational activities. In many cases, real estate development was also a goal, although not generally an explicit justification for the reservoir.

Unfortunately, the reservoirs have also inundated formerly productive timber and farmland and reduced flows in downstream river segments that also provided recreational opportunities and habitat for fish and wildlife. Reservoirs near the coast have resulted in reduced flows to our bays and estuaries and affected the commercial, recreational and ecological values of these systems.

Before considering construction of new reservoirs or other expensive infrastructure, Texas should maximize the use of these existing reservoirs, but do so in ways that do not further degrade the downstream rivers or reduce the water needed by downstream senior water right holders.[1] Assessing the full potential of existing supply in reservoirs requires a greater understanding of how much water our reservoirs can supply under different scenarios and whether the assumptions in the current water planning process are realistic or appropriate.

SURFACE WATER RESERVOIR SUPPLY ANALYSIS

In Texas, the amount of water that can be supplied from a reservoir during a drought is based on a concept called the "firm yield." The firm yield is the maximum amount of water that could be diverted every year including the worst, or driest, year ever recorded, such that the reservoir would just empty and then eventually refill by the end of what is referred to as the drought of record.

In determining the firm yield of, or the supply available from, an existing reservoir, regional water planning groups are required to follow rules established by the Texas Water Development Board (TWDB). These rules require the groups to use the state's approved water availability models ("WAMs"). [2]

WAMs were first developed for water rights permitting, not water planning. These computer accounting programs simulate water supply operations to estimate the amount of water that is available and that could be authorized for use in water right permits. WAMs simulate conditions using past hydrologic records.

FIGURE 4.1 provides an example of how a WAM is used to simulate storage under a firm yield scenario for a reservoir. The historic inflows for the 55 year period are modeled assuming that the reservoir releases sufficient water to satisfy the full use of all senior water rights downstream. During much of this period, the amount of water coming into the reservoir is sufficient to meet those senior downstream uses and the reservoir does not run dry. The reservoir completely refills periodically after some reductions in lake levels.

From May 1950 until June 1957, however, this reservoir did not refill completely. That 7 year period is now defined as the "drought of record" for the period of 1940 to 1995. It is the longest period for which the reservoir will not refill given the use of the historic conditions to define the inflows and given the assumptions on full use downstream during that period. Also, note that in January 1957, the reservoir would have been completely emptied under these assumptions.

Using the WAM it is possible to determine that this reservoir has a firm yield of 220,320 acre-feet of water.

The assumptions that underlie the firm yield analysis are important. If, for example, senior downstream water right holders do not use their full water rights during a drought year, more than the firm yield of the reservoir would be available for others that year.

There are two water availability scenarios used in water rights permitting and these include different assumptions about how much water is used. The first, called the fully permitted scenario (or RUN 3), is used to assess water availability for a new water right that would be granted in perpetuity. This scenario assumes that all existing senior water rights are fully exercised; that is, all senior water right holders have diverted the maximum amount of water allowed under their permits, and that none of the water is returned to the river. The second scenario, called the current conditions scenario (or RUN 8), is used to assess availability for term permits. Term permits are issued for a limited period of time and, thus, are subject to a less conservative availability analysis. In the current conditions simulation, existing water rights are assumed to divert the maximum amount they have reported using in the last 10 years and the average amount they have reported returning to the stream.

The approach of assuring full use of downstream water right holders was developed for water right permitting to honor the 'first in time, first in right" aspect of Texas' prior appropriation doctrine for water rights.[3] A senior water right holder must be satisfied before any water is available for a junior water right. Thus, existing surface water rights have a strong influence on the projected firm annual yield of a reservoir and issuance of new water right permits.

[1] The discussion in Chapter 3 on changes in operations of Lake O' the Pines is one example of how a reservoir operation could be altered to provide additional water supply and enhancement of downstream environmental flows. There have been a number of studies of reauthorization or changes to other reservoirs, almost all for increasing water supplies, but not for downstream conditions in rivers or bays. While not a topic covered here, further analysis of these opportunities to increase supplies appears to have merit.

[2] Texas Commission on Environmental Quality, "Water Availability Models," **www.tceq.texas.gov/permitting/water_rights/wam.html**.

[3] Texas Commission on Environmental Quality, "Rights to Surface Water in Texas," **www.tceq.texas.gov/publications/gi/gi-228.html/at_download/file.**

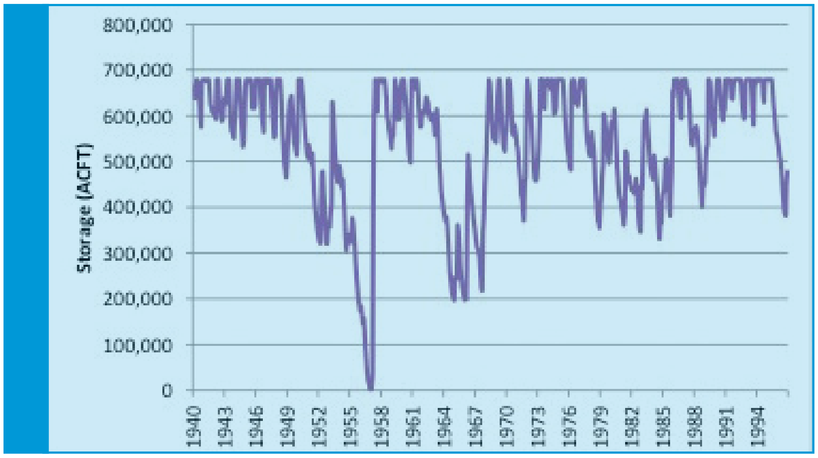

FIGURE 4.1 WAM Simulated Firm Yield

This approach makes sense for water rights permitting. Water rights are granted in perpetuity. Using the full use assumption helps ensure that TCEQ does not grant water rights for more water than is in a river, avoiding "over appropriation" of the river basin.[4] The problem with using this approach for planning purposes, however, is that many water rights are not fully exercised. As demands grow, the amount used may eventually grow into the full permitted amount, but there are likely to be many instances where, even at the end of the 50-year planning horizon, some water right holders will not use all the water to which they are legally entitled.

Modeling for the permitting process also assumes no return flows for most water rights.[5] That assumption is also, in many cases, not valid for the shorter-term water planning horizon and process. Of all the water that is diverted from Texas rivers and streams, a significant portion is returned to the stream, often as tailwater run-off from irrigation or treated wastewater from cities. While there are increased efforts by cities and others to implement reuse, there will continue to be a significant amount of return flows for the short term, and, given the expense of reuse projects, potentially for decades to come.

The assumptions of full use and no return flows may, thus, be resulting in significantly underestimated water supply availability from existing reservoirs for the near future, i.e. 2020 or 2030. That may also be true for the longer term, though many other factors also affect the reliability of the supply projections for 2050 and beyond.

A quick review comparing RUN 3 and RUN 8 figures for water rights across the state suggests that there are large differences between the full permitted amount and the actual uses in the past. In some cases, the amount used is 50% of that authorized. With the peak uses in 2011, the comparisons of the two WAM runs may not show as much water available to meet demands in 2020 and 2030 from existing permits, but the planning process should make the effort to identify significant water rights that are not being fully used, especially in reservoirs.

The use of such water to meet some short term needs is not necessarily a simple matter. Some of the water not being used is tied up in contracts with cities and others that expect to use the full contract amount in the future.

For example, as **FIGURE 4.2** shows, the Brazos River Authority (BRA) currently has close to 700,000 acre-feet of water rights, almost all of which is under long-term contracts. Yet, it never delivered more than 300,000 acre-feet of water to those who had contracts for water until 2011, when it delivered close to 500,000 acre-feet.[6]

Nevertheless, BRA would still likely have several hundred thousand acre-feet of water per year that could be used to meet short-term needs of others in the basin during droughts. For example, the City of Granbury has a take-or-pay contract with BRA for 11,000 acre-feet of water per year,[7] but it is currently using about one-fourth of that.[8] The maximum the city is ever projected to use by 2060 is 6,500 acre-feet per year.[9] Yet, under its contract, Granbury cannot sell any of its water to others. Nearby is Cleburne, which also buys water from BRA. The 2011 Region G plan says Cleburne will need several thousand acre-feet of additional water per year by 2060.[10] The plan strategies, including one costing over $14 million to provide additional supplies for Cleburne,[11] do not involve pumping some of Granbury's water or any other water currently under contract with BRA to Cleburne.

[4] See, Lower Colorado River Authority v. Texas Department of Water Resources, a 1984 Texas Supreme Court case, discussing surface water appropriation and modeling issues. Available at **law.justia.com/cases/texas/supreme-court/1985/c-1620-0.html**.
[5] Some water rights do have explicit return flow requirements and they are accounted for in the WAM.
[6] Brazos River Authority "Water Conservation Plan," (2012) page 4.
[7] Id. at page 3.2
[8] Id. at Appendix B-2
[9] Id.
[10] 2011 Brazos G Regional Water Plan, Region G Water Planning Group, September 2012, Vol. 1. Page 4A-7.
[11] Id. at page 4C-39-3.

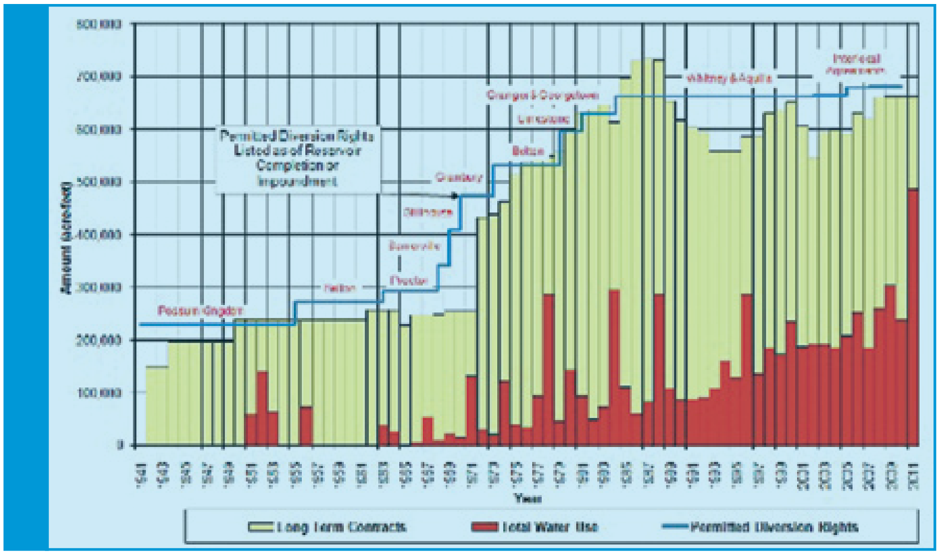

FIGURE 4.2 Permitted Diversion Rights and Total Annual Water Use of the Brazos River Authority

This is one small example of problems with current approaches to water use, contracting and planning. The key problem is that the planning process assumes that Granbury and others will use all of their water now. Thus, using RUN 3, the planning process assumes BRA is delivering all the water it has in water rights. But, as shown in this example, an alternative way of looking at water planning could identify supplies that could be flexibly used to help fill the demand/supply gap over the short term, and possibly over the long-term without the need for expensive new infrastructure.

To the extent the water planning process should identify ways to reach different potential futures and evaluate the costs and benefits of the options, different assumptions could and should be used in the WAM analyses and for planning purposes. Moreover, as with demand forecasting, the planning process would also benefit from clear explanations of the assumptions used and the potential value of using different assumptions or scenarios.

DROUGHT CONTINGENCY PLANS AS A SOURCE OF SUPPLY

The second important area that is not fully evaluated in the supply analysis under the current water planning process involves the determination of how much water could be saved during drought periods to reduce peak demands. As explained elsewhere, these peak demands drive the proposals for many of the new reservoirs and other new projects.

For several decades, drought contingency plans (DCPs) have been required as part of new applications to appropriate surface water for municipal, industrial, mining and agricultural use.[12] DCPs are not required for many older water rights, unless the right is amended to add additional appropriation, extend the term, or change the location or purpose of use.[13] DCPs are required, however, for older water rights of all wholesale water suppliers, retail public water suppliers, and suppliers of water for irrigation.[14]

The DCPs are to describe how water right holders will respond during drought conditions. For reservoirs, these plans typically involve triggers such as water levels in the reservoir, which, when reached, require specific actions. For example, when a reservoir's storage falls below a specified elevation, wholesale providers may request voluntary reduction in water use from its customers. If water levels continue to drop, mandatory reductions may be required in DCPs to achieve a specific percent reduction e.g. **TABLE 4.2**.

DCPs are not routinely incorporated into the future water use scenarios. When the WAMs are used to simulate available supply, the estimates they produce are based on the worst drought on record. They do not normally incorporate any of the response actions that are included in DCPs and that could lead to increases in available water, i.e. supplies. Although regional planning does allow for drought management plans to be incorporated as a strategy to meet the demand supply gap, most regional plans do not even employ them as strategies.

[12] The rules for such DCPs were last updated in 2004 and there are no requirements on reporting on the implementation or success of DCPs. There appears to be only minimal enforcement by TCEQ for failure to implement the plans. As a result, the lessons learned in the droughts of the last 5 or 10 years have not been incorporated and implementation of DCPs is basically done on a voluntary basis by the supplier of the water. For more, see **http://texaslivingwaters.org/drought/.**

[13] 30 Tex. Admin. Code Sec. 295.9.

[14] 30 Tex. Admin. Code Sec. 288.20 – 288.22.

For example, the 2011 Region C Water Plan states:

> Drought management and emergency response measures are important planning tools for all water suppliers. They provide protection in the event of water supply shortages, but they are not a reliable source of additional supplies to meet growing demands. They provide a backup plan in case a supplier experiences a drought worse than the drought of record or if a water management strategy is not fully implemented when it is needed. Therefore, drought management measures are not recommended as a water management strategy to provide additional supplies for Region C.

The idea that DCPs are not reliable sources of additional supply is unsupported and at least an oversimplification. All supply alternatives involve some level of reliability. Even reservoirs carry a certain level of risk as to whether they will provide the supply that they promise.[15] If DCP implementation can result in significant water use reductions, then it should be evaluated like other supply strategies with respect to benefits, costs and effects on natural resources.

The first step in this evaluation would be to quantify the potential supply that could be achieved through implementation of a reasonable DCP. There are several variables and options that will need to be considered. A DCP might need to be triggered only infrequently if it is structured to achieve immediate and significant reductions. Conversely, if a DCP involves starting earlier in a drought period with more steps and each requiring less significant reductions, a similar amount of water might be saved.

Water suppliers could also consider paying compensation for losses that result from required reductions in use. The costs of such payments may be cheaper than new projects. Purchase of dry year options for temporary fallowing of irrigated agricultural lands could free up significant amounts of water to meet those demands that cannot be eliminated or reduced significantly. This would allow farming to continue most years and provide the landowner with money during the drought.

The right mix for any DCP will be a function of a number of factors that should be considered by the water suppliers or users. They should be designed with clear goals, if not requirements, to ensure they result in the reductions in use that may be needed.

However they are structured, DCPs can be a powerful tool because the amount of water available from reservoirs, the firm yield, is based on drought of record conditions and because our water planning process focuses on meeting the peak water demands during drought period.

The WAMs provide a tool for a preliminary investigation of the potential yield effects of DCP implementation. Returning again to the example above, **FIGURE 4.3** shows the same information as in **FIGURE 4.1** above except here reservoir level is displayed as a percentage of water in storage rather than amount of water in storage.

