GROUNDWATER PLANNING IN TEXAS: PARADIGM SHIFTS AND IMPLICATIONS FOR THE FUTURE

A Thesis

by

VANESSA CHRISTINE KELLY

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

December 2007

Major Subject: Water Management and Hydrological Sciences

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Approved by:

Chair of Committee,	Ronald Kaiser
Committee Members,	Samuel Brody
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ABSTRACT

Groundwater Planning in Texas: Paradigm Shifts and Implications for the Future. (December 2007)

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Chair of Advisory Committee: Dr. Ronald Kaiser

Senate Bill 1 and HB 1763 have greatly changed Texas water planning. With SB1 the planning process became a bottom-up approach that allowed 16 regional water planning groups (RWPGs) to create a plan that would be combined to form the state plan. Then in 2005, HB 1763 gave groundwater conservation districts (GCDs) the authority to determine groundwater availability instead of regions. The purpose of this research is to explore the overall impact of the regional planning process and how the change in groundwater availability determination will affect regional water planning. The findings of this research can serve as a guide for legislative changes to improve the process. This is crucial if Texas expects to meet the needs of a doubled population in less than 50 years.

In order to collect opinions from water planners across Texas, a survey was sent to all 322 members of the 16 RWPGs. Also, all 72 members from 10 Groundwater Conservation Districts (GCDs) were selected in Region G. All statements were based on a Likert Scale ranging from strongly agree to strongly disagree. The modified Dillman procedure was used with a response rate of 57%. Independent t-tests and Analysis of Variance (ANOVA) were used to measure differences between regions, interest groups, and level of experience.

Overall respondents agreed that water issue awareness, communication, and regional project support improved except for reservoirs and transfers. Also all thought GCDs were the most appropriate entity to lead groundwater planning and believed that the new process would result in greater resource protection. Several statements in the survey resulted in high levels of uncertainty. This suggests that water planning for water user groups whose future supplies are from groundwater should carefully consider broadening their strategies both in terms of quantities and sources to take this uncertainty into account.

DEDICATION

To my parents

ACKNOWLEDGEMENTS

I would like to thank my advisors Dr. Kaiser and Dr. Silvy for their guidance and encouragement throughout the course of this research. Also, I'd like to thank my committee members, Dr. Brody and Dr. Brumbelow for being such great professors. Thanks also to all the regional water planning group members and groundwater districts who participated in the study. Finally, thanks to my family and friends for all their love and support.

NOMENCLATURE

DFC	Desired Future Conditions
GAM	Groundwater Availability Model
GCD	Groundwater Conservation District
GMA	Groundwater Management Area
GW	Groundwater
MAG	Managed Available Groundwater
RWP	Regional Water Planning
RWPG	Regional Water Planning Group
TWDB	Texas Water Development Board
WAM	Water Availability Model

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CHAPTER I
INTRODUCTION

Water is critical to the economic and environmental well-being of Texas. The state faces some daunting challenges as its population continues to grow as it did during the era of plentiful water when an area's needs could be readily met with development of near-by supplies. Texas' population is expected to double to some 45 million people over the next 50 years and the water demands of its cities and industries are expected to correspondingly increase (TWDB, 2007). At the same time, providing for the water needs of the environment has come to be recognized as an essential element of the state's economic future.

The manner in which Texas plans for these future needs will define, to a large degree, its economic and environmental future. How much water does Texas have? Is it safe to drink? Is there enough for cities, industry, agriculture and the environment? Will there be enough for future generations? Can water be made available for use at affordable costs? To address these perplexing questions, Texas has long engaged in a water planning process. Over the past 70 years many local water plans, projects, and schemes were developed. It wasn't until the early 1960s that the first state-wide water plan was prepared by the staff of the Texas Water Development Board (TWDB). Since publication of that first plan, the TWDB has continued planning and publishing plans in 1968, 1984, 1990, 1992, 1997, 2002, and 2007.

All of the state water plans through 1997 were prepared by TWDB staff. The agency hired engineers, hydrologists, planners and an occasional economist to write these plans. The planning modus operandi was for TWDB staff to write the plan and then distribute it for public comments. After receiving public comments, each plan was published and adopted by the TWDB. All of this changed in 1997. Drought was the driver for the evolution in

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This thesis follows the style of the *Journal of the American Water Resources Association.*

Texas water planning. In 1996 and early 1997 Texas suffered an intense drought that caused some cities to ration water and agriculture to complain of crop failures and losses. In response, the Texas legislature passed Senate Bill #1 changing the state water planning process.

Senate Bill #1 mandated that future state water plans be prepared by regional planning groups composed of local leaders from different backgrounds and interests. The legislation also required that plans be prepared every five years. In this new process, TWDB staff would provide assistance to these groups but the groups were responsible for preparing a plan for their region. These regional plans would then be merged by TWDB into a new state water plan. Some suggest that this was more of a revolution than evolution in water planning since the law decentralized, democratized, and strengthened the planning process (Kaiser et al. 2000; Brown, 1998).

Sixteen regional water planning groups (RWPGs) were established by the TWDB to prepare a plan. By law each RWPG is composed of members represent the following interests: public, counties, municipalities, industries, agriculture, environment, small businesses, electric-generating utilities, river authorities, water districts, and water utilities. Each region is required to prepare plans that quantify current and projected population and water demands, evaluate and quantify current surface and groundwater supplies, and that identify and evaluate water management projects to meet these demands. The first TWDB prepared under this new process was published in 2002. This process was repeated and the second iteration of the state water plan was published in January of 2007.

1.1 Determining Groundwater Availability

In preparing the 2002 and 2007 regional water plan, each regional water planning group (RWPG) determined how much groundwater was available in each aquifer within its jurisdiction and how much of this water could be pumped to meet the anticipated demand. In determining groundwater availability, RWPGs were to consider Groundwater Conservation Districts' (GCDs) determinations of groundwater availability. However, they were not required to use GCD numbers. Essentially, RWPGs determined the desired future management conditions for each aquifer. Groundwater conservation districts had to use the availability data adopted by regional planning groups in regulated pumping. This process created a jurisdictional conflict over aquifer management. Since GCDs were statutorily responsible for the planning and management of aquifers within their geographical boundaries, they asserted that they were in a superior position over RWPGs to determine GW availability.

In 2005 the Texas Legislature agreed with the position of GCDs regarding groundwater availability. In passing HB 1763 the Texas legislature shifted this responsibility to groundwater conservation districts. As a result of this paradigm shift, each GCD is now responsible for determining groundwater availability based on their desired future conditions (DFCs) for each aquifer. Once a GCD determines the desired future condition for the aquifer, the TWDB, using a groundwater availability model, quantifies the amount of water that can be pumped from the aquifer. This amount will serve as the basis for all groundwater planning efforts in Texas as well as the basis for the groundwater component of regional and state water planning (Sledge, 2006).

1.2 Motivation for Study

As a result of the changes imposed by HB 1763, the quantity of groundwater available for use is uncertain and quite likely will change from the quantities now being used by RWPGs. Such changes may have a variety of implications for Texas water planning. First, growth may be severely restricted if GCDs impose strict pumping rules. If so it may be necessary to import water from other areas or require other creative solutions to meet future needs. There is potential for conflict at this stage since procedures for determining DFCs appears uncertain.

Another area of interest involves the evolution and success of the regional planning process. Indicators of success include increasing awareness of water issues among the public as well as state and local officials. Closely related to awareness indicators are those related to improving support, funding, and communication among all interest groups.

1.3 Study Procedures

The purpose of this research is to explore how the change in groundwater availability determination will affect regional water planning and the overall impact of the regional planning process. This study will seek to provide information on three major questions:

(1) What will be the impact on regional water planning and water management strategies when GCDs determine groundwater availability?
(2) Will less groundwater be available for urban water uses when GCDs determine availability?
(3) What is the impact of the regional water planning process in regards to awareness of water issues, availability of state and local funding, and public support for water projects?