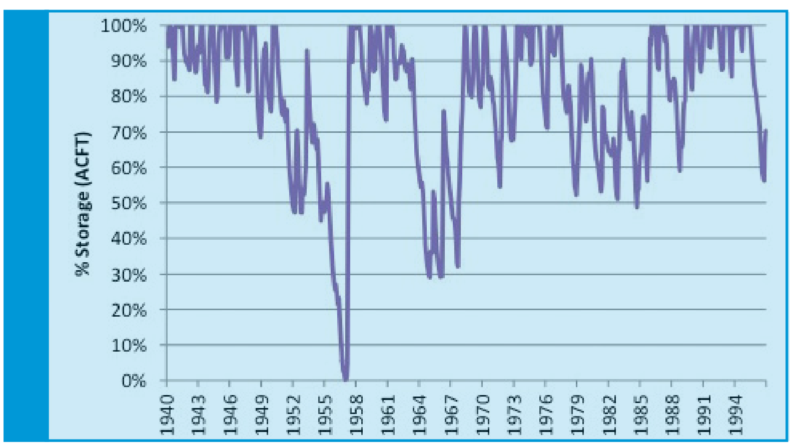

FIGURE 4.3 Firm Yield Storage Trace displayed as percentage of full

STAGE	STORAGE	DEMAND REDUCTION
Stage 1, Water Watch	75%	5%
Stage 2, Water Warning	60%	10%
Stage 3, Water Emergency	45%	20%

TABLE 4.1 Trigger levels for Drought Contingency Plan

[15] The issue of moving to a safe yield approach to lower the risk that a reservoir might run out of water is not addressed in this report. No such effort should be pursued, however, without first obtaining adequate data on actual uses and other factors that affect use of reservoirs such as limits on intake structures. Then the results should be used to develop different scenarios with which risks and options can be considered.

RESERVOIR NAME	RIVER BASIN	REGION	FIRM YIELD[17] WITHOUT DCP	WITH DCP	INCREASE	% INCREASE
Jim Chapman	Sulphur	D	131,540	145,600	14,060	11%
Wright Patman	Sulphur	D	467,480	520,680	53,200	11%
Lake O' the Pines	Cypress	D	162,600	182,440	19,840	12%
Tawakoni	Sabine	D	239,580	266,860	27,280	11%
Lake Fork	Sabine	D	177,920	196,960	19,040	11%
Richland-Chambers	Trinity	C	228,420	258,720	30,300	13%
Ray Roberts	Trinity	C	212,989	247,949	34,960	16%
Cedar Creek Trinity	Trinity	C	220,320	252,840	32,520	15%
Ray Hubbard	Trinity	C	58,740	67,060	8,320	14%
Bridgeport	Trinity	C	111,240	131,200	19,960	18%
Houston	San Jacinto	H	201,840	223,680	21,840	11%
Possum Kingdom	Brazos	G	385,820	430,660	44,840	12%
Belton	Brazos	G	103,500	123,100	19,600	19%

TABLE 4.2 Percentage Increase in Firm Yield Available from Thirteen Texas Reservoirs Assuming Implementation of Drought Contingency Plan

The drought contingency plan that applies to this reservoir includes three trigger levels which set demand reduction goals to be implemented when water supply reaches levels defined as a percentage of the total available storage. (**TABLE 4.1**)

Incorporating use reductions prescribed in the DCP in the calculation of water available during drought can result in a significant increase in the firm annual yield. Here the firm yield or amount of water available from this project, without considering drought contingency plans, is 220,320 acre-feet. In drought years and implementing this DCP, the yield would be increased by 32,520 acre-feet to 252,840 acre-feet, about a 15% increase in available water for use that year.[16]

The 15% additional supply for this reservoir is in the range of the percentage of supplies that would be available from a number of other reservoirs that were subjected to this type of analysis and using the TCWD's DCP. Those reservoirs and the percentage of additional supplies are shown in **TABLE 4.2**.

The 2012 State Water Plan lists 188 large water supply reservoirs in Texas with a combined firm yield of about 9.4 million acre-feet. Assuming the above results are characteristic among the large reservoirs across the state, implementing reasonable drought contingency plans could result in close to 1.5 million acre-feet of water being available during drought years, potentially reducing the demand-supply gap by 10% to 20%.

While it is beyond the scope of this report to conduct such a detailed analysis, it would seem highly appropriate for the regional groups and/or the TWDB to perform this analysis, evaluate the costs of implementation, and compare the results to other ways of reducing the demand-supply gap.

[16] The example reservoir used in the three figures above is based on TCEQ figures for Cedar Creek Reservoir and the DCP prepared by the Tarrant County Water District (TCWD) for the reservoir in 2009.

[17] Calculated using WAMs downloaded from TCEQ web site Nov. 2012. WAM information is available at **www.tceq.texas.gov/permitting/water_rights/wam.html**.

B. STEAM ELECTRIC POWER GENERATION SUPPLY

An analysis of the supply projections for Steam Electric Power Generation (SEPG) provides a further example of how the current state water planning process fails to focus adequately on efficient use of existing supplies and of how the emphasis on the 50-year planning horizon masks opportunities for more cost-effective or less environmentally-damaging near term supply strategies.

The SEPG water supply issue also illustrates the question of whether the state should be exercising more control to decide how existing supplies of water are used.

In the 2012 State Water Plan, SEPG accounts for almost 10% of the demand/supply gap (or "need") for water for all uses by 2060. The over-projection of future demand for the SEPG sector was discussed in Chapter 2.

The 2003 report on water demands for SEPG by the investor-owned utility companies (one of the sources of the over-projected demand) also provided an analysis of the existing supplies for SEPG.[18] Even with its inflated demand projections, that report predicted that total existing supplies for SEPG would exceed water demands for SEPG until the middle of the 2030 decade. **FIGURE 4.4**. That is also true for the SEPG demand projections in the 2012 State Water Plan.

Comparing the supply figures with the medium or high demand projection provided by BEG and discussed in Chapter 2 also suggests that total existing supplies will be adequate to meet total SEPG demands well past 2040. Moreover, this result is before accounting for recent changes in demand forecasts, such as the decision by Luminant not to expand its Comanche Peak nuclear power plant, a decision that reduces projected needs in Region G by 75,000 acre-feet per year.

Of course, total supply and total demand for the state do not reflect short-falls in some regions and excess water in others. The size of the supply and the changing SEPG water use patterns, however, raise some important questions about how Texas can efficiently meet demands for SEPG.

If the supply projections in **FIGURE 4.4** are correct, Texas currently has twice the supplies that are needed now and for the next ten years and clearly adequate supplies well past 2030. The first question is how those excess supplies are or can be used to assist Texas meet supply short-falls for other uses over the next ten or twenty years.

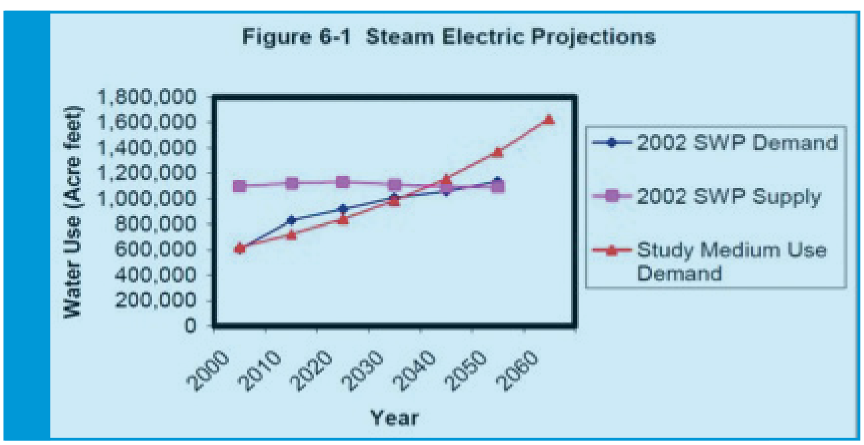

FIGURE 4.4 Supply Versus Demand for SEPG, from 2003 Report of the Investor Owned Utility Companies (FIGURE 6-1).

[18] Texas Water Development Board, "Power Generation Water Use in Texas for the Years 2000 through 2060," by Representatives of Investor-Owned Utility Companies of Texas (January 2003). Available at **www.twdb.texas.gov/publications/reports/contracted_reports/doc/2001483396.pdf**.

To answer that question, the water planning process would need to identify the location and amount of the excess supplies that currently exist and match them with those users needing the water in the short term. Such excess supplies might also be released from reservoirs to help with restoration of rivers and bays, at least in the short term. Another option, once the surplus supplies are identified, is to encourage the siting of new SEPG facilities where the supplies exist.

The regional planning process and the state compilation of regional plans are not, however, well suited for achieving such efficiencies. As Chapter 2 explains, projections for new SEPG are based more on regional goals for attracting power plants than on determining how many new power plants are needed in Texas and where to locate them given needs for power and access to water. A state effort would be needed to guide regional plans based on the overall state goals.

Matching excess supplies is more important for SEPG than other user groups, because of the nature of the water use in SEPG. Most SEPG units require much more water than they consume for once-through cooling systems. Large reservoirs of water are needed to cool the water that is heated in the power plants. The consumptive use is much less than the total amount of water that is needed. Rather than constructing new reservoirs for SEPG facilities, use of existing reservoirs to share existing supplies should be a state priority.

In addition, there are clearly ways to reduce water use by SEPG that could further stretch existing supplies for the future. More efficient systems for cooling SEPG facilities, such as dry cooling, are currently employed in Texas[19] and in other states. A study underway by the National Science Foundation and the Electric Power Research Institute is evaluating the water savings achievable from additional use of dry cooling.[20]

Thus, while there appears to be ample supplies for SEPG for the next 15 to 25 years, there is also a real possibility that expansion of the use of existing supplies through use of new technologies could provide adequate water for SEPG further into the future, possibly through the next planning horizon. If that were true, about 900,000 acre-feet/year of water or 10% of the total demand-supply gap projected in the 2012 plan for 2060 could be eliminated, reducing the need for new water supply projects.

The prudent planning process should focus on best use of existing supplies for the next 15 to 25 years. Any proposals for new water supply strategies that rely upon projected demands for new water for SEPG in the next 25 to 50 years deserve close scrutiny.

MANAGING EXCESS SEPG SUPPLY

Given that SEPG supply exceeds current demand in at least some areas of the state, and appears likely to continue to do so for the next decade or more, would it be appropriate to analyze whether some of that surplus could be made available to others in need of water? Likewise, we should be asking what happens if a power plant is shut down. Should the owner be allowed to sell all of its water right to the highest bidder? What should happen if a former base-load power plant is now run as a peaking plant and no longer requires as much as originally permitted for cooling?

With many coal plants now at, if not well over, their expected life, and the move to gas plants that require less water per BTU, can Texas expect to have even more excess supply for SEPG? Should some or all of the excess water be returned to the state so the state can decide who should be able to use it?

Moreover, if a new power plant is proposed at an existing site, should planners assume that it can simply use the same cooling technology, when water saving steps, such as dry cooling, may be reasonably available for new plants?

The amount of existing supply in the SEPG sector clearly justifies a hard look at these issues to allow Texas to decide how to best use its water and avoid costly and damaging new reservoirs and other large water projects.

[19] See note 30, Chp 2, BEG report pages 30-31.

[20] See National Science Foundation, "NSF/EPRI Collaboration on 'Water for Energy' – Advanced Dry Cooling for Power Plants," Program Solicitation, **www.nsf.gov/pubs/2013/nsf13564/nsf13564.htm.**

C. BRACKISH GROUNDWATER: AN UNDER-PROJECTED SOURCE OF SUPPLY

The 2012 State Water Plan projects that groundwater desalination will account for only about 181,000 acre-feet/year of new water supply by 2060, a mere 2% of the total new water supply envisioned by the plan. The plan does not provide discernable estimates of how much brackish water could be directly used for oil and gas production, for power plant cooling water, or for other uses where fresh water is not needed. Yet, a 2003 study for TWDB indicates that Texas has 2.7 **billion** acre-feet of brackish groundwater, some of it with salinity levels close to what is used for fresh water supplies.[21] This section explores the apparent disconnect between the availability of brackish groundwater and its projected role in meeting water demands.

Barriers to more extensive planning for use of brackish groundwater and desalination include lack of sufficient data on the resource, uncertainty about costs (including energy costs) and disposal of waste brine from the desalination process and regulatory uncertainties.[22] The dispute on where to draw the line between fresh and brackish water is also creating a barrier to greater direct use of brackish water.

Brackish groundwater, used directly or after desalination, should be able provide a much greater percentage of new water supplies if these barriers can be tackled at the statewide level.[23]

Desalination of brackish surface and groundwater is being used across the state, indicating that these barriers can be overcome and that desalination is an increasingly viable alternative to unreliable or over-stretched freshwater supplies. Particularly west of Interstate 35, where the current water plan projects construction of several expensive new surface water reservoirs, brackish groundwater can be a competitive and more reliable supply alternative.

Moreover, the current state water planning process fails to provide sufficient incentives or support for increasing use of brackish groundwater directly. Brackish groundwater can be used as an alternative to freshwater for power plant cooling, hydraulic fracturing, enhanced recovery of oil and gas, and for mining and other industrial activities. Doing so would allow greater use of freshwater resources for drinking water and other essential needs.

BRACKISH GROUNDWATER RESOURCES

Over the last 15 years, with encouragement from the legislature, Texas water planners have begun to pay more attention to brackish groundwater as a potential source of supply. In 2003, TWDB commissioned an extensive study by the firm LBG-Guyton and Associates. Using data from existing well logs and other sources, LBG-Guyton mapped brackish groundwater resources by salinity level (with anything over 1000 mg/liter total dissolved solids (TDS) considered brackish) and estimated volumes of brackish water present in the various aquifers across the state. **FIGURE 4.5** shows the results of that mapping.

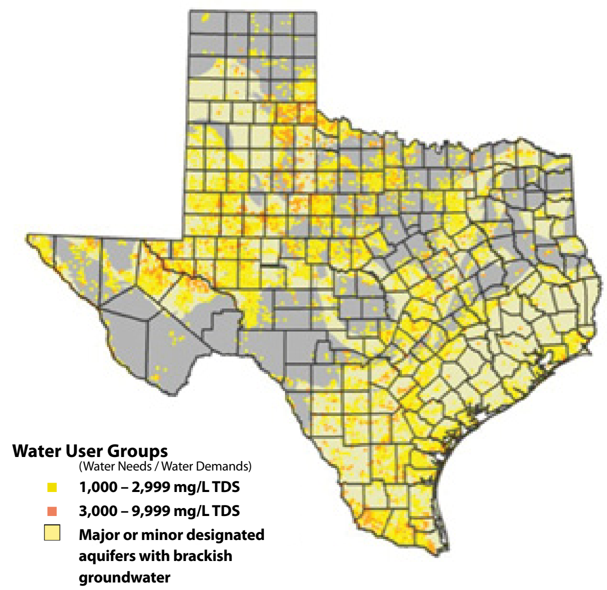

FIGURE 4.5 Brackish Groundwater Resources Map[24]

[21] Texas Water Development Board, "Brackish Groundwater Manual for Texas Regional Water Planning Groups," by LBG-Guyton Associates (February, 2003), **www.twdb.state.tx.us/publications/reports/contracted_reports/doc/2001483395.pdf**.

[22] Lone Star Chapter of the Sierra Club, "Desalination: Is It Worth Its Salt?,"(Nov. 2013) **http://texas.sierraclub.org/press/Desalination.pdf**.

[23] See, e.g., "Brackish Water Abounds, But Using It Isn't That Simple," Texas Tribune, Jan. 8th, 2014, **www.texastribune.org/plus/water/vol-2/no-2/plenty-brackish-water-underground-still-elusive/.**

[24] Texas Water Development Board, "Brackish Wells in the Groundwater Database," **www.twdb.state.tx.us/innovativewater/desal/doc/maps/bracwells_gw_db.jpg.**

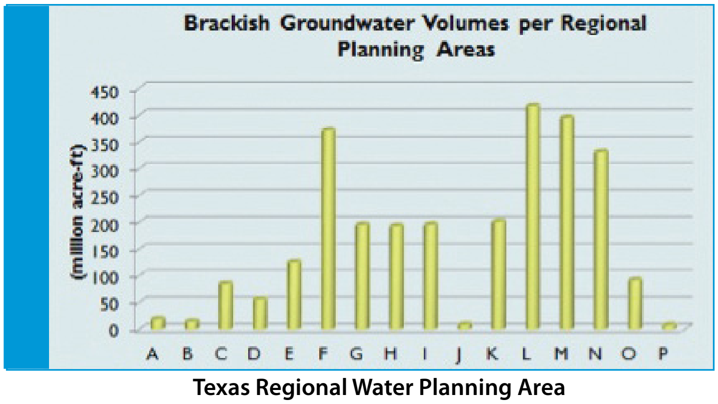

FIGURE 4.6 Brackish Resources by Region[25]

Region	2010	2020	2030	2040	2050	2060
E	0	1,607	3,304	4,764	16,245	27,726
F	2,004	2,954	2,954	15,050	15,050	15,050
L	0	14,000	26,596	33,116	38,716	40,216
M	33,951	62,239	67,170	73,955	86,409	90,915
O	0	3,360	3,360	3,360	3,360	3,360

TABLE 4.3 2012 Water Plan Proposed Brackish Desalination Water Supply Strategies

The TWDB used this analysis to estimate the volume of brackish groundwater of less than 10,000 mg/liter TDS available by planning region. **FIGURE 4.6**.