Data to address these three questions is drawn from an opinion mail survey sent to every RWPG member from the 16 regions in Texas as well as every GCD board member within Region G. A total of 322 RWPG members and 72 GCD board members are included in the survey. The survey is designed to gather their opinions regarding regional water planning and the new groundwater availability process. In order to measure attitudes, all questions are structured on a five point Likert scale. Data was analyzed using SPSS 14.0 and includes descriptive statistics and means as a measure of central tendency. Analysis of variance and t-tests are used to determine differences among and between groups.

1.4 Organization of Thesis

This thesis is organized into five chapters. Chapter II traces the development of state-wide water planning in Texas. It also describes the evolution of groundwater conservation districts, not only in number but also in jurisdictional responsibility. Chapter III outlines the research questions, procedures and responses to the opinion mail survey. Chapter IV contains the analysis of the opinion survey on the impact on regional water planning based on the new water availability process. Chapter V explores the impacts of the regional planning process on public and policy maker awareness of water issues, improvements in communication, increases in funding and support for reservoirs and water transfers. Lastly, Chapter VI will contain concluding comments and summarize future implications.

CHAPTER II
STATE WATER PLANNING

Statewide water planning in Texas has evolved over the last 50 years. Drought and scarcity crises have driven this evolution. After the drought of the 1950 devastated the state, resulting in 244 of the state's 254 counties being declared disaster areas, the Texas legislature established the Texas Water Development Board (TWDB) and charged it with the responsibility for preparing a state water plan. In 1961 the first state water plan was published. The 1961 plan was followed by another plan in 1968, 1984, 1990, 1992, 1997, 2002 and 2007. These plans sought to quantify Texas' water resources and to determine how much water was needed in the future. They also proposed ways to provide water to meet these future needs.

The 1961 and 1968 plans identified the need to construct 107 new dams and reservoirs as the preferred means to provide this water. Many of the reservoir recommendations were followed, resulting in the construction of 211 major reservoirs with a capacity to store more than 5,000 acre-feet. After a 16-year planning hiatus, TWDB staff prepared the next state water plan in 1984. This plan, while proposing the construction of 65 more reservoirs, indicated the need to emphasize other water management strategies. Planning, for the first time, recognized that there were alternatives to the traditional focus on structural responses to meet rising water demands (Frederick et al., 1997; Kaiser et al., 2000). For the first time the vernacular of "management of existing supplies" and "demand management" appeared in the plan. Agricultural and urban water conservation, reusing treated wastewater, desalination, and the more exotic options of rainmaking and brush control were suggested in the plan as future strategies. Plans prepared in 1990, 1992 and 1997 continued to advocate reservoir construction as a way to meet increasing urban demand but they also suggested that some of this demand could be met by conservation and frugality of water use.

All of the state water plans through 1997 were prepared by TWDB staff. Over the years TWDB hired engineers, hydrologists, planners and an occasional economist to write these plans. The planning modus operandi was for TWDB staff to write the plan and distribute it for public comments. After receiving public comments, the plan was published and adopted by TWDB.

2.1 State Agencies Involved in Water Planning

Three state agencies are responsible for different aspects of water planning in Texas. They include: Texas Parks and Wildlife Department (TPWD), the Texas Commission on Environmental Quality (TCEQ), and the Texas Water Development Board (TWDB). Beginning in 1992, these agencies began working together to "increase transparency and efficiency in the process and solicit knowledge from a wider range of interests" (TWDB, 2007b). The 1997 State Water Plan was the first plan adopted as a consensus effort by the TWDB, the TPWD and the TCEQ (TWDB, 1997). These combined efforts include data collection, instream flow management, and groundwater protection.

The Texas Parks and Wildlife Department (TPWD) is primarily responsible for protecting the state's fish and wildlife resources. Their activities include investigating fish kills and seeking restoration for lost resources, and providing recommendations to the TCEQ on scheduling instream flows and freshwater inflows to Texas estuaries. Several of their projects provide data from large geographic areas to address broad scale policy and regulatory issues. Data from these projects are also utilized for site-specific assessments. TPWD staff also participate in the review of policy, standards, and project assessments associated with water development, water planning, and water quality issues. Educational activities inform the public, decision makers, and others of the need to protect water quantity and quality so that present and future generations can enjoy the natural heritage of Texas.

The Texas Commission on Environmental Quality (TCEQ) has a Water Quality Division that issues wastewater, pollution and runoff permits, and develops surface water quality standards. They also have a Water Supply Division that ensures the efficient administration of surface water use, drinking water, and utility service. This Division reviews applications for surface water use, changes in water rights ownership, and use of riverbeds or riverbanks. In addition it maintains water-availability models for all river basins, evaluates water conservation plans and drought contingency plans, administers the Water-Saving Plumbing Fixtures Program, conducts groundwater quality planning and assessments, and manages the Water Utility Database and the Water Availability Modeling (WAM) Database.

The Texas Water Development Board's (TWDB) mission is to provide leadership, planning, financial assistance, information, and education for the conservation and responsible development of water. Their leadership and planning functions come in to play as the coordinators of the regional planning process. They provide support and technical assistance to each region as well as the publication of the State Water Plan every 5 years. As far as financial assistance there are a variety of funds, loans, and grants made available through the TWDB. Some of these include: the Agricultural Water Conservation Loan and Grant Program, the Clean Water State Revolving Fund (SRF), the Drinking Water SRF, and the Groundwater District Assistance Fund. Another function of the TWDB is to conduct studies of the occurrence, quantity, quality, and availability of the state's surface water and groundwater, including development of groundwater availability models for the state's major and minor aquifers.

2.2 Regional Water Planning: The New Era

In 1996 and early 1997 Texas suffered an intense drought which caused over $11 billion in agricultural losses, a drop in statewide reservoir levels to 68% of conservation storage, the implementation of mandatory water use restrictions by more than 300 cities and water utilities, almost 500,000 acres burned by wildfires, and more than 14,000 farm workers out of jobs (TWDB, 2007a). The Texas legislature responded to this crisis by passing legislation known as SB #1 that changed state water planning. This law mandated that future state water plans be prepared by regional planning groups composed of local leaders from different backgrounds and interests. The legislation also required plans be prepared every five years. In this new process, TWDB staff would provide assistance to these groups but the groups were responsible for preparing a plan for their region. These regional plans would then be merged by TWDB into a new state water plan. Some suggest that this was more of a revolution than evolution in water planning since the law decentralize, democratize, and strengthened the planning process (Kaiser et al., 2000; Brown, 1998).

There are several reasons, according to the TWDB, why stakeholders should embrace this new process (TWDB, 2007b). First, the number of Texans is expected to more than double from 2000 to 2060 with some regions possibly tripling their populations. Demand also varies between regions. For example, Region C (which includes the Dallas-Fort Worth metroplex) projects a 140% increase in demand by 2060 while some areas expect their demand to decrease (TWDB, 2007).