TWDB has also embarked on a project to provide more detailed mapping and characterization of brackish groundwater resources. The Brackish Resources Aquifer Characterization System (BRACS) uses existing geophysical log data which includes the deeper formations where brackish water is often found.[26] It began with the Pecos Valley Aquifer and is now focused on the Queen City and Sparta Aquifers in McMullen and Atascosa counties; the Gulf Coast Aquifer in the Lower Rio Grande Valley; and the Carrizo and Wilcox Aquifers in Central Texas.

Brackish groundwater desalination currently provides about 56,500 acre-feet/year of potable water supply. Existing brackish groundwater and brackish surface water desalination plants are shown in red in **FIGURE 4.7**.

In the 2012 State Water Plan, five planning regions (E, F, L, M and O) proposed using brackish groundwater desalination as a new source of municipal supply (**TABLE 4.3**). Almost half of the approximately 180,000 acre-feet/year total projected 2060 capacity would be in Region M, the Lower Rio Grande Valley. With an over-appropriated Rio Grande and only brackish groundwater, Region M has few other future water supply options.

[25] Jorge Arroyo, Texas Water Development Board, "The State of Brackish Groundwater Desalination in Texas," 2010 (Less than 10,000 mg/liter TDS).

[26] Texas Water Development Board, "Brackish Resources Aquifer Characterization System," **www.twdb.state.tx.us/innovativewater/bracs/index.asp**.

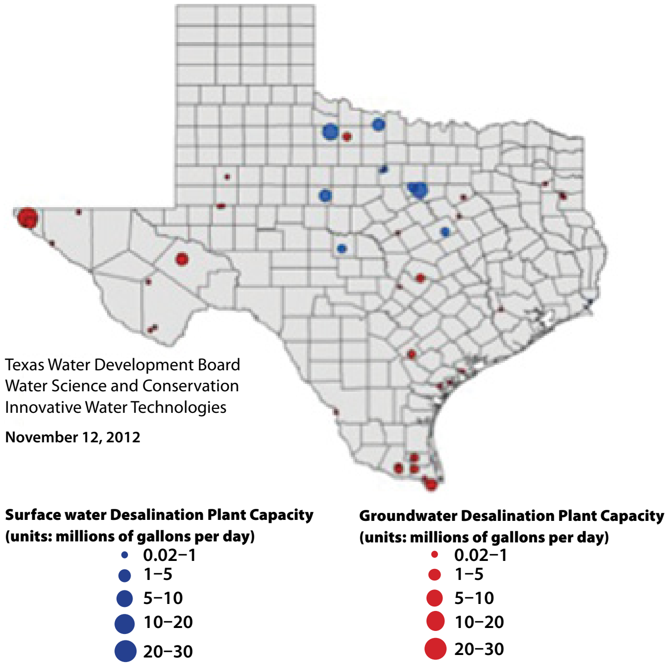

FIGURE 4.7 Texas Desalination Plant Capacity[27]

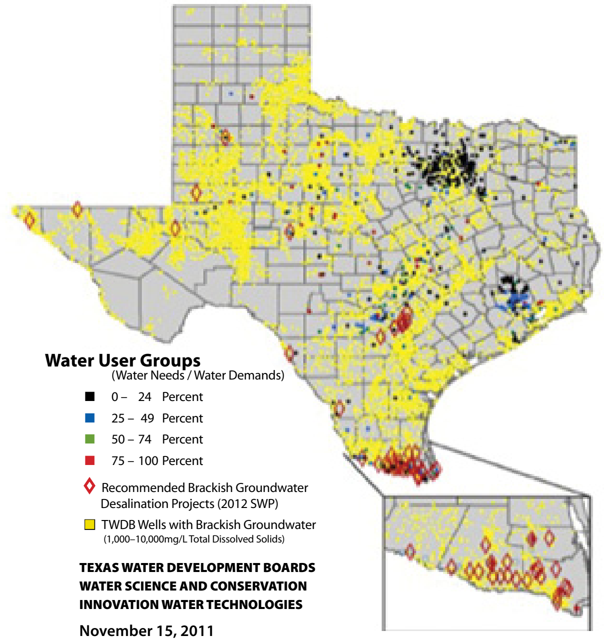

FIGURE 4.8 Water Needs relative to Brackish Groundwater Locations and 2012 SWP projects.[29]

Together, Regions L and M account for about 72% of the proposed new desalination capacity. The largest individual project proposed is by San Antonio Water System. SAWS is proposing development of a built-out capacity of at least 30,525 acre-feet/year brackish desalination facility in Bexar County with an estimated capital cost of $ 300 million.[28] (The 2011 regional water plans, from which Table 4.3 was prepared, reflects only 26,400 acre-feet/year capacity for the proposed SAWS plant.)

FIGURE 4.8 maps water user groups with projected unmet demands in conjunction with brackish resources and proposed projects. While the economics and viability of the use of brackish groundwater desalination for municipal needs is certainly site-specific, there are many water user groups with needs in areas with brackish groundwater resources where groundwater desalination has not been proposed as a future supply strategy.

Other cities beginning to actively examine brackish groundwater desalination projects that are not included in the 2012 State Water Plan include Odessa and Corpus Christi.

Some brackish water is currently used without desalination for oil and gas production and cooling water for SEPG.[30] There are, however, few incentives for increased direct use.

Apparently, none of the 2011 Regional Water Plans identified specific projects to use brackish groundwater for power plant cooling. This is a significant omission, since cooling water needs for steam electric power generation are projected by the 2012 Water Plan to increase significantly after 2030 or 2040. With the lead time available, Texas has time to create incentives or even require new plants to rely upon brackish water and reserve fresh water supplies for those uses that require fresh water.

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[27] Texas Water Development Board, "Texas Desalination Plant Capacity," (Nov. 2012) **www.twdb.state.tx.us/innovativewater/desal/doc/maps/desal_capacity_12.jpg**.

[28] SAWS recent announcement of a cooperative plant with City Public Service may increase the ultimate capacity of this desalination facility. See **www.saws.org/latest_news/NewsDrill.cfm?news_id=962**.

[29] Texas Water Development Board, "Brackish Groundwater Sources and Municipal Water Needs Relative to Projected Demands 2010," (Nov. 2011) **www.twdb.state.tx.us/innovativewater/desal/doc/maps/wug_plants_well.jpg**.

[30] Viability and Impacts of Implementing Various Power Plant Cooling Technologies in Texas, Texas Center for Applied Technology, Texas Water Resources Institute, Water Conservation & Technology Center, Texas A&M University System, August 2012, p. 2-3.

Region	Reservoir	Capital Cost (millions)	Yield (acre-feet)
B	**Lake Ringgold**	**$382.9**	**27,000**
G	**Cedar Ridge**	**$285.2**	**23,380**
	Coryell	**$51.9**	**6,730**
	Turkey Peak	**$50.3**	**7,600**
	Miller's Creek new dam augmentation	**$47**	**17,582**
O*	**Jim Betram 7**	**$68**	**17,650**
	Post	**$110**	**25,720**

TABLE 4.4 Reservoirs Proposed in 2012 State Water Plan for West of IH-35

* Both Region O Reservoirs are proposed to store a significant amount of reclaimed water discharged from the City of Lubbock's sewage treatment plants. Also, the yields reported in the Region O plan are substantially higher than those in the City's 2013 Water Resources Plan.

There are a number of other examples of the failure of the water planning process to evaluate the benefits of direct use of brackish ground water or to propose ways to encourage such use. For example, while state legislation in the 1980's required oil companies to evaluate the use of brackish groundwater as an alternative to fresh water for enhanced recovery of oil and gas, that has not been done for fracking water.

The Railroad Commission may request justification of use of fresh water for enhanced recovery,[31] and brackish water is now used more than fresh water for enhanced recovery.[32] Greater use of brackish water for hydraulic fracturing is possible, but it is not required or even encouraged in a systematic fashion.[33] Such use would be especially beneficial where freshwater use is putting pressure on local aquifer levels.[34]

DESALINATION VERSUS RESERVOIRS

As recent years have shown, reservoirs west of IH-35 are extremely vulnerable to drought and higher temperatures. Reduced inflows and increased evaporation have brought major supply reservoirs in this area, such as Lakes Ivie, Spence, Meredith, Fisher, Abilene and others, to 10% or less of normal storage capacity, and most others are near 25% capacity (maps).[35]

Despite the clear unreliability of reservoirs as a water supply strategy in this part of the state, the 2012 Plan proposed 7 new surface water reservoirs west of IH-35 (**Table 4.4**), with a total yield of about 126,500 acre-feet/year and a total projected capital cost of $895 million. Most of these projects are targeted to municipal water supply, though the proposed Cedar Ridge Reservoir near Abilene was also justified on the basis of a proposed new power plant (a plant that has since been cancelled).

For example, in the 2012 Plan, Wichita Falls in Region B proposes development of Lake Ringgold, which would purportedly supply about 27,000 acre-feet/year in 2050 at an estimated cost of $382,900,000.[36] This potential reservoir site was first identified in the early 1980s. It was not included as a proposed supply strategy in either the 2002 or the 2007 Region B plan, though it was included in the "unique reservoir site" designations recommended by TWDB in the 2007 State Plan and in the subsequent list of unique reservoir sites listed in Senate Bill 3, which was passed by the legislature in 2007.

Wichita Falls overlies the Seymour Aquifer. The 2003 LBG-Guyton report characterizes brackish groundwater availability from that aquifer in Region B as "moderate" and as having "low" production costs. Yet, the 2012 Region B plan did not evaluate brackish groundwater desalination as an alternative to the Lake Ringgold site. (Region B does propose desalination of surface water stored in Lake Kemp, which is currently at about 25% capacity). The Region B plan's evaluation of Lake Ringgold fails to acknowledge the problems that have arisen with other nearby reservoirs, in terms of lack of inflows and sedimentation, even concluding that a new lake would have "good reliability."[37]

Similarly, Region G recommends three expensive new reservoirs west of IH-35 (Turkey Peak, Cedar Ridge, and Coryell County) and a new dam for increasing the capacity of an existing reservoir for a combined total capital cost of over $334,000,000 and purportedly able to supply a combined total of about 56,000 acre-feet/year. Region G appears to have examined groundwater desalination alternatives only in the northeast portion of Johnson County, despite the LBG-Guyton report characterizes several areas of Region G, west of IH 35, as having moderate availability and productivity of brackish groundwater.

[31] Water Use I Association with Oil and Gas Activities Regulated by the Railroad Commission of Texas, Senate Natural Resource Committee, January 10, 2012, page 2, See, **www.senate.state.tx.us/75r/Senate/commit/c510/handouts12/0110-RRC.pdf.**
[32] Id.
[33] Id.
[34] See, e.g. "Fracking Boom Spurs a Rush to Harness Brackish Water," (March 2013) **stateimpact.npr.org/texas/2013/03/28/drilling-boom-spurs-a-rush-to-harness-brackish-water/**.
[35] Texas Tribune, "Texas Reservoir Levels," available at **www.texastribune.org/library/data/texas-reservoir-levels/**.
[36-37] *On next page.*

While the Region O reservoirs would store a significant amount of treated wastewater (vs. just rainfall run-off), their expense and potentially contentious permitting issues seem to justify a harder look at desalination. Desalination was ranked low in the city's strategic plan largely because of the lack of data on brackish groundwater resources. This may also be an area of the state where co-locating quick-start natural gas peaking power plants with desalination facilities is an attractive option.

LEGAL ISSUES

In 2011, the House Natural Resources Committee interim charges included a directive to evaluate "the status of desalination projects in Texas, including an evaluation of the regulation of brackish groundwater and whether opportunities exist to facilitate better utilization of this groundwater to meet future needs." The Committee's Report included the following recommendations:

PILOT STUDIES AND PERMITTING

Consider the effectiveness of pilot studies and testing requirements in the development of desalination projects.

Continue streamlining the process review for planning in order to expedite the permitting process for a desalination plant.

LOCAL AND REGIONAL PLANNING

Encourage local and regional entities to further consider desalination as an available alternative water supply to meet immediate demands, especially in times of drought.

WASTE DISPOSAL OF BRINE

Continue studying the environmental impacts of brine disposal, while continuing to improve and advance more cost-effective disposal methods.

DISTINGUISHING BETWEEN FRESH GROUNDWATER AND BRACKISH GROUNDWATER

Consider clarifying statutory language in order to distinguish fresh groundwater from brackish groundwater in the management and development of groundwater resources.

As a result of the legislative interest, the Texas Commission on Environmental Quality (TCEQ) recently addressed the pilot testing requirement by revising its guidance to allow computer modeling in place of pilot testing for most desalination projects that will provide potable water through a public water supply system, as well as making some other changes to streamline permitting.

Likewise, a host of desalination bills were filed in the 2013 legislative session based on the work in 2011. One of the most comprehensive was HB 2578 by Representative Lyle Larson (R, San Antonio), a member of the House Natural Resource Committee. HB 2578 passed the House but did not make it through the Senate. As it passed the House, it would have required that each regional water planning group examine "opportunities for and the benefits of developing large-scale desalination facilities for brackish groundwater or seawater that serve local or regional brackish groundwater production zones." It would have also expanded TWDB responsibilities for feasibility studies and legislative reporting to include brackish groundwater desalination (in addition to current responsibilities for seawater desalination). It would have required groundwater conservation districts to identify "goals for the development of brackish groundwater desalination strategies in designated brackish groundwater production zones." Finally, it would have prohibited desired future conditions, which are set by groundwater management areas, from applying to brackish water zones. As initially filed, the bill would also have defined brackish groundwater as having a total dissolved solids content between 1,000 and 10,000 mg/liter.

The debates over HB 2578 illustrated some key legal issues that need resolution in order for brackish desalination to fulfill its potential. These include, but are not limited to:

- A statutory definition for brackish groundwater (whether it should start at 1,000 mg/liter TDS or a more concentrated level, or whether a qualitative definition linked to the need for desalination treatment before use is a better option);
- Whether desired future conditions and managed available groundwater limits for aquifer management should apply solely to freshwater or should include brackish water, and, if brackish water is included, guidance for developing separate DFCs and MAGs for brackish zones; and
- How to protect freshwater aquifers from infiltration of poorer quality water that may result in some locations if too much pumping of brackish groundwater.

Of course, the state of legal uncertainty surrounding ownership rights and the extent that groundwater districts can regulate groundwater in Texas further complicates brackish groundwater projects that involve purchasing pumping rights from private landowners.

[36] See, e.g., "Lake Ringgold Study," by Freese and Nichols (Nov. 2013) **www.slideshare.net/kfdx/lake-ringgold-study-november-5-2013**.

[37] It is not clear that Lake Ringgold would even be needed at all, given that the 2060 supply shortfall for Wichita Falls is predicted to be less than 5,000 acre-feet/year. Thus, the Region B plan could have examined a smaller scale brackish groundwater desalination plant for comparison.

Even with improved technology (and potentially lower costs), brackish groundwater desalination will not be a silver bullet for every community's future water needs. However, it appears that there is significant potential for a more extensive use of brackish ground water through direct use or desalination. It would be a viable and sustainable strategy in areas of the state where traditional reservoir strategies are increasingly unreliable.