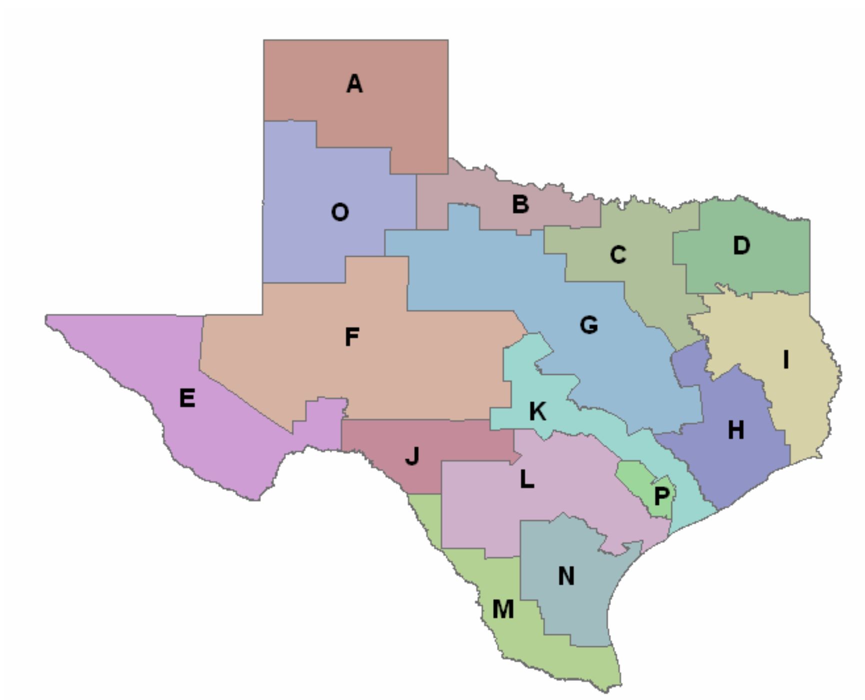


FIGURE 1. TWDB's Regional Water Planning Groups

Second, during a future severe drought, many cities will not have enough water without instituting severe water restrictions for their customers (Kluge, 2007). In the recent dry period of October 2006, customers of 176 water systems faced mandatory water restrictions. With a repeat of the 1950's drought of record, water restrictions will not be enough to ensure all regions a stable water supply (Kluge, 2007). Third, the development of additional water to provide a stable supply for the future will not be cheap. The total capital cost of over 4,500 strategies recommended in the 2007 state water plan is estimated to be $30.7 billion over the next 50 years. Despite these high costs, the potential costs of not developing additional water supplies will be even higher.

Sixteen regional water planning groups (RWPGs) were established to prepare a plan. The geographical boundaries of the 16 groups are depicted in Figure 1. All planning groups were required to prepare plans that:

- Described their planning area
- Quantified current and projected population and water demands
- Evaluated and quantify current surface and groundwater supplies
- Identified surpluses and needs
- Evaluated water management strategies and prepare plans to meet needs
- Recommended regulatory, administrative, and legislative changes

In order to receive state funding for local water projects, the project must be included in and be consistent with the adopted regional and state water plan. This finally gave legal and financial teeth to the regional water planning process. Before SB 1, past state water plans were largely ignored and served mostly as reference documents (Kaiser et al., 2000).

Each RWPG is composed of members representing the following interests: public, counties, municipalities, industries, agriculture, environment, small businesses, electric-generating utilities, river authorities, water districts, and water utilities. Several regions choose to include additional specific interests to their boards. Most planning groups consist of 15 to 24 members, with an average membership of 19 people. The regional water planning process was a grassroots effort that strongly encouraged the public to attend meetings and participate in the planning process. The TWDB maintains an area on their website with meeting information, as well as other planning related information and documents. Some of the planning groups have developed their own websites as well to help inform the public of their activities and progress.

2.21 Texas Water Plan: 2002

Approximately $21 million was spent on developing the first set of regional water plans. (Mullican, 2003). In 2002, the TWDB aggregated these 16 regional plans into the first state water plan prepared under this new planning process. During the 3 years of preparation, 900 public meetings were held across the state and over 600 citizens provided comments on the draft plan. Some highlights of the plan include the identification of 883 water users that will have unmet needs by 2050 if management strategies proposed in the plan aren't implemented. The cost to implement these strategies totals some $17.9 billion. Several demand management strategies were included such as conservation and reuse. Supply-side strategies included 8 major and 10 minor (<5000 acre-ft) reservoirs, 53 water transfers, new groundwater wells, and desalination. The 2002 State Water Plan also included several major water policy recommendations on the regional water planning process, as well as issues regarding agricultural and rural water, groundwater, surface water, conservation, innovative strategies for meeting water needs, environmental issues, and providing and financing water and wastewater service.

Responses to the 2002 plan and process have generally been positive (Gooch T.C., 2003). The public became more involved and more aware of the need to conserve water and the need to secure water supplies for the future. Through the SB1 process, water suppliers became aware of the water needs projections and the estimated timing that new supplies might be needed to meet their projected demands. While some suppliers already knew where they stood in relation to their supplies and water needs, SB1 was an eye-opening experience for many other water suppliers. The regional water planning process created an opportunity for improved cooperation, both between regions and among water suppliers. Another significant benefit of the SB1 planning process is the increased momentum to implement water management strategies and recommended water supply projects (Mullican, 2003).

The planning process has brought major water suppliers to the table to discuss regional water management strategies. This has encouraged regional cooperation in the development of new supplies. One specific success story took place in the El Paso area (Region E). This area of Texas is arid and prone to drought. In developing their regional water plan, water planners determined that the City of El Paso and the U.S. Army Air Defense Artillery Center stationed at Fort Bliss would experience extreme water shortages by the year 2050 if no other water supplies were developed. The Planning Group recommended a variety of water management strategies to meet the needs at Fort Bliss, including purchasing fresh water and reclamation water from El Paso and desalination. El Paso's recommended strategies included additional water conservation, converting irrigation water rights to municipal water rights, importing groundwater, and desalination (Gooch T.C., 2003).

2.22 Texas Water Plan: 2007

The planning process was repeated to produce the second iteration in January of 2007. This plan identified 1,175 users with needs by 2050 which is an increase of 292 from the previous plan. In order to meet these needs, 4,500 strategies were recommended costing some $30.7 billion. The cost of not implementing these strategies is far greater. TWDB's 2007 State Water Plan calculates that without appropriate steps being taken to increase water supply, Texas businesses and workers could lose approximately $9.1 billion in 2010. By 2060, this figure increases to roughly $98.4 billion. Forgone state and local business taxes associated with lost commerce could amount to $466 million in 2010 and $5.4 billion in 2060. Lost jobs total approximately 119,000 in 2010 and 1.2 million in 2060.

In the 2007 State Water Plan, conservation savings would supply about 23% of the needed water in 2050. This would total about 2 million acre-feet compared to 990,000 acre-ft in the 2002 plan. Greater emphasis was also placed on reuse which now accounts for 15% of the water needed to meet needs in 2050. As far as supply management, 16 reservoirs (14 major and 2 minor) and 41 water transfers were recommended. This plan also focused attention on the impacts of proposed strategies on the environment.

The TWDB claims in their 2007 plan that the new bottom-up approach has resulted in greater public education, awareness, and participation (TWDB, 2007b). Brody (2003) confirms that mutual learning through citizen participation often enhances the planning process and leads to a more desirable outcome that meets the needs of all parties.

2.3 Revising Groundwater Availability Determinations in the Regional Water Planning Process

In determining groundwater availability, planning groups were to consider Groundwater Conservation Districts' (GCDs) assessments of groundwater availability. However, they were not required to use GCD numbers. Essentially, the regional planning groups determined the desired future management conditions for each aquifer. Groundwater conservation districts had to use the availability data adopted by regional planning groups to regulate pumping. This process created a jurisdictional conflict over aquifer management. Since GCDs were statutorily responsible for the planning and management of aquifers within their geographical boundaries, they asserted that they were in a superior position over RWPGs to determine GW availability.

GCDs argued that they had a better understanding of specific local needs and issues such as subsidence, depressurization, reduced stream flows, and water well declines.

In response to the GCDs plea for greater control, 2005 the Texas Legislature passed HB 1763 which greatly increased the importance of water availability determinations. Instead of having the RWPGs determine groundwater availability, the Texas legislature shifted this responsibility to groundwater conservation districts (GCDs). Before HB 1763, GCDs could not adopt numbers that conflicted with RWPGs but now the tables have turned and the RWPGs must use—not just consider—the district's numbers. As a result of this paradigm shift, each GCD is now responsible for determining groundwater availability based on their desired future conditions for each aquifer. Once a GCD determines the desired future condition for the aquifer, the TWDB, using a groundwater availability model (GAM), quantifies the amount of water that can be pumped from the aquifer. This amount, called the Managed Available Groundwater (MAG), will serve as the basis for all groundwater planning efforts in Texas as well as the basis for the groundwater component of regional and state water planning (Sledge, 2006). See figure 2 for an illustration of the changes imposed by HB 1763.

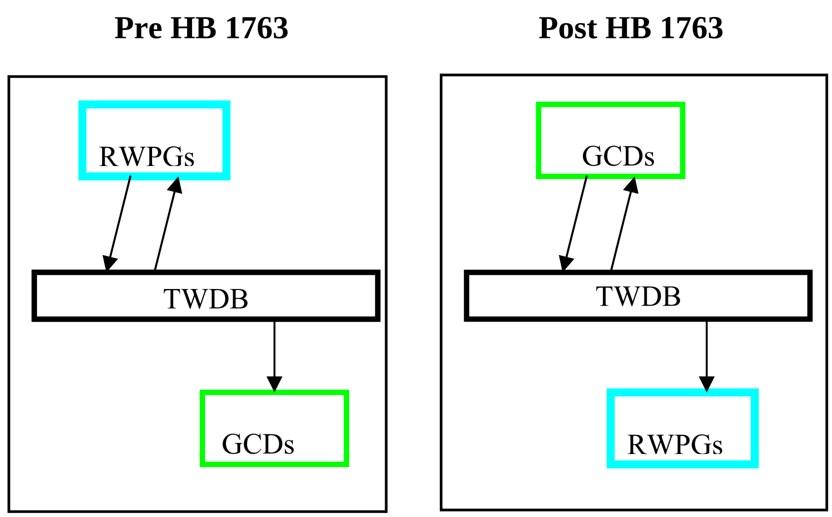


FIGURE 2. HB 1763's Effect on the Determination of Managed Available GW.

2.4 Importance of Groundwater

Nine major and 21 minor aquifers provide a critical source of water for Texas. These aquifers hold approximately 430 million acre-feet, 90 percent of which is in the Ogallala aquifer beneath the Panhandle. Aquifers supply slightly more than 60 percent of Texas' annual water consumption, but more than 80 percent of agricultural water consumption (TCCRI, 2007).

About 36% of water used to meet municipal demands is from groundwater (TWDB, 2007). According to the plan, total groundwater supplies are expected to decline by 32% over the next 50 years. Some of the greatest declines will occur in the Ogallala. This aquifer is projected to experience a 52% decline over the next 50 years. The Edwards-Trinity High

Plains aquifer is also facing a 50% decline over the next 50 years. On the other hand, several aquifers project increased production with current permits and existing infrastructures. For example, the Capitan Reef Complex will increase supplies by 27%, from 15,271 acre ft/yr to 19,454 (TWDB, 2007b).

2.5 GCDs: What, Why and How Many?

Groundwater Conservation Districts (GCDs) are required by law to develop and submit a groundwater management plan for state certification. The plan must provide for the most efficient use of local resources, control of land subsidence, and prevention of water waste. In addition, the plan must include provisions related to drought, conservation, natural resource issues, and conjunctive surface water issues. Each district also must adopt rules to implement the plan, permit and register certain wells, and keep records of groundwater production and use.

At this point the state is well covered by 87 GCDs which account for 9/10ths of the reported groundwater usage (Kaiser, 2006). Certain features and trends related to the geographic distribution of the new GCDs are worth noting. Prior to the 2001 session, only 12 out of 52 were located east of interstate highway 35 (Kaiser, 2005). Now 24 of the newly created GCDs are in this area. Such a dramatic increase in the number of districts in the eastern portion of the state can be attributed to the existence of plentiful, unregulated groundwater supplies in close proximity to areas of rapidly growing population. Citizens of rural counties with plentiful supplies are beginning to feel that their future water supply may be threatened by thirsty metropolitan areas (Ellis and Houston, 2002).

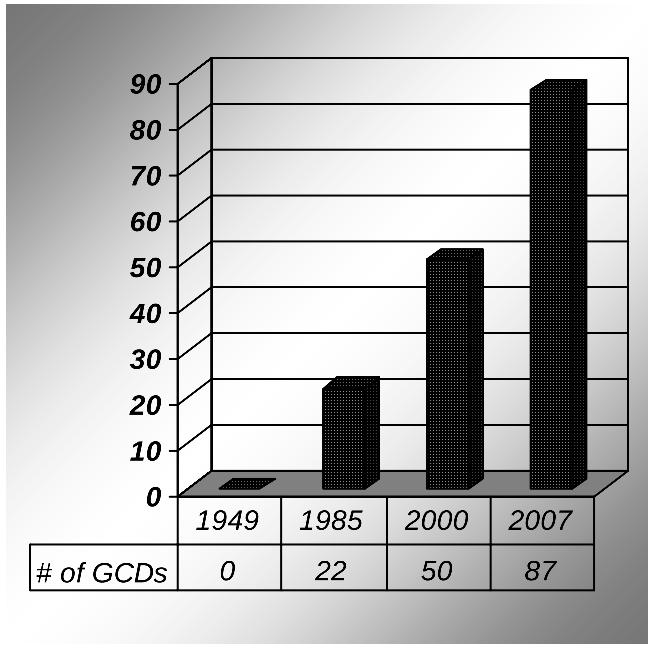


FIGURE 3. Number of GCDs formed from 1949 to 2007.

Another interesting geographic feature of the 35 new GCDs is the number of counties included within each of their boundaries. 26 districts contain only one county which has raised some concern regarding their ability to fund operations and effectively manage the resources within their jurisdiction. Also when the district covers only a small portion of the aquifer, the financial burden of program implementation falls on a limited number of citizens (Ellis and Houston, 2002). Another difference is the variable size of GCDs with some covering only 31 square miles while others are responsible for over 10,000. Figure 4 depicts GCD distribution across the state.