To ensure that brackish ground water can play a significant role in filling future water needs, much more should be done at the state level to resolve statutory and regulatory barriers and to create incentives for its use. The new Senate Natural Resources Committee interim charges,[38] which include a directive to examine recommendations to encourage the use of brackish resources, and the newly-established Joint Interim Committee on Desalination, provide important opportunities to move forward on these critical issues.

LAND STEWARDSHIP

The 2012 State Water Plan projects that about 20,000 acre-feet year of new water supply could be derived from removing ash juniper and other brush species to revive spring flow. Greater use of brush control and a broader conception of land stewardship activities could produce a much more significant supply.

For example, a Texas Wildlife Association report predicted that 503,446 acre-feet of water could be saved through brush control over a 10-year period.[39]

Likewise, funding conservation easements on existing farm and ranch land can preserve aquifer recharge zones, enhancing groundwater supplies. Cities such as San Antonio and Austin are already moving forward with this option, and the new Texas Agricultural Land Trust is poised to expand this option throughout the state.[40] Other options include funding for voluntary changes in grazing or farming practices to enhance recharge and stream flow.

To date, these larger opportunities to increase water supplies though land stewardship have not received sufficient attention or quantification in the regional water planning process. Opportunities do exist in many areas of the state and should be made a priority in the water planning process.

D. CONCLUSION

The obvious first question that the planning process should ask is how Texas can better use its existing supplies. There are a number of options, some that are addressed in the current planning process and some that are clearly not receiving the attention that they should.

Excessively conservative estimates of available surface waters from reservoirs are driving up the demand-supply gap significantly. This approach is resulting in proposals for projects in the short term that will not be needed if, for example, serious drought contingency plans are required and implemented. Moreover, it appears that projections of supplies could be increased by over 1 million acre-feet of water by 2060 during the peak use drought periods with strong implementation of drought contingency plans.

Excess supplies for SEPG should be available for the next 20 to 30 years for increased demands in SEPG and other uses. New energy generation and cooling technologies should also increase the amount of water available for this sector and other uses after 2040 significantly.

Use of brackish water, especially brackish groundwater, offers significant new supplies for many uses. Desalination is likely to provide much more fresh water than is projected in the 2012 state plan. Direct use of brackish water could also free up fresh water for other uses. There may indeed be sufficient brackish groundwater to meet many future demands at costs similar to those for the more expensive currently proposed strategies to develop freshwater, such as reservoirs.

[38] See Committee charges at **www.ltgov.state.tx.us/prview.php?id=511**.

[39] "Texas' Looming Water Crisis: Recognizing Land Stewardship's Untapped Potential," Texas Wildlife Association, 2004, page 6.

[40] See website at **www.txaglandtrust.org/**.

THE PATH FORWARD

PEDERNALES FALLS, PEDERNALES STATE PARK ©LOIS SCHUBERT

This chapter presents the major findings and conclusions derived from the demand and supply analyses of previous chapters. It also contains several policy recommendations for improving Texas' water planning process, with the goal of ensuring affordable, sustainable water for people and healthy rivers and bays.

A. REDUCING THE DEMAND/SUPPLY GAP

The analysis presented in Chapter 2 (demand) and Chapter 4 (supply) shows that the 2060 demand/supply gap of 8.3 million acre-feet/year projected by the 2012 State Water Plan is greatly over-stated.

On the demand side, Chapter 2 provides several examples of how the Plan overstates how much water Texas will need. It shows that the projected 2060 demand could be reduced by **(1)** more reasonable municipal demand and conservation projections in Region C; **(2)** more reasonable irrigation demand projections in Region O; and **(3)** more reasonable demand projections for steam electric generation statewide.

On the supply side, Chapter 4 has examples of how available supplies could be greatly extended or increased by: **(1)** reasonable drought contingency plan implementation; **(2)** increased use of brackish water; and **(3)** other steps to use existing supplies.

TABLE 5.1 summarizes the demand/supply findings of Chapters 2 and 4.

AREA OF ANALYSIS	FINDING	COMMENT
Reduction in Region C municipal demand/supply gap.	Over 1 million acre-feet/yr of the projected demand/supply gap could be reduced with new projections and a 140 GPCD 2060 target for all municipal user groups.	Would eliminate the need for Marvin Nichols (at least). Marvin Nichols alone would cost at least $3.3 billion.
Eliminate over-inflation of Region O irrigation demand.	Eliminates 2.146 million acre-feet/yr of over-projected demand.	Demands in Region O should reflect reality of limitations on use of the Ogallala Aquifer.
More reasonable steam electric power generation demand projections.	Reduce SEPG demand projection by at least 500,000 acre-feet/yr by 2060.	Planning should be based on reasonable need for new electric generation, as scoped by the Bureau of Economic Geology, not on regional desires for attracting new coal-fired power plants.
Implement effective drought management plans for all major Texas reservoirs.	Extend existing supply by an estimated 1.5 million acre-feet/yr.	Estimated using reasonable drought triggers applied to all of Texas' major supply reservoirs.

TABLE 5.1 Demand/Supply Findings Summary

Taken together, these four items would reduce the projected 2060 demand/supply gap from 8.3 million acre-feet (as projected in the 2012 State Water Plan) to about 3.3 million acre-feet.

The resulting reductions in demand-supply gap could significantly reduce the price tag for the State Water Plan.[1] In addition, this report has shown that a more sustainable and affordable water plan for Texas would make greater use of brackish groundwater desalination, better use of the existing supply for steam electric power generation and increased implementation of land stewardship to benefit streams and aquifers.

B. POLICY RECOMMENDATIONS

The Texas water planning process has increased decision-maker and public attention to water issues and provided a forum for involving people from various water use sectors all across the state. The bottom-up approach has benefits; however, it also has led to inconsistent planning across the regions and decisions that do not always reflect the broader state interests.

The state has essentially used the same process and the same set of rules and guidelines for three rounds of planning over the last 15 years. Now, as Texas faces a continuing severe drought, the effects of which are magnified with a population that has grown by 6.5 million since 1997,[2] it is time for the planning process to evolve once again. Our recommendations fall into categories:

- Developing more realistic demand projections;
- Ensuring more effective use of existing supplies;
- Making healthy rivers and bays and vibrant rural economies co-equal goals to the other goals of the planning process;
- Moving away from the 50-year, single-scenario planning approach;
- Improving the baseline data and modeling for all aspects of planning;
- Making broader policy improvements in Texas water management that will benefit development of a sustainable water plan.

MORE REALISTIC DEMAND PROJECTIONS

Chapter 2 discusses several areas where future water demand is over-projected substantially. The state could take steps to generate more realistic demand projections. As the discussion of the Region C plan shows, a serious effort to reduce the per capita use of water can reduce demands significantly, at least in regions with major urban areas. The state may, however, need to set standards or create significant incentives to assure a continuous process of conservation. State funds to replace lost revenues for cities that have overbuilt water supply infrastructure may be needed in the short term and disincentives for overbuilding in the future should be considered.

Likewise, TWDB should also exercise more substantive review of demand projections for other user groups. It should adopt rules that direct projected irrigation demands to be more reflective of a probable future than one where demand is based on what irrigators would like to pump if they had unlimited supply.

Finally, each new regional or state plan should not simply be built on the prior plan. Major new manufacturing facilities, power plants, or other sources of significant demand projections should not automatically be included in new plans. Justification of such projects and reevaluation of the resulting demands should be required to assure more accurate demand projections.

TWDB could also take a much more strategic look at how many new power plants, of what type, are likely to be located in Texas and plan for steam electric power generation use on that basis, rather than letting each region project its SEPG water demand on the basis of wanting to attract new power plants. While this would be a deviation from the strict bottom-up planning that Texas has been engaged in for the last 15 years, there is sufficient data to show that SEPG demand projections in that current process are often significantly exaggerated by the regions.

MORE EFFECTIVE USE OF EXISTING SUPPLIES

As the analysis in Chapter 4 demonstrates, making different assumptions about likely use of existing permits, return flows, and the effectiveness of drought management plans on reservoir supplies could show that existing supplies can be stretched much further to meet increasing demand, at least over the near-term.

While it is not possible to quantify exactly how much more water might be made available through these approaches, TWDB should require all regions to take a more systematic and aggressive look at these issues. TWDB could, for example, require each region to look at the difference in available supply between the Run 8 of the Water Availability Model (current use and return flows) versus Run 3 of the Water Availability Model (full use of paper permits and no return flows except required by permit). Identification of significant differences could lead to ways to better use the water not needed for many years into the future. That analysis would at least add transparency.

[1] The resulting cost reduction was not determined, since they will depend upon the mix of strategies chosen to fill the gap. The figure would not necessarily be proportional to the reduction in the gap.

[2] Texas State Library and Archives Commission, "United States and Texas Populations 1850-2012," available at **www.tsl.texas.gov/ref/abouttx/census.html**.

Similarly, a requirement that regions evaluate a wide range of steps for saving water that could be included in drought contingency plans should help identify ways to reduce peak demands during droughts. TWDB should also adopt rules or guidance that focus on reductions in the peak uses, not simply assuring adequate supplies during drought years, regardless of how those peak demands could be reduced.

As shown in Chapter 4, the 2012 State Water Plan proposes only 180,000 acre-feet/year of new brackish groundwater desalination by the year 2060, far short of the available supply. While it might be reasonably expected that more brackish use will be proposed in the 2017 Plan, resolving the legal issues surrounding brackish groundwater desalination will be essential if this water source is to meet its potential. The recently created joint interim legislative committee on desalination[3] is a golden opportunity to make progress on these issues with consensus recommendations, providing a basis for action by the 2015 session of the legislature.

Another step the legislature could take is to amend planning rules and the provisions of HB 4 to encourage the regions to propose projects that meet both human and environmental water demands. Projects of this type include, but are not limited to: re-use projects that meet municipal demand while dedicating a portion of the re-use to environmental flow needs; voluntary market transactions of water from one use to another, with a portion of the transacted water dedicated to flow needs; construction of off-channel reservoirs that will be operated to meet both human demand and environmental flow needs; and land stewardship projects that help increase aquifer recharge and spring flow.

These kinds of projects, which may be particularly important during drought times, will help avoid environmental conflict and degradation while effectively meeting reasonable municipal, industrial or agricultural demands.

Other ways to use existing supplies more effectively also deserve greater consideration. Reallocation of storage capacity in reservoirs, better regional interconnection of supplies and increased use of aquifer storage and recovery have all been considered on an ad hoc basis, but TWDB has neither done the type of study needed or required regions to look closely at these alternatives for extending existing supplies.

HEALTHY RIVERS AND BAYS AND VIBRANT RURAL ECONOMIES AS CO-EQUAL TO THE OTHER PLANNING GOALS

With the broad goals of SB 1 of protecting state and local economies and agriculture and natural resources and with the added focus of SB 2 and SB 3 on goals of protecting environmental flows, the planning process needs to evolve to one that helps find balanced solutions to future water needs. The SB 1 process clearly was not intended just to project demands and recommends strategies in a vacuum. A true planning process needs to integrate the state's and regions' broader goals and identify options for meeting the full range of goals. Failure to do so can, in many cases, lead to strategies that cannot be implemented or can only be implemented with great costs to the cultural, natural, and historic resources of the state.

NEW PLANNING APPROACH

Given the uncertainty of 50-year demand and supply forecasts and the difficulty of predicting what water-saving and treatment technologies may come on line by then, the planning process should shift to focus more heavily on the next two to three decades. While decadal projections are included in the 2012 and prior state plans, virtually all the public relations and other emphasis has been on the 2060 figures (8.3 million acre-feet per year demand/supply gap and $53 billion in funding).

As our analysis demonstrates, many of the big demand/supply gaps and expensive projects designed to meet those gaps will not occur until the last decade of the Plan, if then. Spending time and money now on those proposed projects only distracts from what must be done to meet more demonstrable needs in the shorter-term.

Chapter 4 shows how many demands could be met with existing supplies in the short term. Priorities for planning, permitting and funding should be focused on strategies for which there are clear needs, not on speculation of long-term needs that could result in over building and disincentives for conservation and peak demand reductions.

The uncertainty in demand and supply forecasting also argues for a multiple scenario approach to planning, especially for the longer-term. For example, instead of precise projected demand figures for municipal use for each water user group in a region, the planning process could be used to look at a range of likely demand scenarios, from low to high, that would in turn allow a more serious look at a range of supply strategies, from increased emphasis on conservation to more expensive infrastructure projects. Such an approach to planning would not only provide decision-makers with a clearer choice among water management alternatives, it would show the public the actual costs embedded in the currently obscure assumptions behind a "one scenario" approach.

[3] Office of the Lieutenant Governor, "Lt. Governor Dewhurst Issues Interim Charges for Natural Resources, Announces Water-Related Appointments," January 16, 2014, available at **www.ltgov.state.tx.us/prview.php?id=511**.

The TWDB should require each region to develop scenarios. It could require a "low demand" scenario reflecting stronger assumptions about how per capita use is likely to trend downward and the savings in peak demand that could be achieved by implementation of drought contingency plans.

Both the state of Colorado's Statewide Water Supply Initiative (SWSI)[4] and the federal Colorado River Basin Study[5] provide potential models for scenario-based planning approach that also helps focus on near-term versus longer-term demand/supply gaps. In fact, the 1997 State Water Plan included an initial approach to using scenarios, but that approach was not carried forward in the SB 1 planning process.

BETTER BASELINE DATA AND MODELING

As documented in Chapters 2 and 4, there is significant room for improvement in the state's baseline water use and supply data collection, which is critical for a planning process that is used to set priorities on state funding and permits. In particular, data on water use in the irrigation, mining, and steam electric power generation sectors could be improved through more use of monitoring (versus estimated use) and stronger enforcement of the existing TWDB and TCEQ rules on use reporting. Improved data on brackish water supplies are needed. Collection of more accurate data by groundwater districts is also needed, but will require additional state funding.

To limit costs, such data collection can, however, be focused on the areas where the need is the greatest. The water availability models (WAMs) used for planning also need to be improved with the addition of more recent hydrological data and, in some areas, more flexibility to model different assumptions about reservoir operations and levels of use of existing permits. In priority areas of the state (where demand is bumping up against supply and surface and groundwater are clearly interconnected), integration of the surface water WAMs and groundwater availability models (GAMs) or some other approach is needed to provide regions the data that they need to avoid overestimating supplies or ignoring potential impacts of different strategies. Again, the effort could be focused where it is needed most for the near term.

BROADER POLICY IMPROVEMENTS

While this report is focused on the water planning process, it is impossible to completely separate water planning from the overall legal and institutional context for water management. It is beyond the scope of this report to detail the policy improvements that have been described in previous reports by various sources, including legislative committees, universities, and conservation organizations. Several improvements are vital, however, including:

- Enhancing groundwater management by assuring better data on aquifers and impacts of pumping on supplies, quality and surface water where there is interconnection between the ground and surface waters;[6]
- Requiring stronger integration of water and energy planning and permitting at the state level to take advantage of existing water supplies and water saving technologies; [7]
- Better recognition of and planning for the connections between land use, water use, and water supply, especially in rapidly suburbanizing counties; [8]
- Improving municipal water rate design to foster conservation while ensuring adequate revenue; and[9]
- Increasing public awareness and understanding of Texas water challenges and the benefits of and opportunities for conservation.[10]

[4] See, e.g., "Basin M&I Gap Analysis," page 4, available at **www.cwcb.state.co.us/public-information/publications/Documents/ReportsStudies/GapAnalysisMemo-062111FinalWFigures.pdf**.

[5] U.S. Department of Interior, "Colorado River Basin Water Supply and Demand Study," available at **www.usbr.gov/lc/region/programs/crbstudy.html**.

[6] See, e.g. Texas Center for Policy Studies, Groundwater in Texas: Policy Recommendations for the 83rd Legislative Session, January 2013, available at **www.texascenter.org/water_plan.html.**

[7] See, e.g., The University of Texas at Austin and Environmental Defense Fund, Energy Water Nexus in Texas, April 2009, available at **www.texaslivingwaters.org/wp-content/uploads/2013/04/energy-and-water-in-tx09.pdf.**

[8] See, e.g. Texas Association of Land Trusts, www.texasaglandtrust.org and Hill Country Alliance, **www.hillcountryalliance.org**.

[9] University of North Carolina and Lone Star Chapter of the Sierra Club, Designing Water Rate Structures for Conservation and Revenue Stability, March 2014, available at **texaslivingwaters.org/wp-content/uploads/2013/04/energy-and-water-in-tx09.pdf**.

[10] See, e.g., **http://texaswater.org/**.

Appendices

Appendix A:	Financing a Sustainable Water Plan for Texas
Appendix B:	Rules and Guidance of Texas Water Development Board for Water Planning
Appendix C:	Legal Authority of State and Regional Agencies to Obtain Historic and Projected Water Use Data for Mining and Other Uses.
Appendix D:	Excerpts from the 2011 Region D Regional Water Plan on Environmental Flows
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Appendix A

Financing a Sustainable Water Plan for Texas

In a series of three guest blogs for the Texas Center for Policy Studies, Sharlene Leurig, Water Program Director for CERES, discusses the details of Proposition 6, the water project financing measure approved by Texas voters on November 5th. Proposition 6 amends the Texas constitution to appropriate $2 billion from the state's Rainy Day Fund to seed a new water infrastructure loan fund directed to water supply projects included in the State Water Plan.

Sharlene's three posts examine how this new fund will work (in concert with House Bill 4, passed in the recent session of the Texas legislature) and what it could achieve—or fail to achieve—in terms of Texas' water security. The first post focuses on the mechanics of the fund and what choices the Texas Water Development Board (TWDB) is likely to face in ensuring that the $ 2 billion appropriation is used for maximum public benefit. The second post looks at how administration of the fund will be affected by the new project prioritization process authorized by House Bill 4, the companion legislation passed earlier this year. The third post explores whether and how the fund can be used to support water conservation projects.

Installment 1: Proposition 6 and the Mechanics of Funding State Water Plan Projects

This post examines how the new infrastructure loan fund will operate and the choices that will need to be made to ensure that the funds are allocated for maximum public benefit. It explores the tensions between using the new fund for "state participation" in longer-term, big-ticket projects, such as reservoirs and pipelines, versus distributing funds more widely to smaller, near-term projects across the state. (*Note: the following discussion draws on an excellent analysis of the mechanics of Prop 6 and differences with existing financing mechanisms by the Energy Center at the University of Texas School of Law*.)

The 2012 State Water Plan estimates that the cumulative capital cost of all recommended water management strategies through 2060 would be $53.1 billion, only $26 billion of which the Regional Planning Groups reported could be financed through local capacity. As part of the 2012 Plan, TWDB recommended that the Legislature "develop a long-term, affordable, and sustainable method to provide financing assistance for the implementation of the state water plan."

This recommendation was taken up by the Legislature in the 2013 session in three pieces of legislation: House Bill 4, House Bill 1025 and Senate Joint Resolution 1. Collectively, these bills: restructured the Texas Water Development Board (see TCPS's post on the restructuring here), established the State Water Implementation Fund for Texas (SWIFT); and sent voters a ballot proposition to approve the transfer of $2 billion from the Economic Stabilization Fund ("Rainy Day Fund") to SWIFT. With Proposition 6 approval, the $2 billion will be permanently transferred from the State Treasury to a trust held by the state on behalf of the Texas Water Development Board, to be used exclusively for the financing of recommended water management strategies in the State Water Plan.

TWDB is the state's water infrastructure financing agency, providing $14.3 billion in loans for water and wastewater infrastructure across the state over the last 56 years. TWDB makes use of its superior credit rating and low borrowing costs to raise money through bond sales. It then lends that money to local sponsors of water projects at a lower interest rate than what would be available to the local if it sold its own bonds in the open market. For very small systems, the subsidized lending made available by the TWDB is especially critical as they have fewer options for borrowing money.

Despite this substantial amount of financing activity at the state level, Texas water infrastructure needs have been growing, while TWDB's lending capacity has been limited by Article III, § 49 of the state Constitution, which generally prohibits the state from issuing debt without voter-approved expansion of constitutional authority.

In 2011, Texas voters approved a constitutional amendment granting TWDB authority to issue up to $6 billion worth of debt for the Texas Water Development Fund II. One of the issues in the Prop 6 election was the difference between the new Prop 6 funding and the previously authorized $6 billion. The answer generally comes down to the state's constitutional debt limit.

While bonds sold under this new authority were considered "self-sustaining" they are counted against the debt limit of the state—which prohibits new bond issuances when the percentage of debt service payable by general revenue in any fiscal year exceeds 5% of the average unrestricted general revenue for the past three years. This can theoretically limit the ability of the TWDB to issue future bonds. So while the TWDB technically could have $6 billion of active market debt, it is constrained in its own debt issuance by the larger set of debt obligations undertaken by other Texas agencies and by the state's constitutional debt limit.

Thus, H.B. 4 and Prop 6 seek to create a self-sustaining funding mechanism for water supply projects that can grow beyond the initial $2 billion allocation without bumping up against the state's debt limit. That is, the $2 billion can be used to fund much more than $2 billion in capital costs, but the total amount of financing will depend on how the funds are used.

Table 1 provides a definition of some terms that are key to understanding the specifics of the new financing mechanisms.

Table 1. Glossary of Key Terms (adapted from Investopedia)

Term	Brief definition
Revolving Loan Fund	A fund that is structured so that repayments can be used to make more loans. As borrowers repay their loans, this money is made available to new applicants. A fund has fully revolved when all of the original principal lent has been repaid.
Bond	A debt investment in which an investor loans money to an entity (corporate or governmental) that borrows the funds for a defined period of time at a fixed interest rate. Bond buyers are repaid both principal and interest.
General Obligation Bond	A municipal bond backed by the credit and "taxing power" of the issuing jurisdiction rather than the revenue from a given project. Also called a "GO" bond. Most bonds issued by the Texas Water Development Board have been GO bonds.
Revenue Bond	A municipal bond supported by the revenue from a specific project, such as a wastewater treatment plant or reservoir. Revenue bonds are municipal bonds that finance income-producing projects and are secured by a specified revenue source. Most locally-financed water infrastructure in the United States is financed by revenue bonds repaid by payments from water or wastewater system customers.
Credit Enhancement	A method whereby a borrower attempts to improve its debt or credit worthiness. Through credit enhancement, bond buyers are provided with reassurance that the borrower will honor the

Term	Brief definition
	obligation. Credit enhancement can take many different forms, including additional collateral, insurance, or a third party guarantee to pay a defined amount of principal and interest. Credit enhancement reduces credit/default risk of a debt, thereby increasing the overall credit rating and lowering interest rates for the borrower.
Deferred principal/interest loans	Loans can be structured using terms that allow the borrower to defer payments for a specified period of time. Lending terms can defer principal payments, interest payments or both. For example, a loan with a 10-year deferred principal period would mean that for the first decade, the borrower would pay only interest on the amount borrowed, and not begin paying down the principle until after the 10-yr period.
Leverage	Leverage is a technique for multiplying limited funding by using those funds as collateral for debt issued. For many years, the Texas Water Development Board has used leverage to amplify the amount of funding it receives from the Environmental Protection Agency under the EPA's State Revolving Funds for water and wastewater projects. TWDB issues bonds secured by its State Revolving Fund allocation. The proceeds of those bonds are then used to lend money to local water project sponsors to comply with drinking water and surface water standards. The money received from the EPA is invested by the TWDB in low-risk securities, like Treasury bonds. That investment is pledged as collateral to bond buyers, thereby securing a strong credit rating and low borrowing cost for TWDB. In addition, the interest gained by its investments is used to subsidize the interest rate for TWDB's borrowers. Through leverage, TWDB is able to make more money available to its borrowers

SWIFT AND SWIRFT

Prop 6 enables the TWDB to expand the amount of loans available to local sponsors applying for financial support for water supply projects, by creating two separate but related funds: 1) the State Implementation Fund for Texas (SWIFT) and 2) the State Water Implementation Revenue Fund for Texas (SWIRFT). Though the latter has received less media attention, it is actually the more important of the two when it comes to the matter of growing the $2 billion seed fund.

SWIFT exists to subsidize loans made by the TWDB to local sponsors of water supply projects—it is simply a dedicated pool of money to allow TWDB to lower the effective interest rates paid by its borrowers. SWIFT can only be used to subsidize lending through five of TWDB's funding programs. Four of these programs are briefly described in the table below; the fifth, SWIRFT, is described in Table 2.

Table 2. TWDB Water Financing Programs

Eligible TWDB Program	Purpose of Program
Water Infrastructure Fund	Subsidized and deferred loans for state political subdivisions and water supply corporations, for projects in SWP or approved regional water plans
Rural Water Assistance Fund	Loans for political subdivisions and nonprofit water supply corporations, for infrastructure or for consolidation or regionalization

Agricultural Water Conservation Fund	Loans for political subdivisions, colleges, interstate compact commissions and nonprofit water supply corporations, for conservation projects
State Participation Program accounts in Texas Water Development Fund II	Deferred interest obligations to repurchase TWDB's temporary ownership interest in facilities, for political subdivisions and water supply corporations

These four programs are funded by the TWDB through the sale of general obligation bonds, which are then used to create revolving loan funds (meaning that as borrowers repay their debts to the board, the fund is replenished to be made available to other beneficiaries).

At its heart, SWIFT is a means of subsidizing these revolving loan funds. There are four types of subsidy SWIFT can provide: 1) low-interest loans (TWDB may lend at as little as 50% the rate of interest at which it borrows); 2) longer repayment terms for loans; 3) incremental repurchase terms for projects in which the state owns a share; and 4) deferral of loan payments. For example, under Option 1, if TWDB can borrow money at 3%, SWIFT funds could be used to lower the interest rates of the TWDB's own lending programs to as little as 1.5%. An example of Option 4 would be TWDB purchasing up to 80% of a water supply facility, with no principal repayment due from the borrower for as long as 20 years.

Because SWIFT subsidizes revolving funds (repayments from existing borrowers are used to make new loans), SWIFT could enable more than $2 billion worth of projects over time as loans are repaid with interest. Combined with SWIRFT, however, SWIFT can, in theory, be leveraged to provide substantially greater amounts of financing.

SWIRFT is one of the funds that may receive disbursements from SWIFT. Like SWIFT, SWIRFT can only be used to finance water projects in the State Water Plan, through same set of existing TWDB loan programs to which SWIFT is targeted (those in the table above). Unlike the other funds eligible for SWIFT subsidies, SWIRFT is capitalized through new revenue bonding authority granted under H.B. 4, meaning it is totally free of any constraints related to the state debt limit. Also, unlike the other four programs eligible for SWIFT subsidies, SWIRFT revenue bonds can be used for an expanded set of financial assistance tools, including direct loans to local water project sponsors, purchasing of debt obligations from these local sponsors, or credit enhancement for TWDB's own funding programs.

SWIRFT thereby opens a new chapter in the board's financing programs. The credit enhancement component of SWIRFT is especially important to understand because of its potential for amplifying TWDB's lending capacity. Under H.B. 4, TWDB may pledge SWIRFT as collateral for the debts it incurs through the funding programs eligible for SWIFT support. In this way, SWIRFT could increase substantially the amount of debt TWDB could sell, as bond buyers would be promised revenues from borrower repayments and have as added security access to SWIRFT funds in the event that borrower repayments fell short of TWDB's own obligations.

This credit enhancement authority under SWIRFT, combined with its revenue-backed bond authorization collectively create the potential for TWDB to multiply the $2 billion authorized by voters to provide up to $26 billion in total financial support. That is an important figure only in as much as it is the full amount of state financial support requested by Regional Planning Groups in the 2012 State Water Plan. (Whether the political subdivisions and water authorities who participate in the Regional Planning Groups will ever ask the Board to make the full $26 billion available to them is another matter entirely, and will be discussed more fully in the second blog in this series.)

However, there are a number of factors that will determine how much the $2 billion appropriation to TWDB will actually grow over time. That will in turn determine how well the new funds can be used to support the wide range of needs in the State Water Plan, from conservation and reuse, to smaller scale projects in rural areas, to larger, longer-term projects proposed for growing urban areas.

As one option, TWDB could simply move the $2 billion through SWIFT, bypassing SWIRFT, and directly support its existing funding programs. While the money would be repaid to SWIFT over time, it would not necessarily take advantage of leverage to grow the $2 billion. It would then be simply be a $2 billion revolving loan fund, recapitalized as borrowers repaid their debts to the board, with (subsidized) interest. In addition, if SWIFT is managed to provide financing subsidies (cash outflows) that outpace the value gained in the fund through market investments (cash inflows), the $2 billion could be substantially drained.

Another option would be for TWDB to put the lion's share of the $2 billion into the State Participation Program fund. This fund is generally used for longer-term, big-ticket projects, such as reservoirs and pipelines, a number of which are proposed in the 2012 State Water Plan. The State Participation Program allows TWDB to purchase a temporary ownership stake in a water project, with the idea that the loan would be paid back after the project was built and operating near capacity. Nearly 30% of funds the state has *already* made available to projects in the State Water Plan have been through programs with deferred repayment, including some $93 million through the State Participation Program in which repayment of the principal typically is deferred for 20 years, and $189 million through the Water Infrastructure Fund Deferred program, which defers principal and interest for up to 10 years.

This approach, however, would tie up most of the money in deferred loans, as illustrated by a January 10, 2013 memo to the Members of the State House of Representatives from H.B. 4's sponsor, House Natural Resources Chairman Allan Ritter: loans with 20-year deferred repayment periods would prevent SWIFT from fully revolving for more than 30 years.

If most of the SWIFT seed funds were sent directly to the state participation programs with deferred payments, then these few borrowers would receive the greatest benefit, and the opportunity to use the Prop 6 funds to shore up water security throughout the state could be compromised. In essence, a "big dog eats first" approach to using the new funds would mean that smaller projects for meeting real short-term water needs in smaller communities, including throughout rural Texas, could be undermined. On the other hand, a more balanced approach, more equitably distributed among different financing options, would allow greater leverage for the $ 2 billion and cover more water needs throughout the state.

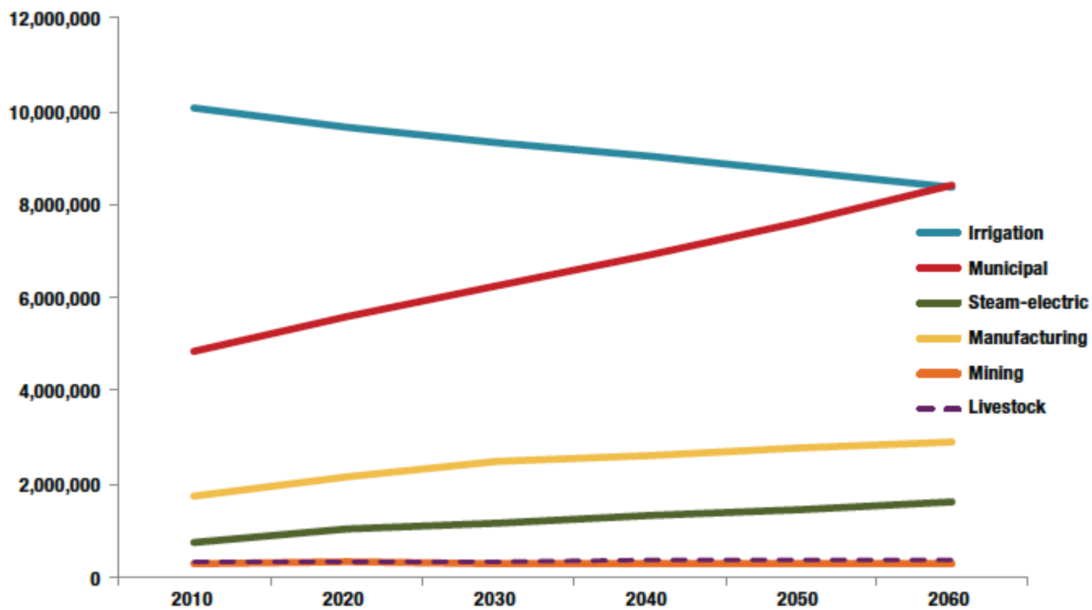
The TWDB now has the task of balancing these competing interests, all of which will take place in the context of the project prioritization process set up by HB 4. We'll look at that topic in our next blog.