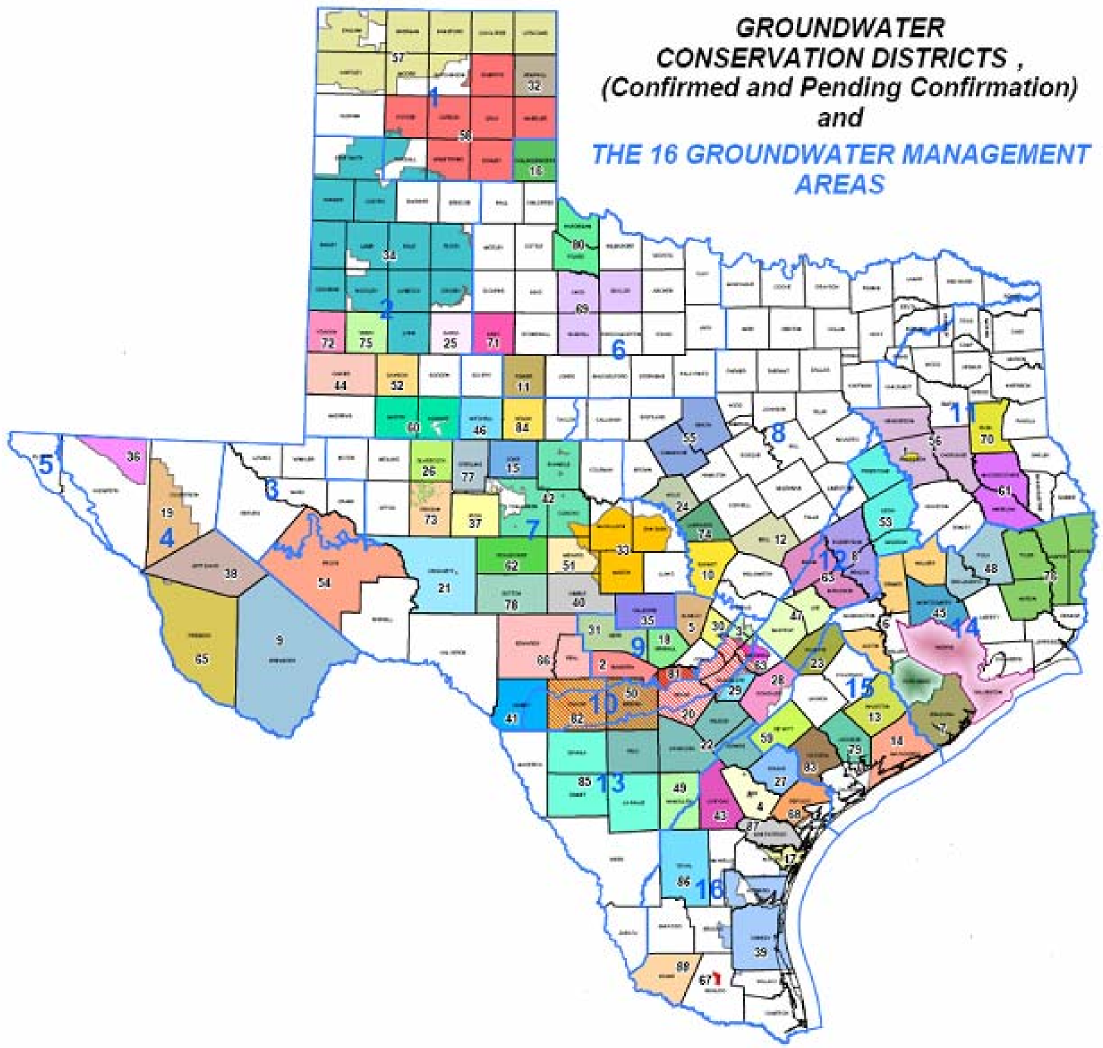


FIGURE 4. Geographic Distribution of GCDs

2.6 Regions' Past Relationship with Groundwater

Prior to 2005, planning groups were to consider Groundwater Conservation Districts' determinations of groundwater availability. However, they were not required to use their numbers. To determine availability, most RWPGs used one of two policies: sustainability which allows for indefinite pumping, or planned depletion where the aquifer will be drained over a period of time. Based on these determinations, specific numbers were then generated using TWDB's Groundwater Availability Models. These models estimate current and future trends in the amount of water available for use from an aquifer. An important point to be made, that is the basis for this research, is that each regional planning group determined how much groundwater was available in each aquifer within its jurisdiction and how much of this water could be pumped to meet the anticipated demand. Essentially, the regional planning groups determined the desired future management conditions for each aquifer

2.7 Impact of New Process and Local Resource Control on Planning

Several issues have arisen from the new desired future conditions process. One concern with the new process is the overlap of political and aquifer boundaries. Adding overlapping and spatially inconsistent management layers adds political and administrative complexity (Giordano, 2003). Since GCD boundaries aren't aligned with RWPGs it may cause greater conflict. Also the trend toward single county districts can make consensus within each GMA more difficult. Having a larger number of participants in a common pool resource increases the difficulty of organizing, agreeing on rules, and enforcement (Ostrom et al., 1999).

In addition to the boundary issues, the process is confusing. See Appendix B for diagrams from the TWDB that attempt to clarify the procedures for determining DFCs. The process to create DFCs as well as the process to resolve conflicts seems overly complicated. When aquifers are shared and managed by different GCDs, their competing objectives may become more difficult to resolve because of the inherent emotional nature of the problem coupled with administrative obstacles (Muthukumar, 2003).

Another possible problem may occur when GCDs impose permit restrictions, fees, or limitations on transfers that will reduce groundwater availability. The smaller GCDs may lack the larger perspective to see what is better for the region as a whole. Regulations that were created in the attempt to protect the aquifer may have unintended impacts on the economy. Kaiser (2005) recommends that the legislature should determine if and how districts impact the local and regional economy. If the legislature intended that economics be a factor in GCD regulations than GCDs should be required to undertake an economic impact analysis to determine how their pumping regulations impact private property rights as well as the local and regional economy. Some counties may require more water than others; however, their economy may be supporting the more rural surrounding counties.

Still another issue is whether GCDs should have the responsibility to determine DFCs and be the regulators of such a decision. Ultimately GCDs may determine whether water should be reserved for agriculture, given to growing cities, or kept for future sale. Ad hoc groundwater management policies adopted by a single county GCD without systematic integration of science, management and cooperation among adjoining counties may act as a serious impediment for regional-scale sustainable growth (Muthukumar, 2003).

Local politics may also be detrimental to future groundwater management. When only four members are required to make a decision on a GCD board, it seems like power can play too great a role. Nunn asserts that no property system designed to achieve economic efficiency improvements "will be adopted which injures interested parties who are powerful enough…to keep it from being adopted" (Nunn, 1985). An evaluation of public participation in North Carolina's water quality planning showed that leaders of affected interest groups – farm, business, and local government dominated participation. Initially state water planners sought public support for stronger regulation of pollution sources but ended up with the favor of voluntary compliance. This example shows that people without a direct economic interest largely failed to participate (Godschalk, 1981).

In spite of the plethora of concerns with the new process, here are certain advantages resulting from the emphasis on GCDs for groundwater planning. First, the development of rules has helped avoid the repetitive interpretation of social values and arguments of fairness and utility. For example well-spacing requirements are straightforward and provide certainty (Castle, 1978). Clear rules are thought to be desirable for property relations because they increase the reliability of expectations, thus encouraging investment and transactions (Pound, 1963; Weber, 1947). In Arizona, the 1980 Groundwater Management Act created Active Management Areas (AMAs) similar to GCDs. By providing regulatory certainty, a clear water rights system, and the grandfathering of existing users, the Act has encouraged investments in conservation and use of renewable supplies (Jacobs and Holway, 2004).

GCDs are also thought to protect property rights better than courts (Shapiro, 1965). There is a greater opportunity for comment in rule development which results in decisions that are more likely to be the result of consensus and compromise. Flexibility is also cited as an advantage of GCD driven planning. Providing for sufficient flexibility is imperative to allow for change and for what we don't yet know (Sophocleous, 2000). Besides increased depth to the water table, over pumping can have other impacts on the environment. For example, in Kansas, stream flows have been decreasing which has led to the degradation of riparian vegetation (Spray, 1986). To deal with this problem, Kansas GMDs amended their safe-yield regulations to include base flow (the natural GW discharge to the stream). Nodes were created along streams that are treated just like permitted wells for spacing requirements. By embracing the experimental ideals of basic science, adaptive management better equips planners and their organizations to deal with changing socioeconomic, demographic, and physical conditions across the landscape (Brody 2003).

Local control can also improve groundwater planning by allowing for increased attention to specific problems. The following describes examples in the High Plains of Texas and Kansas. The High Plains Underwater Conservation District (HPUWCD) only regulates well spacing and gross tail-water waste. Instead they prefer to work out solutions informally with landowners. They deemphasize their regulatory role by relying on education and voluntary technical conservation programs. The district has developed perhaps the most comprehensive conservation program for irrigators of any groundwater management organization in the US (Emel and Roberts, 1995). Since the 1960s on-farm water use efficiency has increased by 30-40%. Their guiding principle is that citizens provided with sufficient information will make socially desirable decisions regarding water usage.

In Kansas, the Groundwater Management Districts (GMDs) showed that local decision making is the best way to fully account for local variability in water management

(Sophocleous, 2000). In addition, (Emel and Roberts, 1995) found that community-organized regimes have greater potential for maintaining economic sustainability and encouraging conservation. (Zwingle, 1993) stated that communities want to solve their problems but not using rules that apply to somebody else. If rules are imposed by outsiders without consulting local participants, local users may engage in a game of "cops and robbers" with outside authorities (Ostrom et al., 1999).

Lastly, the greater opportunity for public participation and increased trust among locals when working in small groups can help increase support for solutions. Groups of people who identify with one another are more likely to draw on trust, reciprocity, and reputation to develop norms that limit use (Ostrom et al., 1999). Cooperation has been shown to disintegrate as the number of players increases and communication between them decreases (Roberts and Emel, 1992). A study in Australia concluded that there is a potentially strong demand for participation in water planning and emphasizes the need to ensure that involvement is planned with methods appropriate to all sectors of the community (Syme and Nancarrow, 1992).