Installment 2: Relationship Between Prop 6 and State Water Plan

Proposition 6 arose from debate about the need to "fund implementation" of the State Water Plan. But, the current state plan may not be the best roadmap for expenditure of the new funds. A few charts from the 2012 State Water Plan illustrate the concerns. .

We'll start with the plan's projection of future water demand.

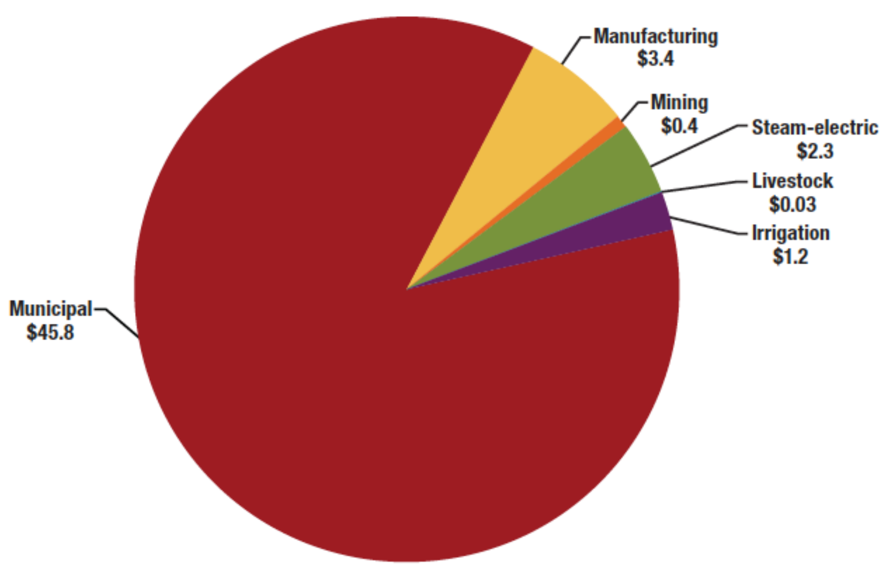
FIGURE 3.6. WATER DEMAND PROJECTIONS BY USE CATEGORY (ACRE-FEET PER YEAR).*



*Water demand projections for the livestock and mining water use categories are similar enough to be indistinguishable at this scale.

The biggest increase in of projected water demand growth by far is for municipal households and businesses. This municipal demand projection drives the total projected 2060 capital cost of the water plan, accounting for $ 45.8 billion of the $53 billion total.

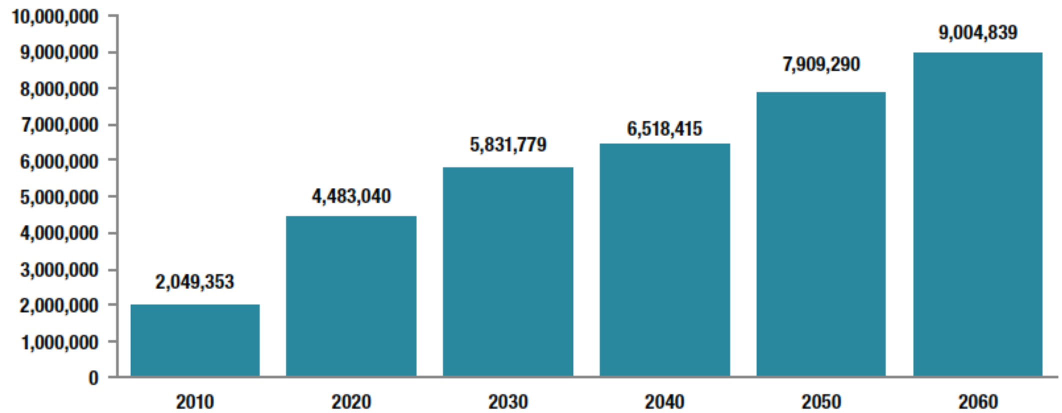
FIGURE 9.1. TOTAL CAPITAL COSTS OF RECOMMENDED WATER MANAGEMENT STRATEGIES BY WATER USE CATEGORY (BILLIONS OF DOLLARS).



The 2012 plan projections are based on the assumption that municipal demand will rise in direct proportion to population growth. These projections do not consider changes in land use or changes in consumer behavior that have resulted in state household water use falling 8 % over the past decade. As discussed in a separate analysis, the linear increase assumption is likely resulting in a substantial over-projection of future municipal demand.

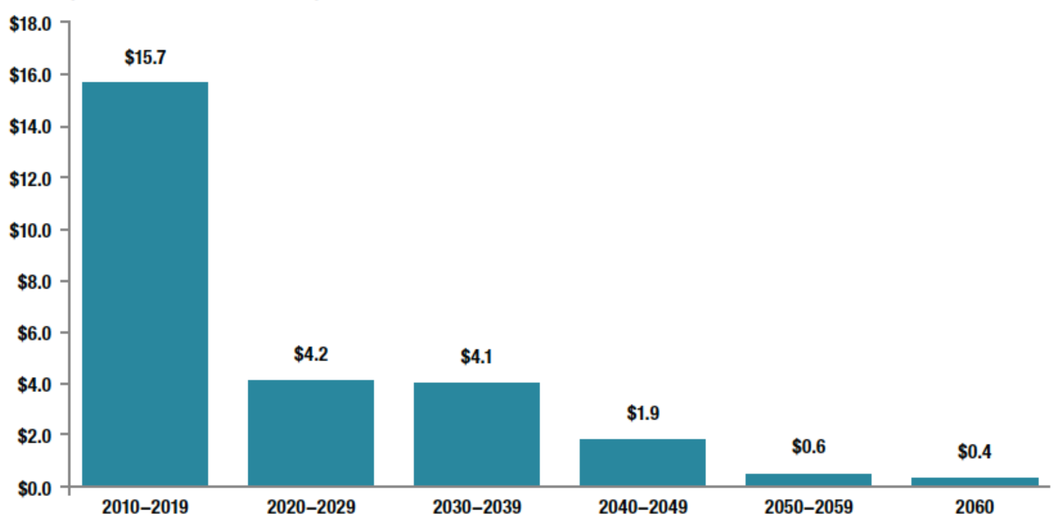
In any case, to meet this projected demand, the Regional Groups say they plan to steadily add new supply over the coming fifty years. (This figure includes new water supply for all types of uses, not just municipal, but municipal use accounts for the majority of the new projected supply).

FIGURE ES.4. WATER SUPPLIES FROM WATER MANAGEMENT STRATEGIES IN THE STATE WATER PLAN (ACRE-FEET PER YEAR).



But, here is how the regional water planning groups translate these water demand and supply projections into in state financing needs.

FIGURE 9.3. DEMAND FOR TWDB FINANCIAL ASSISTANCE PROGRAMS BY DECADE OF ANTICIPATED NEED (BILLIONS OF DOLLARS).



This graph looks dramatically different from the previous graphs. In fact, a full 58% of the total amount of state financial support sought by the regional groups is requested for the first decade to serve a potential future demand that would not emerge for decades according to their own projection—and may not emerge at all if the projections are over-stated.

Remember that SWIFT would be a lending program where the loans are repaid by borrowers—borrowers that receive revenues from their customers. This means that what we build will be paid for by ratepayers and the loans must be repaid whether or not what is built is actually needed. If actual demand is less than projected demand, then rates could have to be increased substantially to pay back the loans (not to mention the disincentive for conservation if demand falls short of projections).

This is where the link to HB 4 and prioritization of projects becomes extremely important. The prioritization process (which we have described previously here) was recognized by the legislature as essential to ensuring that state funds are efficiently managed for the greatest public benefit. It is also an implicit recognition that not all the projects in the 2012 state water plan will need state funding (or will even be needed at all).

Thus, the prioritization process must ensure that state financial assistance from Prop 6 is both cost-effective and takes into account the possibility that future municipal demands may be substantially less than projected. A slow but steady approach to investment in water supply strategies that will meet a clearly demonstrated need in the near-term would be the most fiscally responsible approach to management of the new Prop 6 funds. And the prioritization process, carefully implemented, is the tool the Texas Water Development Board needs to structure that fiscally-responsible approach.

One essential component of this slow but steady funding approach is investment in helping Texans to reduce their water demand (and save money) by implementing cost-effective efficiency measures. These measures, given time to take hold, can postpone or even avoid the need for massive, expensive new supply projects.

House Bill 4 requires the Texas Development Board to allocate some of the Prop 6 funds toward water conservation. Specifically, H.B. 4 directs the Board to make "premium financing" options available for conservation and water reuse, with at least 20% of the SWIFT funds meant to flow toward these purposes. Yet, many of the conservation strategies in the 2012 plan do not have an associated capital cost, making them unlikely candidates for recipients of the Board's lending program. Whether Prop 6 funds managed by the Board can effectively be used to achieve this allocation toward water conservation is the subject of our next post.

Installment 3: Financing Water Conservation and Efficiency

As the debate over Prop 6 played out, many advocates highlighted the fact that the underlying legislation, HB 4, provides that a certain percentage of funding should be dedicated to water conservation and reuse. The specific terms are important. HB 4 creates section 15. 434(b) of the Texas Water Code, as follows:

> *(b) Of the money disbursed from the fund during the five-year period between the adoption of a state water plan and the adoption of a new plan, the board shall undertake to apply not less than:*
>
> *(1) 10 percent to support projects described by Section 15.435 that are for:*
> *(A) rural political subdivisions as defined by Section 15.992; or*
> *(B) agricultural water conservation; and*
>
> *(2) 20 percent to support projects described by Section 15.435, including agricultural irrigation projects that are designed for water conservation or reuse.*

Even with this "undertake to apply" goal (which is a minimum, not a maximum, of what can be spent on conservation), there are serious questions about how TWDB can provide financial support for some types of non-agricultural conservation strategies, especially those involving improving assets held by private citizens or businesses outside of the agricultural sector. This is important because a significant portion of the state's conservation potential is in reducing the water footprint of homes, industry and businesses, something that often requires replacing inefficient appliances, irrigation systems and industrial equipment with water-efficient technologies. The central questions are (1) whether these improvements are amenable to the type of "debt-financing" available through the Prop 6 funding and (2) whether there are constitutional or other statutory prohibitions on using state funds for these strategies since they would create a "private benefit."

Because the TWDB already has a program for agricultural conservation loans, the use of Prop 6 funds through SWIFT for those activities should be more straightforward. The 2012 State Water Plan projects significant needs for agricultural water conservation. For example, Region M projects that $ 132 million would be needed to conserve about 140,000 acre-feet/year in agriculture by 2060. Region O projects a need to invest $ 346 million in agricultural efficiency measures to save 480,000 acre-feet per year, helping to reduce pressure on the dwindling Ogallala aquifer. Given these needs and the issues with financing customer-side efficiency improvements at the municipal level, it may be that most of the conservation funding through SWIFT goes to agricultural efficiency projects. (It is important to note that agricultural efficiency programs don't necessarily make more water available for other uses, as farmers often use the water saved to expand crop production. However, there are examples of arrangements in which water efficiency improvements on the farm have yielded water for municipal or environmental uses.)

Nevertheless, municipal conservation is a vital strategy for Texas to balance growth with limited water supply. The remainder of this post looks at what role, if any, Prop 6 might play to advance this strategy.

Debt-financing municipal conservation measures

The first question is *why* municipal water systems would choose to debt-finance water efficiency improvements for their customers?

Water conservation is actually a source of supply, just like a reservoir or a desalination plant. The redefinition of water conservation from a demand tool to a supply source was a major paradigm shift for water providers, but is now commonly understood. Investments in water conservation strategies with a clearly defined yield and lifetime can be debt-financed, and repaid through revenue raised from a water suppliers' customer payments, just as they would pay back costs for any other water supply investment.

It appears that the only source of municipal water conservation to which the Board has provided financial assistance in the past is the repair of leaky distribution systems—the aging pipes that move water from the source to the customer. The amount of water lost in transport from source to user can be significant. A 2010 survey by the Texas Water Development Board found that, on average nearly 15% of water treated and sent through municipal systems is lost before ever reaching a customer (based on 1,900 systems reporting data) Small systems serving 10,000 customers or less averaged about 20% total water loss, and large systems with 100,000 customers or more averaged 15%.

Because the replacement of a distribution system is an investment in the water system's own assets, it is a perfectly acceptable use of debt funds. Thus, reducing system water loss should be a desirable and authorized use of the SWIFT funds.

However, there are other municipal conservation programs aimed at individual water customers that can provide a reliable source of water supply. The most reliable of these "customer-side" approaches are those that replace physical systems, such as programs that provide rebates or other incentives for replacement of inefficient toilets or water boilers or for replacement of water-intensive landscaping with water-efficient landscaping.

These types of programs generally are more reliable in terms of supply than those that rely on changes in customer behavior (changes which may or may not be permanent and which are often influenced by perceptions of immediate drought).

Through a combination of appliance retrofits and lawn buy-back programs, Las Vegas has saved over 59.3 billion gallons of water since 1999. The city has spent $200 million to replace more than 150 million square feet of turf lawn over the past decade, with long-term water savings guaranteed by covenants ensuring that homeowners will not reinstall lawn they were paid to remove unless they repay their rebate. Recently, Austin Water announced it was launching its own lawn buy-back program.

Debt-backed capital investment programs allow water utilities to mobilize far more capital today than cash-backed capital programs. (For more explanation of the debt-financing envisioned by SWIFT, including a glossary of terms, see Installment 1 in this blog series). The benefit of debt-financing is that water systems can borrow the money for what is needed today, with future repayment backed by a pledge of future customer revenues. In comparison, cash spent today must be available today. Since water systems raise their cash from customer payments, a cash-financed program typically means higher rates today than a debt-backed program. As a result, debt-financed programs allow water systems to smooth the increase in customers' rates.

Debt cannot be used for behavior change programs—the debt issued for a capital program must be used to finance the construction, acquisition or improvement of capital assets. It cannot be used for operations and maintenance (for example, paying the energy bills for a water treatment plant) or for public outreach programs (for example, media campaigns to educate water users about conservation). These aren't rules set in Texas, they are rules set by the Governmental Accounting Standards Board, the entity that defines accounting standards for the municipal bond market in which the Texas Water Development Board participates.

But efficiency programs with a defined water yield are an investment in a capital asset—water supply—and should thus qualify for debt financing. And, in fact, there are water systems that use bond proceeds to finance customer efficiency programs. Seattle Public Utilities has used debt funds to finance the retrofitting of toilets and other water-using devices with low-flow replacements. In Seattle what made this possible was defining the "asset" being financed not as toilets, but as the long-term water savings gained by toilet retrofits.

The potential for water efficiency investments on customers' property does not end with toilets or turf grass. Institutional irrigation systems, industrial machinery, any physical water distribution or water-using device with a long lifetime can be a source of long-term water savings, and therefore supply. And Texas is uniquely positioned to unlock the water savings in its industrial, commercial and institutional sectors with the passage last session of the Property Assessed Clean Energy Act. This new law permits municipalities to use bonds to finance customer loan programs for energy and water conservation purposes, including water conservation systems, high efficiency irrigation equipment, on-site improvements to use municipal reclaimed water, and more. This type of bond (called a PACE bond) is repaid through tax assessments that remain attached to the property no matter who the future owner may be. The PACE bond concept holds significant potential for funding a transformation in the water intensity of Texas' economy.

So, if it is desirable to pursue a large-scale customer efficiency program (and if such approaches are included in the state water plan), and if debt financing would make it easier to do that, SWIFT funds would be made available for that purpose, right? Not necessarily.

Public Purpose v. Private Benefit

The ability to use SWIFT funds for these customer-side efficiency improvements largely comes down to whether programs that improve an asset owned by a private citizen or a business can be financed with public monies.

Texas, like most states, has a Constitutional prohibition against the use of public funds for private benefit, something called "the gift clause." As discussed in this post by the Energy Center at the University of Texas School of Law, Article III, Sec. 52(a) of the Texas Constitution prohibits the state from lending credit or granting money to "any individual, association or corporation whatsoever," a prohibition that can be relaxed for activities that would enable a public purpose.

Defining a public purpose is where the complications begin, however. In many instances, legislators have opted to explicitly authorize the use of state financing for specific activities rather than leave to the courts what might be reasonably construed to serve a public purpose. Such is the case with toll roads, for which purpose the state's credit has been authorized in numerous amendments.

In fact, one piece of legislation from the 2013 session attempted to do just that for water conservation. House Joint Resolution 142, filed by Chairman Alan Ritter (the House sponsor of H.B. 4), would have expressly defined water conservation as a public purpose eligible for state funding. As filed, HJR 142 provided that "[n]otwithstanding any other provision of this constitution, the legislature may provide for the creation of programs and the making of loans and grants of public money, other than money otherwise dedicated by this constitution to use for a different purpose, for the public purpose of water conservation."

Unfortunately, H.J.R. 142 did not advance through the legislature, leaving the question of whether the Board or other state agencies can lend their credit for the public purpose of municipal water conservation open to the determination of the Texas Water Development Board and for potential challenge in the courts.

Texas does have some history of using state credit for private benefit that serves a public purpose. One example is the use of TWDB funds to address the lack of safe drinking water and sewage treatment in colonias along the Mexican border. (The following is adapted from email correspondence with former bond counsel to the TWDB.) In the 1990s, the Board deliberated whether the gift clause prohibited it from making financing available for connections of homes water and wastewater utilities. Ultimately, the Board decided that as long as four tests were met, use of public funds would not constitute an unlawful gift or lending of credit. The four tests were:

1. Does the expenditure serve a public purpose?
2. Are there sufficient controls on the expenditure to ensure that the public purpose will be carried out?
3. Is the public protected in the use of public funds to accomplish the intended result?
4. Has the political subdivision making the expenditure adequately considered this use of funds?

If TWDB defines water conservation as a public purpose in its prioritization and rulemaking processes, and if it ensures sufficient controls over the use of funds to achieve that purpose (such as audits of water savings, installation of water-saving devices and deed restrictions or other assurances for their longevity), the TWDB would likely have sufficient grounds to include customer-side municipal water conservation programs as eligible for SWIFT funds. Using SWIFT funding for customer-side municipal water efficiency programs could help ramp up this cost-effective water supply strategy in communities across the state.

Effective use of the Prop 6 conservation earmark to include these programs will require a change in practice and perspective and clear rules from the TWDB, (and it will require that such programs be explicitly included as strategies or projects in the state water plan).

Appendix B

Rules and Guidance for the Regional and State Water Planning Process

I. Rules and Guidance for the 2011 Regional Planning Process and 2012 State Plan:

A. TWDB Rules

§357.7. Regional Water Plan Development.

(a) Regional water plan development shall include the following. . . .

(2) . . . current and projected . . . water demands. Results shall be reported:

(A) by . . .

(iv) categories of water use (including . . . steam electric power generation . . .) for each county or portion of a county in the regional water planning area. If a county or portion of a county is in more than one river basin, data shall be reported for each river basin;

(B) for each wholesale water provider by category of water use (municipal . . . steam electric power generation . . .) for each county or portion . . . . The wholesale water provider's current contractual obligations to supply water must be reported in addition to any demands projected for the wholesale water provider;

(3) evaluation of adequacy of current water supplies legally and physically available to the regional water planning area for use during drought of record. The term "current" means water supply available at the beginning of this task . . . . Results of evaluations shall be reported:

(A) by . . .

(iv) categories of water use (including . . . steam electric power generation . . . .

(B) for each wholesale water provider by category of water use . . . .

(4) water supply and demand analysis comparing:

(A) water demands as developed in paragraph (2) (A) of this subsection with current water supplies available to the regional water planning area as developed in paragraph (3) (A) of this subsection to determine if the water users identified in paragraph (2) (A) of this subsection in the regional water planning area will experience a surplus of supply or a need for additional supplies. . . . Other results shall be reported by . . . categories of water use (including . . . steam electric power generation . . .) for each county or portion of a county in . . . .

(5) using the water supply needs identified in paragraph (4) of this subsection, water management strategies to be used during the drought of record to provide sufficient water supply to meet the needs identified in paragraph (4) of this subsection as follows:

(A) Water management strategies shall be developed for . . . categories of water use (. . . steam electric power generation,) for each county or portion . . . .

Thus, there were no requirements that projected water demands be justified as reasonable demands. There were no requirements for how a regional planning group develops reasonable projections for demands.

B. TWDB's General Guidelines for 2011 Regional Water Plan Development

2.0 Population and Water Demand Projections

Water Demand Projections

…. Entities may also request changes to water demand projections for other water user groups, including irrigation, livestock, and manufacturing, assuming they provide verifiable supporting data and documentation to their respective planning group and the TWDB. The TWDB is currently engaged in a study with the Bureau of Economic Geology at the University of Texas at Austin to revise and/or verify steam-electric water demands for each planning region. Results of this study should be available by September of 2008; at which time, the TWDB will disseminate results to each planning group for review and comment.

II. Rules and Guidance for the 2016 Regional Planning Process and 2017 State Plan:

A. TWDB Rules

31 TAC §357.31: Projected Population and Water Demands

(a) RWPs shall present projected . . . water demands by WUG[1] . . . .

(b) RWPs shall present projected water demands associated with WWPs[2] by category of water use, including municipal, manufacturing, irrigation, steam electric power generation, mining, and livestock for each county or portion of a county in the RWPA . . . .

(c) RWPs shall report the current contractual obligations of WUG and WWPs to supply water in addition to any demands projected for the WUG or WWP. Information regarding obligations to supply water to other users must also be incorporated into the water supply analysis in §357.32 of this title (relating to Water Supply Analysis) in order to determine net existing water supplies available for each WUG's own use. . . .

(f) . . . water demand projections shall be presented for each planning decade for each of the above reporting categories.

B. TWDB's First Amended General Guidelines for 2016 Regional Water Plan Development

2.0 . . . Water Demand Projections . . . .

Draft non-population related water demand projections (e.g. mining . . . steam-electric power, and livestock) were made available for review and comment by RWPGs in late 2011.

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[1] **Water User Group (WUG)**--Identified user or group of users for which water demands and water supplies have been identified and analyzed and plans developed to meet water needs. These include:

(A) Incorporated Census places of a population greater than 500, including select Census Designated Places, such as significant military bases or cases in which the Census Designated Place is the only Census place in the county;
(B) Retail public utilities providing more than 280 acre-feet per year for municipal use;
(C) Collective Reporting Units, or groups of retail public utilities that have a common association;
(D) Municipal and domestic water use, referred to as county-other, not included in subparagraphs (A) - (C) of this paragraph; and
(E) Non-municipal water use including manufacturing, irrigation, **steam electric power generation**, mining, and livestock watering for each county or portion of a county in a RWPA.

[2] **Wholesale Water Provider (WWP)--**Any person or entity, including river authorities and irrigation districts, that has contracts to sell more than 1,000 acre-feet of water wholesale in any one year during the five years immediately preceding the adoption of the last regional water plan. The regional water planning groups shall include as wholesale water providers other persons and entities that enter or that the regional water planning group expects or recommends to enter contracts to sell more than 1,000 acre-feet of water wholesale during the period covered by the plan.

TWDB staff, in conjunction with . . . (TCEQ) . . . (TPWD), and . . . (TDA) will prepare draft . . . water demand projections for all water demands including . . . steam-electric power . . . . TWDB staff will update … water demand projections for all associated Water User Groups (WUGs) and provide these draft projections to RWPGs for their review and input . . . . TWDB will directly populate the Regional Water Planning Application (DB17) with all WUG-level draft projections and make related changes to DB17 if adjustments are approved by the TWDB.

The TWDB will consider requests for changes to draft population and draft water demand projections if warranted. Entities wishing to adjust draft projections shall address their requests through their respective RWPG. If the RWPG concurs, it will submit a request to the EA of the TWDB for consideration.

2.3 Industrial (Manufacturing, Steam-Electric, Mining . . .) Water Demand Projections Industrial Water Use:

Industrial water use is defined as water used in the production process of manufactured products, steam-electric power generation, and mining activities, including water used by employees for drinking and sanitation purposes.

Criteria: One or more of the following criteria must be verified by RWPG and the EA for consideration of revising the industrial water use projections:

a. An industrial facility which has recently located in a county and may not have been included in the Board's database. Documentation and analysis must be provided that justify that the new industrial facility will increase the future industrial water use for the county above the industrial water use projections. Exhibit C, Page 12,

b. An industrial facility has recently closed its operation in a county.

c. Plans for the construction of an industrial facility in a county at some future date.

Data Requirements: The RWPG must provide the following data associated with the identified criteria for justifying any adjustments to the industrial water use projections.

1. The quantity of water used on an annual basis by an industrial facility that has recently located in a county and was not included in the Board's database.

2. The North American Industrial Classification (NAIC) of the industrial facility that has recently located in a county. The NAIC is the numerical code for identifying the classification of establishments by type of activity in which they are engaged as defined by the U.S. Office of Management and Budget and is a successor of the Standard Industrial Classification (SIC).

3. Documentation of plans for an industrial facility to locate in a county at some future date will include the following data:

   a. Confirmation of land purchased for the facility or lease arrangements for the facility.

   b. The quantity of water required by the planned facility on an annual basis.

   c. The proposed construction schedule for the facility including the date the facility will become operational.

   d. The NAIC for the planned facility.

Appendix C

Legal Authority of State and Regional Agencies to Obtain Historic and Projected Water Use Data for Mining and Other Uses.

Texas Water Code Section 16.012(m) - TWDB Survey Authority

[TWDB] may conduct surveys of entities using groundwater and surface water for municipal, industrial, power generation, or mining purposes at intervals . . . to gather data to be used for long-term water supply planning.

Recipients of the survey shall complete and return the survey . . . .

A person who fails to timely complete and return the survey is not eligible for funding from the board for board programs and is ineligible to obtain permits, permit amendments, or permit renewals from the commission under Chapter 11.

A person who fails to complete and return the survey commits an offense that is punishable as a Class C misdemeanor.

Texas Water Code Section 11.031 – Annual Reporting for Surface Water Use

(a) Not later than March 1 of each year, each person who has a water right issued by the commission or who impounded, diverted, or otherwise used state water during the preceding calendar year shall submit a written report to the commission on a form prescribed by the commission. . .

(b) A person who fails to file an annual report with the commission as required by Subsection (a) or fails to timely comply with a request by the commission to make information available under Subsection (d) is liable for a penalty for each day the person fails to file the statement or comply with the request after the applicable deadline in an amount not to exceed:

(1) $100 per day if the person is the holder of a water right authorizing the appropriation of 5,000 acre-feet or less per year; or

(2) $500 per day if the person is the holder of a water right authorizing the appropriation of more than 5,000 acre-feet per year

(b-1) The state may sue to recover a penalty under Subsection (b).

Texas Water Code Section 36.111 – Groundwater Conservation Districts Records and Reporting Authority

(a) The district may require that records be kept and reports be made of the drilling, equipping, and completing of water wells and of the production and use of groundwater**.**

(b) In implementing Subsection (a), a district may adopt rules that require an owner or operator of a water well that is required to be registered with or permitted by the district, except for the owner or operator of a well that is exempt from permit requirements under Section 36.117(b) (1), to report groundwater withdrawals using reasonable and appropriate reporting methods and frequency.

Texas Water Code Section 36.117 – Coal mining reporting

(e) An entity holding a permit issued by the Railroad Commission of Texas under Chapter 134, Natural Resources Code that authorizes the drilling of a water well shall report monthly to the [Groundwater Conservation] district:

(1) the total amount of water withdrawn during the month;
(2) the quantity of water necessary for mining activities; and
(3) the quantity of water withdrawn for other purposes.

Texas Natural Resources Code Section 131.354 - Uranium Exempt Exploratory Wells

(c) A well described by Section 131.353(c) is subject to a groundwater conservation district's rules for registration, production, and reporting if:

(1) the well is located in the groundwater conservation district and the well is used for rig supply purposes; and

(2) the cumulative amount of water produced from the wells located inside the area subject to the exploration permit and completed under the exploration permit issued under this subchapter exceeds 40 acre feet in one year.

(d) Each month, the holder of an exploration permit governing a well described by Section 131.353(c) and located in a groundwater conservation district shall report to the district the total amount of water produced from each well described by Section 131.353(c) . . . .

Texas Water Code Section 27.024 –Uranium Mining

SHARING OF GEOLOGIC, HYDROLOGIC, AND WATER QUALITY DATA. (a) …for an area permit for an area located in a groundwater conservation district has identified a permit boundary, the person shall provide to that district . . .
(4) on a monthly basis, the amount of water produced from the wells described by Section 27.023(a) . . . .

Appendix D

Excerpts from 2011 Region D Regional Water Plan

1.5 DESCRIPTION OF WATER DEMAND IN THE REGION

1.5(a) **Historical and Current Water Use**

Historical and current uses in the North East Texas Region include municipal, manufacturing, recreation, irrigation, mining, power generation and livestock. . . .

In addition to these uses, which are mostly consumptive uses, **there are non-consumptive uses such as flows in rivers, streams, and lakes that have been relied upon to maintain healthy ecological conditions, navigation, recreation and other conditions or activities that bring benefit to the Region.** These historic non-consumptive uses and future needs have not yet been the subject of detailed consideration in the State's Senate Bill 3 planning process, but are discussed in *Section 2.3.7 Regional Environmental Flow Demand Projections* and will be addressed in more detail in Round 4 of the planning process. . . .

1.5(e) **Environmental Water Demands**

Environmental water demands in the Region include the need for water and associated releases necessary to support migratory water fowl, threatened and endangered species, and populations of sport and commercial fish. Flows must remain sufficient to assimilate wastewater discharges or there will be higher costs associated with wastewater treatment and nonpoint discharge regulations. Periodic "flushing" events should be allowed for channel maintenance, and low flow conditions must consider drought periods as well as average periods. In recognition of the importance that the ecological soundness of our riverine, bay, and estuary systems and riparian lands has on the economy, health, and well-being of our state, the 80th Texas Legislature created the Environmental Flows Advisory Group. . . .

Another ongoing study is the Cypress Basin Flows Project, initiated in 2004, which is a voluntary effort by the non-profit Caddo Lake Institute and The Nature Conservancy in partnership with the U.S. Army Corps of Engineers and others. This project is studying the environmental flow needs of the Cypress Basin as they impact Caddo Lake and its surrounding wetlands. . . .

2.3.7 Regional Environmental Flow Demand Projections

An additional demand for water in the Region is that water needed for "environmental flows," as that term is defined in Senate Bill 3 of the 2007 Regular Session (S.B. 3). While no volumes or rates have been projected in this plan, NETRWPG anticipates a significant amount of water will be needed in the Region's rivers, streams, and lakes to fill the need.

As discussed in *Section 3.5 Impact of Environmental Flow Policies on Water Rights, Water Availability, and Water Planning,* S.B. 3 establishes a process to determine the environmental flow needs for each river basin. The Texas Water Development Board is anticipated to seek funds for the process for basins in the North East Texas Region. Moreover, a voluntary process authorized by S.B. 3 is ongoing for the Cypress Basin. Thus, the NETRWPG recognizes that environmental flow needs will likely be defined during Round 4 of the planning process and can then be incorporated more specifically in that regional plan. . . .

8.8 CYPRESS CREEK BASIN

It is the position of the North East Texas Water Planning Group that there will be unavoidable negative impacts to the integrity of the ecological environment of the water bodies of the Cypress

River Basin and especially Caddo Lake, should there be development of new reservoirs in the Cypress River Basin or transfer of water out of the basin, unless such new reservoirs or transfers do not conflict with the environmental flow needs for the water in the North East Texas Region. Those flow needs are defined as the low, pulse and flood flows needed for a sound ecological environment in Senate Bill 3, 2007 Regular Session of the Texas Legislature (SB-3).