2.8 Water Modeling Issues

Once GCDs establish their DFCs, the next crucial step is quantifying how much water will be available under those conditions. This involves the use of a groundwater availability model often referred to as a GAM. The Texas surface water availability models (WAMs) have become a tremendously important technology for both planning and management of surface water resources in the state (Brumbelow, 2007). However, the GAMs have yet to gain such high confidence. The WAMs allow efficient coordination between groups that share common water resource with very few disagreements on planning data. This is not the case with groundwater where model results often produce greater conflict and uncertainties. Some GCDs have consultants that run these models to test possible management strategies, while others depend on the TWDB which is currently overwhelmed with requests. Smaller, less established districts may not have the resources to have consultants quickly run their models which may force them to accept the lead of neighboring districts within their GMAs.

Other issues related to models include their overall inaccuracy to predict future conditions. According to (Frederick et al., 1997), models that estimate future climate changes are not accurate enough to provide useful hydrological information. The uncertainty associated with the prospect of climate change underlines the importance of keeping options open and building flexibility into water plans. Uncertainties in data, most significantly in distribution and intensity of recharge and withdrawals, significantly impacted the calibration and predictive modeling efforts (Rainwater et al., 2005). Because of the strong spatial and temporal variability of important primary variables (land, vegetation, climate, and water interactions), the estimation of key parameters will be a predominantly statistical undertaking (Sophocleous, 2000). Another shortcoming of both WAMs and GAMs is their ignorance of the connections between ground and surface water. Conjunctive management is virtually non-existent in Texas and large changes will be required before it becomes commonplace (Brumbelow, 2007).

2.9 Outcomes

As a result of the changes imposed by HB 1763, the quantity of groundwater available for use is uncertain and quite likely will change from the quantities now being used by RWPGs in regional planning. Therefore, water planning for water user groups whose future supplies are from groundwater should carefully consider broadening their strategies both in terms of quantities and sources to take this uncertainty into account. Such changes may have variety of implications for Texas Water planning.

Gathering survey responses from the 16 RWPGs and 10 GCDs in Region G is useful to see which issues generate the greatest disagreement. Region G was selected since it is located in an area of rapid population growth and has already had conflict with GCDs. A previous survey conducted in 2006 by Region G elicited several concerns regarding the new planning processes. Responses were collected from Region G members and other related interest groups including GCDs. With demand far outweighing the supply in future years, it is imperative that the procedure to create State Water Plans is as streamlined as possible. The findings of this research can serve as a guide for legislative changes to improve the process. This is crucial if Texas expects to meet the needs of a doubled population in less than 50 years.

As fresh water resources are strained with the growing population there are increased tensions over its availability, accessibility, provision, and protection. Various communities, interest groups, private and public entities, and other stakeholders have conflicting notions of how the remaining water should be valued, managed and allocated (Eckstein, 2006).

CHAPTER III

RESEARCH METHODS AND QUESTIONS

This study will seek opinions from RWPG and GCD members on three major questions:

- What will be the impact on regional water planning and water management strategies when GCDs determine groundwater availability?
- Will less groundwater be available for urban water uses when GCDs determine availability?
- What is the impact of the regional water planning process in regards to awareness of water issues, availability of state and local funding, and public support for water projects

3.1 Data Collection

Data for this study was collected through a mail survey designed to elicit opinions from regional water planning officials and groundwater district board members regarding the impact of the new process for determining groundwater availability and their opinions on the overall impact of the regional water planning process. The survey was mailed in March of 2007. A modified Dillman method was used in that a reminder letter with another copy of the survey was sent to non-respondents three weeks after the initial mailing. In order to measure attitudes, all questions were structured on a five point Likert scale (see Appendix A, for copy of survey).

The entire population of regional water planning representatives in the 16 regions (N=322) was included in the study as was every board member (n=72) in the 10 groundwater conservation districts in planning Region G. See Figure 5 for the planning regions and Figure 6 for the groundwater conservation districts in Region G. Tables 1 and 2 list the response rates for the 16 planning regions and 10 groundwater districts.

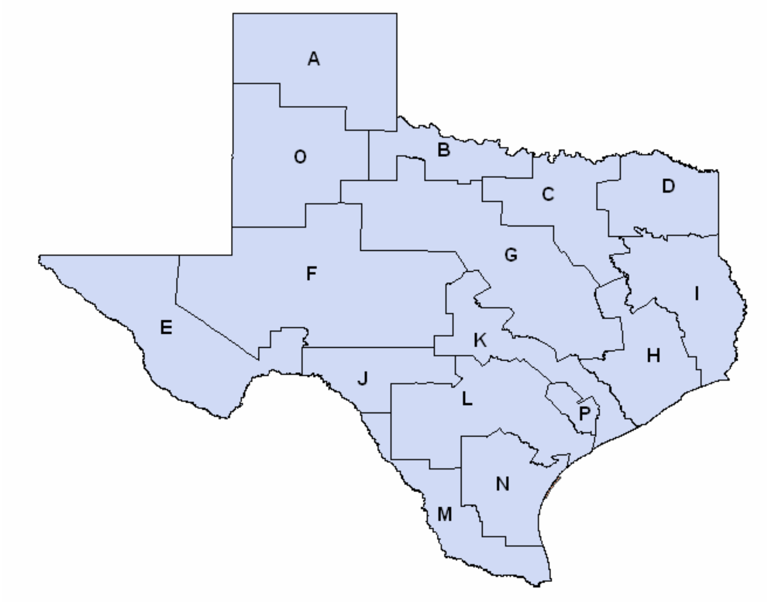


FIGURE 5. Regional Water Planning Groups Surveyed

TABLE 1. Response Rates for Planning Regions

	Planning Region	Number Mailed	Number Returned	Percentage Returned
1	A	21	17	81%
2	B	16	13	81%
3	C	19	7	37%
4	D	24	14	58%
5	E	25	10	40%
6	F	18	9	50%
7	G	19	12	63%
8	H	23	12	52%
9	I	21	7	33%
10	J	17	10	59%
11	K	22	10	45%
12	L	23	15	65%
13	M	19	15	79%
14	N	16	11	69%
15	O	22	11	50%
16	P	17	11	65%
TOTAL		**322**	**184**	**57%**