Those flow needs have been identified initially by the process of obtaining recommendations from scientists and stakeholders for the flow regimes for the Cypress Basin through a process initiated in 2004 and summarized in the draft Report on Environmental Flows for the Cypress Basin, updated May 2010 and provided as Appendix to the May 31, 2010 Comments of the Caddo Groups to the Region D IPP and referred to as the *Cypress Basin Flow Project Report*. . . .

The Cypress Basin lies entirely in the North East Texas Region (Region D). The amount of needs in the Cypress Basin for environmental flows is not fully or finally determined. Once the State has set aside water for such needs, the State will have made its determination on such needs. There is, however, sufficient unappropriated water in the Cypress Basin to meet the environmental flow needs and unused or unsold water from Lake O' the Pines is one potential source for the additional needs, should appropriate strategies be developed to protect the interests of the NETMWD member cities and others in the Basin that will need such water.

Proposals for new reservoirs or interbasin transfers can be made consistent with the environmental flow needs in the Cypress Basin only after final decisions have been made to determine those needs and sources to fill them. Until then, however, no water should be proposed for a new reservoir or for uses in other regions unless the proposals in other regional plans explicitly recognize the environmental flow needs for Region D and that the amount, timing, diversion rate and other characteristics must be consistent with the needs. . . .

8.11 SULPHUR RIVER BASIN

. . . It is the position of the North East Texas Regional Water Planning Group that there be no development of new reservoirs in the Sulphur River Basin within Region D nor transfer of water out of the basin for that part that is within Region D until the flow needs for a sound ecological environment are defined for the Sulphur River Basin through the process established in SB 3, 2007 Regular Session of the Texas Legislature. Those flow needs are defined as the low, pulse, and flood flows.

The flow needs assessment for the Sulphur River has not yet begun. No development should take place until the State has identified the flow needs for the Sulphur River and established a demand for the environmental flows for the basin. . . .

Development of new reservoirs prior to determination of the water demands required for environmental flows in the Sulphur River Basin would be premature. Once the State has set aside water for such needs, the State will have made its determinations on such needs. Proposals for new reservoirs or interbasin transfers can then be made consistent with the environmental flow needs in the basin.

Appendix E

Excerpts from the Science Advisory Committee Report on Environmental Flows, October 26, 2004

7. IMPLEMENTATION STRATEGIES FOR ENVIRONMENTAL FLOWS

7.1 Available Environmental Flow Implementation Strategies

Turning from the previous section's discussion of the various tools available to assess the environmental water needs of rivers, streams, bays, and estuaries, this section discusses the possible implementation strategies that could be used to achieve the desired flows, once the target amounts and allocation pattern have been established.

Implementation strategies for achieving desired levels of environmental flows can be generally grouped into two categories: regulatory and market-based. An overview of these two categories and the types of strategies that fall within them are described in the following sections. These strategies are drawn from the literature and from what is being practiced in Texas today. They are intended to provide a relatively broad representation of available options rather than serve as recommendations.

It is important to observe at the outset that the starting point can matter a great deal in shaping the implementation strategy or strategies for providing for environmental flows. Broadly stated, two starting points are possible, depending on whether or not sufficient unappropriated water is available to meet environmental flow targets. If insufficient unappropriated water exists, one of the main objectives of the implementation strategy is to "recover" water for environmental flows from existing permits (water rights). In this case, many of the regulatory approaches described below may prove to be politically difficult to implement, and could raise the possibility of legal challenges. Market-based strategies, by which existing water right holders voluntarily enter into transactions by which their rights are converted or modified to provide for environmental flows, are likely to offer the best means to recover the necessary water to satisfy environmental flow requirements. In the case where sufficient unappropriated water exists, regulatory approaches that allocate the water to fulfill environmental flow needs may prove to be efficacious strategies, with market-based strategies serving as a mechanism for adapting to the natural dynamics and inherent uncertainties associated with environmental flows. In general, it certainly is more difficult/costly to recover the water to meet environmental flow needs from existing permits than it is to allocate or reserve water for environmental flows directly, if that option is available.

7.1.1 Regulatory Environmental Flow Strategies

Regulatory strategies are those that would utilize the legal and regulatory authority of the state to directly allocate water for environmental purposes, stipulating that specified quantities of water be passed downstream before any water can be diverted or impounded, thereby reserving the bypassed flows for environmental purposes, for a specified stretch of a river or stream. A broad spectrum of strategies exists. Some of the most common approaches are described briefly in the following sections.

This section draws from a variety of sources that include Seibert et al. (2000), National Wildlife Federation (unpublished), and Instream Flow Council (2002).

7.1.1.1 Environmental Flow Reserves

An authorized state entity would reserve or "set aside" surface water flows solely to meet the target environmental flow requirements for a particular watershed or stream reach. No permits for consumptive use (diversions or impoundments) could be issued by the state that would reduce these reserved flows. In Texas, the state currently does not have such authority.

Pros – The state entity could act directly on behalf of the public, in the interest of the public good. With proper authority, the implementation process is relatively simple.

Cons – The use of the reserved water would have a priority date that is "junior" to existing water rights permits, thus potentially limiting its availability during low-flow periods when supplies are diminished. To be effective, there must be sufficient unappropriated water available to provide for the reserved flows.

7.1.1.2 Environmental Flow Permits

A permit (water right) for a given quantity of environmental flows would be issued to a governmental or non-governmental entity or private individual through the water rights permitting application process. The total amount available for environmental flows permits in a particular watershed or stream reach would be set at the target level for that particular watershed or stream reach, and permits for environmental flows would not be issued in excess of that amount.

Pros – An enforceable water right for environmental flows would be created, with all of the authority and protection afforded other water rights.

Cons – Any new permit authorizing a certain level of environmental flows would have a priority date that is "junior" to existing water rights permits, thus potentially limiting the availability of water to sustain the environmental flows during low-flow periods when supplies are diminished. To be effective, there must be sufficient unappropriated water available to allocate to the environmental flow permit. Acquisition of an environmental flow permit also would require an applicant willing to shepherd the permit through the permitting process and pay the associated costs.

7.1.1.3 Environmental Flow Conditions Attached to New Water Rights Permits

New water rights permits for non-environmental uses would include conditions to protect environmental flows, stipulating that specified quantities of streamflow be passed downstream before any water can be diverted or impounded, thereby reserving the bypassed flows for environmental purposes, for a specified stretch of river or stream. The nature and scope of these conditions would be established by a state entity using all available information regarding environmental flow targets for the subject watershed or stream reach. Also, the conditions would be subject to scrutiny and review by affected parties, and possibly to revision, through the permitting process. This is basically the strategy that has been used for providing for environmental flows in Texas. (See detailed description in Section 7.3)

Pros – The state entity can act directly, in the interest of the public good. It is relatively easy to implement (and in the case of Texas, is already in place). This approach has been done and accepted, the mechanism for implementing this approach is in place within the State, and it is an established practice that can assure adequate environmental flows for limited segments of rivers and streams and for the bays and estuaries.

Cons – Without proper state coordination and direction, adding environmental flow conditions to new permits can result in an ad hoc approach that makes it difficult to sufficiently and comprehensively achieve environmental flow targets. This strategy cannot address existing water rights that do not have environmental flow conditions, and there must be sufficient unappropriated water available to ensure that the environmental flow targets can be satisfied during low-flow periods when supplies are diminished. Unless conditions explicitly incorporate mechanisms for later modification, adjusting the quantity of environmental flows provided for in the condition could be difficult, if not impossible.

7.1.1.4 Water Taxes

A portion of the water involved in market transfers would be returned to the environment in the form of environmental flows. Such water taxes for environmental flows could be a fixed percentage of the transfer amount or a sliding-scale fixed amount as a function of the transfer amount. The resulting environmental flow amount would then be converted to either an environmental flow reserve or an environmental flow permit subject to administration by the state.

Pros – This strategy could be effectively implemented, provided that the necessary authority was provided to the administering state agency. The resulting quantities of water available for environmental flows would be authorized and protected to the same extent as the originating water rights.

Cons – This strategy could discourage beneficial and necessary water transfers; it would provide and protect environmental flows within a watershed or stream segment only in the immediate vicinity of the originating water rights and downstream only as far as the next senior water right; and its implementation would likely be controversial among stakeholders.

7.1.1.5 Reservation of Return Flows

Instead of allowing full reuse of all historically discharged municipal return flows when wastewater reuse applications are being considered, the state would reserve a specified percentage, e.g., 10% to 30%, of the return flows for environmental purposes. The resulting environmental flow amount would then be converted to either an environmental flow reserve or an environmental flow permit subject to administration by the state.

Pros – This strategy would be relatively simple to administer, provided the necessary authority was provided to the administering state agency. If applied to both direct (flange-to-flange) and indirect (bed and banks) reuse projects, there would be trade-off between less water available for direct reuse projects and reduced permitting complexities for indirect reuse projects. The resulting quantities of return flows available for environmental flows could be authorized and protected to the same extent as the originating water rights.

Cons – Return flows originating from groundwater or interbasin transfers would require special consideration; benefits of any environmental flows resulting from return flows would be realized and protected only in the immediate vicinity of the reuse project and downstream only as far as the next senior water right; and implementation of this strategy could be controversial among stakeholders. The use of return flows to create environmental flows (either as a permit or reserve) could have a priority date that is "junior" to existing water rights permits, thus potentially limiting its availability during low-flow periods when supplies are diminished.

7.1.1.6 Superceding Public Interest

Based on the public trust doctrine and the "usufructary" nature of water rights permits in Texas, the state could assert superceding interest on existing permits (water rights) for the purpose of providing environmental flows for the greater public good. Possible applications of this approach range from the cancellation of unused rights and their conversion into environmental flow reserves or permits (possible under existing water code); placing environmental flow conditions (reservations) on existing water rights;

or, in the most extreme case, "condemning" existing water rights permits for public use as environmental flows.

Pros – This strategy can address sharing of the burden of providing for environmental flows among all existing water rights, even senior water rights that currently have no duty to pass or reserve flows for environmental purposes, and it can provide for environmental flows in over-appropriated basins where the issuance of new permits is not likely.

Cons – This strategy would be politically unpopular to implement and extremely controversial among stakeholders, and it is likely to be perceived as interfering with property rights (i.e., unconstitutional), with very high potential for extended litigation.

7.1.2 Market-Based Environmental Flow Strategies

Like most other western states, surface water supplies in much of Texas are fully appropriated. As noted above, when starting from a position of over-appropriation, achieving target environmental flows will likely require reallocation of existing supplies. Market-based approaches have become important mechanisms that can create unique and important opportunities for voluntary water reallocation, helping to balance competing water demands, including environmental flows.

7.1.2.1 Water Markets

The term "water market" refers to the exchanges of water rights (permits) by willing sellers and willing buyers in a given region, or for a particular water body. It is important to recognize that the geographic extent of markets for surface water is dependent on the size of the watershed (excepting interbasin transfers). States that contain multiple watersheds would consequently require multiple water markets that allow for exchange of permits within those watersheds. Water markets can take a number of forms, and exchanges can be made for both water rights themselves (permanent), and leases of agreed-upon quantities of water but not the rights (temporary). In the specific case of environmental flows, exchanges may also take the form of a donation, if water regulation makes that option available. Water markets exist in nearly every state in the western United States, and are being considered in eastern states such as Florida, North Carolina, and New York.

As with any water management tool, water markets face a number of potential problems and complications. Restrictions on certain types of trades are common, particularly in the case of irrigation organizations, such as cooperatives or irrigation districts. Restrictions may include those on trades that involve changes of use, transfers of ownership outside of the organization, and trades to locations outside the river basin (Wilkinson 1986). In addition, water markets are particularly prone to third-party effects. Transfers of water rights may alter the spatial and temporal pattern of diversions and return flows, affecting large numbers of right holders not directly involved in the transaction (i.e. third parties). In some irrigation organizations, trades may be blocked by the protest of a third party who would be adversely affected (Colby 1990b). Other problems that may impair the performance of water markets include few buyers and sellers (i.e. thin markets), high transaction costs, imperfect information, and the public good aspects of instream uses for water (Brajer and Martin 1990; Colby 1990a, b, and 1989a; Randall 1983). Bauer (1998, 2004) analyzes the experiences of Chile, where the government has been among the most active in the world in establishing water markets, and finds that virtually all of these problems have affected Chilean water markets.

Nonetheless, participation in water markets can be an effective approach for acquiring water rights to meet environmental flows needs. For markets to be used to provide water for environmental flows, environmental flows—or more generally, non-consumptive uses—must be recognized as legitimate and legal. Such "instream flow" rights are recognized in some form in nearly every western state. However, individual participation in water markets for the purpose of acquiring rights for environmental flows is rare, and may be precluded under existing water regulation. Instead, transactions to acquire environmental flows typically involve either state entities or, if the water code permits, private, non-profit organizations (see the following discussion of water trusts) established to represent the demand for environmental flows in the market. Environmental and instream flow demands are a growing part of nearly every western state water market. With the exception of Wyoming, environmental water sales have occurred in every western state. This market sector has increased steadily since 1990, when less than $500,000 was spent on water purchases. In comparison, more than $11 million dollars was expended from 1990 to 1997 on purchases of water to improve habitat conditions for fish and wildlife (Landry, 1998). Expenditures for environmental water acquisitions throughout the western United States are currently estimated at $20 million per year (Landry 2003).

Pros – This approach provides a voluntary mechanism by which existing water rights for human uses can be reallocated for use as environmental flows. Because it is an "ownership rights" based approach, it avoids many of the potential problems associated with regulatory approaches previously described. It also provides the opportunity to acquire senior water rights for use as environmental flows.

Cons – The water-market approach requires that entities seeking to acquire water rights for environmental flows have the financial resources to participate in the market sufficiently to obtain the target level of environmental flows. If left to decentralized efforts and financing from multiple participants, it is unlikely that sufficient water rights will be acquired to meet environmental flows targets. Decentralized efforts may also lead to high "transaction costs," which include costs associated with locating trading partners, developing contracts, and working out trading procedures. Because widespread use of water markets in Texas would be a new approach, potential participants may have limited experience with banking and may not fully understand how the bank functions. Potential participants may hold back during the initial trading periods to observe and gain market information and then enter once the market is more established. Water trusts (see following section) represent a way to address many of these issues.

7.1.2.2 Water Trusts

For the purposes of this report, an environmental flows "water trust" is a formally organized and recognized entity that has been established to hold and manage water rights specifically to provide environmental flows. A water trust can exist as either an entity of the state or as a private non-profit organization. Oregon and Washington have statutes that specifically allow private entities to acquire water rights for instream use. The new instream water rights are held in trust with the state. However, the organizations maintain a fiduciary responsibility to instream rights. As a result, private entities have legal authority to monitor and enforce the instream rights. Though it may be too early to tell, it appears that states such as Oregon, Washington, and Montana that allow for some form of private ownership or holdership have tended to see environmental flows evolve more quickly. Table 7-1 provides a summary of private conservation organizations active in water throughout the western United States. Assuming that sufficient funding is available to them, water trusts can participate in water markets to acquire rights to be used for environmental flows. Importantly, water trusts can also acquire water rights through donation. It is important note that, although Texas has established a state entity called the "Texas Water Trust," it serves a slightly different function as simply the holder of water rights that can be placed in the Water Trust—either for a limited period of time or permanently—for use in meeting environmental flow needs (see more detailed discussion of the Texas Water Trust that follows).

TABLE 7-1 PRIVATE NON PROFIT ENVIRONMENTAL

WATER MARKET ORGANIZATIONS Organization	State	Focus
Colorado Water Trust	Colorado	State-wide organization
Deschutes Water Exchange	Oregon	Deschutes Basin
Klamath Basin Rangeland Trust	Oregon	Klamath Basin
Great Basin Land & Water	Nevada	Truckee Carson Basin
Montana Water Trust	Montana	State-wide organization
Montana Trout Unlimited	Montana	State-wide organization
Oregon Water Trust	Oregon	State-wide organization
Washington Water Trust	Washington	State-wide organization
Walla Walla Watershed Alliance	Washington	Walla Walla Basin