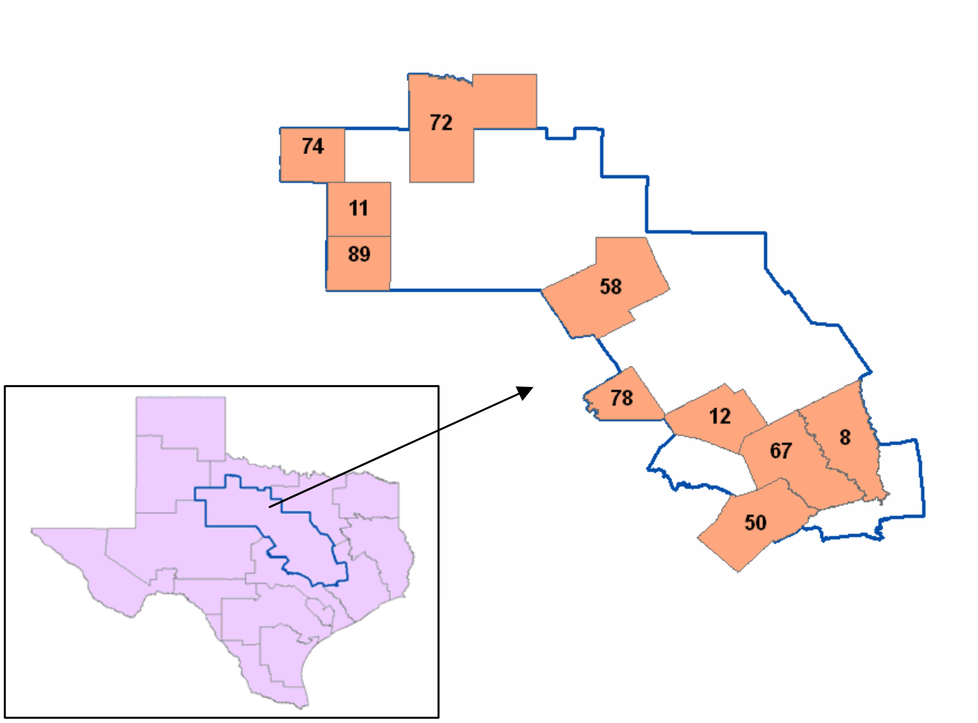


FIGURE 6. Surveyed Groundwater Districts in Region G

TABLE 2. Response Rates for Groundwater Districts

District Number	District Name	Number Mailed	Number Returned	Percentage Returned
8	Brazos Valley	8	7	88%
11	Clear Fork	5	3	60%
12	Clearwater	5	4	80%
50	Lost Pines	10	7	70%
58	Middle Trinity	6	2	33%
67	Post Oak Savannah	10	4	40%
72	Rolling Plains	11	4	36%
74	Salt Fork	4	1	25%
78	Saratoga	5	3	60%
89	Wes-Tex	6	6	100%
TOTAL		**72**	**41**	**57%**

3.2 Statistics

The data was analyzed using SPSS 14.0. Descriptive statistics and means are used to measure central tendency. Analyses of variance (ANOVA) were used to determine if differences in responses could be attributed to certain regions or interest groups. An independent t-test was used to test for any significant variations between the opinions of GCD board members and RWP members. Three other t-tests were used to compare the following: 1.) users to providers, 2.) experience greater or less than 5 years, and 3.) GCDs to region G specifically. For all four t-tests, equal variances were assumed. All counts, means, and standard deviations are listed in Appendix C. The 6 tables listed follow the order they are presented in chapters IV and V.

For each question, any significant differences (p-value >.05) between GCDs and regions will be reported first. Charts will display the means and standard deviations of responses from GCDs and regions to each question. Then any difference will be reported in the order presented above. If there are variances among interest groups or regions, graphs will be included.

CHAPTER IV
REGIONAL PLANNING IMPLICATIONS OF GCDS MAKING DECISIONS REGARDING GROUNDWATER AVAILABILITY

As previously outlined, Regional Water Planning Groups (RWPGs) are to determine regional water needs and the availability of surface and groundwater resources to meet those needs. This planning assessment required RWPG's to ascertain the demand for groundwater, the availability of groundwater and ultimately suggest how aquifers and groundwater should be managed within their respective regions. RWPG's followed this procedure in preparing the 2002 and 2007 state water plans' groundwater availability for aquifers within their jurisdiction.

This process was changed by the Texas legislature with the enactment of HB 1763. However, the changes were made late in the regional water planning process and the old procedure was used in preparing the 2007 state water plan. This chapter analyzes the opinions of RWPG members on the implications of this change on (1) population growth, (2) water supply strategies, (3) potential for increased conflict, (4) science basis for planning, and (5) groundwater protection.

Five levels of analysis were undertaken for each question. This format will be followed throughout this chapter. Only statistically significant differences are reported at each level for each question. If no differences were found, they are not reported. First, responses between RWPGs and GCDs are reported based on t-tests. Second, responses between regions are reported based on analysis of variance (ANOVA). Thirdly, responses between RWPG interest groups are analyzed using the ANOVA process. The 11 interest groups were also categorized into 2 groups: users and providers. These groups will be compared using a t-test. Fourthly, RWPG responses based on years of service are reported based on t-tests. Two categories were used for years of service: less than 5 years and greater than 5 years. Lastly, a t-test compared the opinions of RWPG and GCD members in central Texas designated as Region G, but no significant differences were found.

4.1 Growth Impact

Urban population growth is driving the demand for water. Regional planning must account for this growth in determining the amount of groundwater needed to meet the increasing demands. An important concern is whether there will be less groundwater available for future water uses when GCDs determine availability. When a GCD creates their desired future condition for a specific aquifer, their rules may prevent any further development once a critical water level is reached. If cities and urban areas face increased restrictions they may be forced to search for alternate sources. Regional water planners will also need to account for GCD restrictions and may have to research other management strategies to meet future demand. If alternate supplies are not economically feasible then it is possible that future growth may be limited due to a lack of sufficient water supply.

Four questions were posed to gauge the opinions of regional water planning members and GCD board members on possible impacts that the DFC process would have on growth.

TABLE 3. Respondents' Opinion of the Impact of DFCs on Growth.

Part 1 (M,sd)	*9--Less GW will be available for future use	13--GCD' s could use DFC's to restrict economic growth	14—GCD's could use DFC's to restrict population growth	16--Cities and urban areas will lose access to GW
All Regions Statewide	2.97,1.195	2.65,1.233	2.77,1.250	3.13,1.193
GCDs in Region G	3.35,1.272	3.10,1.172	3.10,1.215	3.23,1.271
Total (Regions + GCDs)	3.04,1.216	2.74,1.232	2.83,1.247	3.15,1.205

*Indicates a statistically significant (p-value <.05) difference between regions and GCDs.

1 = strongly agree → 3 = uncertain → 5 = strongly disagree

Regions were unsure if less groundwater would be available once GCDs determine their DFCs. GCDs, on the other hand, felt that their DFCs would not result in less groundwater for future use. All appeared to agree that GCDs could use DFCs to restrict both economic and population growth (#13 & #14). Then for #16, all respondents disagreed on the average that cities will lose access to groundwater as a result of the DFC process. There were, however, some significant differences among interest groups (figure 7) and years of experience.

ANOVA was used to find significant differences between each interest group's responses. Only one conflicting view was found and this occurred for #16 between Agriculture and Industry. On average, Industries agreed that cities would lose access to water (m =2.33, s=0.888) while Agriculture (m=3.67, s=0.816) disagreed. Then to compare years of service, a t-test was used to find that regional members with less than 5 years of experience agreed (m=2.90, s=1.088) that cities would lose access while those with more experience disagreed (m=3.29, s=1.228).

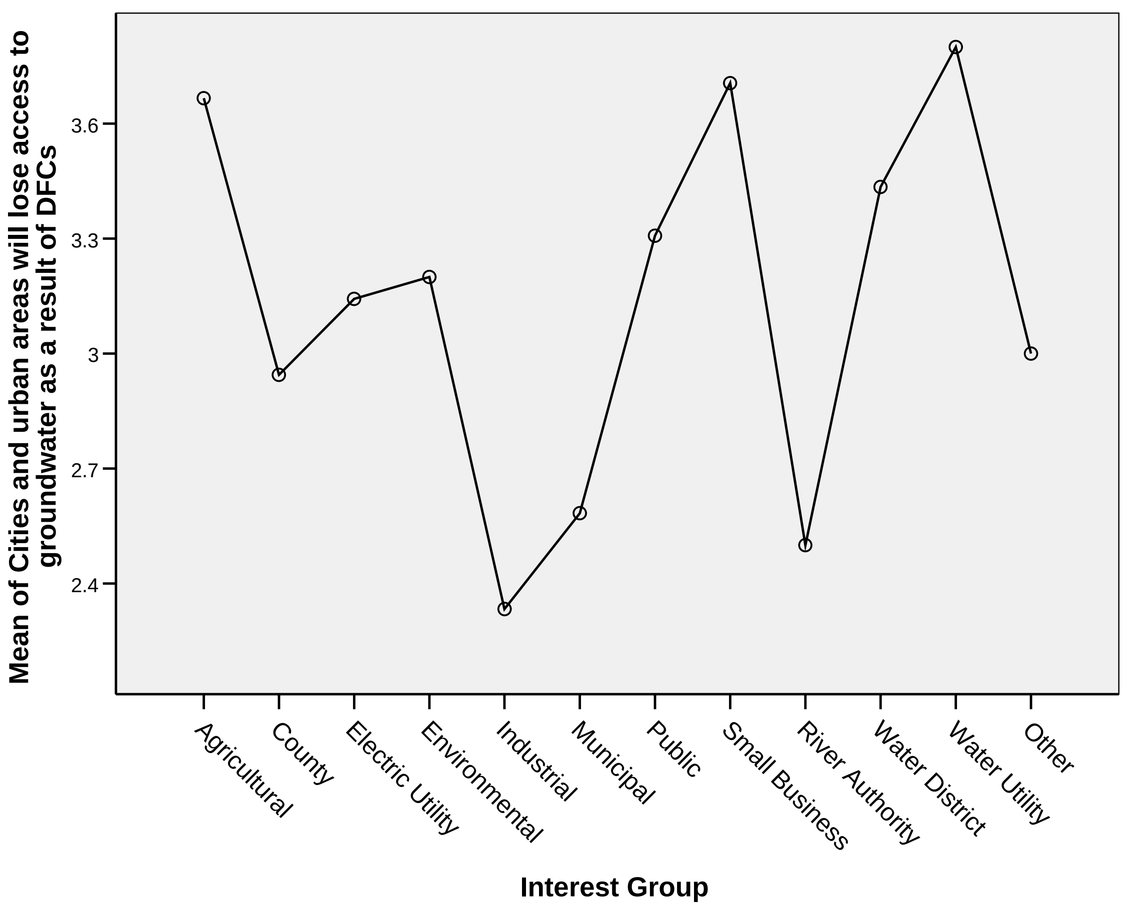


FIGURE 7. Interest Groups' Opinion of Cities' Future Access to Groundwater.

1 = strongly agree → 3 = uncertain → 5 = strongly disagree

Overall regions appear to be more concerned that GCDs will use DFCs to limit growth, although on average, neither group believes that cities will lose access to groundwater. Industries, on average, agreed that cities would lose access while agricultural representatives did not. This may be due to the fact that industries themselves are growing and have faced restrictions that limit their own growth. They are connected with the city more closely and may have a better understanding of the conservation measures already in place. The hurdles that industries/cities must pass before acquiring additional water are becoming higher so they are more concerned that new rules imposed by GCDs will add to their difficulties. Agricultural members, on the other hand, have greater access to water and don't seem concerned with the possibility of cities losing access. They may think that cities have greater resources to acquire additional sources when in reality those other sources are becoming more scarce and expensive.

4.2 Water Supply Strategies

Regional planning groups evaluated various strategies to meet water demands. In the 2007 state water plan, over 4,500 water management strategies were recommended to produce 9.0 million acre-ft of new supplies by 2060. Some of these strategies include: implementing water conservation and drought management, developing new groundwater and surface water supplies, expanding and improving management of existing water supplies, water reuse, desalination, brush control, and weather modification. Table 4 lists the main categories of strategies used statewide.

TABLE 4. Water Management Strategies Statewide in 2007

Category	Million acre-ft/yr	% of Total
Surface water management • Water transfers • Obtain additional water rights • Purchases through contracts with major providers • Reservoirs reallocation & system optimization	3.30	37%
Municipal water conservation • Change water pricing structures • Educational campaigns • Install efficient plumbing fixtures.	.617	7%
Irrigation conservation • Irrigation scheduling • Furrow dikes, land leveling, brush control • Line ditches, advanced sprinkler systems • Replace district canals with pipelines	1.40	16%
14 new major reservoirs	1.10	12%
Groundwater management • New wells or increase pumping from existing wells • Temporarily overdraft aquifers during drought • Expand treatment plants • Water transfers	.800	9%
Water reuse	1.30	14%
Desalination of brackish groundwater or seawater	.313	3%

Three statements in the survey were intended to determine the impact of DFCs on the RWPGs' planning efforts and choice of water supply strategies. Table 5 lists the results of the comparison between RWPGs and GCDs for each question.

TABLE 5. Respondents' Opinion of DFCs' Impact on Regional Planning and Strategy Choice

Part 1 (M,sd)	1--DFC process will weaken regional planning	2--RWPGs' choice of mgmt strategies will decrease	15—GCD's could use DFCs to restrict water transfers
All Regions Statewide	3.35,1.256	2.99,1.134	2.29,1.111
GCDs in Region G	3.32,1.150	3.21,1.044	2.58,1.174
Total (Regions + GCDs)	3.35,1.235	3.03,1.120	2.34,1.126

1 = strongly agree → 3 = uncertain → 5 = strongly disagree

The responses to question 1 show that GCDs and Regions disagreed that the DFC process would weaken regional planning. A t-test found that regional members with greater than 5 years of experience (m=3.53, s=1.264) disagreed more strongly than members who have served for less than 5 years (m=3.08, s=1.195) with a p-value of 0.023. This suggests that members who have been involved in more than 2 planning cycles have more faith in the strength of regional planning. Greater trust could be placed on their responses since they have a clearer understanding of how the process could be impacted.

Another interesting comparison looked at the differences between water suppliers and water users. Question 2 results showed that water suppliers (m=2.83, s=1.189) believe that RWPG strategy choice will decrease compared to users (m=3.22, s=1.184) who disagree. This finding was significant with a p-value of .051. These results could be explained by the fact that water users are not responsible for acquiring supplies and may not recognize the effect of groundwater restrictions imposed by GCDs.

To summarize these results, both regions and GCDs anticipate that the use of water transfers will decrease. Still, both groups feel that the DFC process will not weaken regional planning. Even though water transfers may decrease due to an increase in GCD imposed restrictions, regional water planning is not expected to suffer. This optimistic view anticipates that other alternatives are available to acquire additional groundwater. Future state water plans will be tasked with considering each groundwater district's regulations in their choice of strategies.

4.3 Potential for Conflict

One concern with the new process is that the change adds a level of uncertainty that has the potential to increase conflict. The survey included five statements that sought to determine potential areas of confusion and conflict. Table 6 and the following analysis organizes the results from this section.

TABLE 6. Respondents' View of Process Clarity and the Potential for Conflict

Part 1 (M,sd)	*3-- Process to establish DFC's is clear.	10-- Petition process to resolve conflicts is clear	*11-- Criteria used for DFC determination is uncertain	*12-- Legislature should specify criteria to be used for DFC determination	17-- Litigation over GW rights will increase
All Regions Statewide	3.17,1.100	3.32,0.917	2.48,1.069	3.04,1.392	2.50,1.124
GCDs in Region G	2.70,1.091	3.28,0.905	3.00,0.934	3.73,1.320	2.25,1.149
Total (Regions + GCDs)	3.08,1.111	3.31,0.913	2.58,1.063	3.16,1.401	2.45,1.130

*Indicates a statistically significant (p-value <.05) difference between regions and GCDs.

1 = strongly agree → 3 = uncertain → 5 = strongly disagree

These 5 questions focused on the conflicting and confusing mix of directives given to Regions and GCDs. For question 3, the t-test showed that GCDs and Regions had a very significant difference in opinions (p-value = 0.009). GCDs thought the process was clearer than Regions. Another t-test found that RWPG members with less than 5 years of experience thought the process was less clear (p-value = 0.048). This makes sense since those with greater than 5 years of experience are able to grasp the new process more easily.

Questions 11 and 12 both had significant differences between regions and GCDs with p-values of 0.005 and 0.003 respectively. Regions agreed more strongly that the criteria to be used in determining DFCs are uncertain, and were also more likely to agree that the legislature should specify these criteria. GCDs, on the other hand, were against the legislature getting involved. Another difference of opinions on question 12 occurred between users and providers. Users (m=2.86, s=1.303) agreed on average that the legislature should specify the criteria to be used in determining DFCs, while providers (m=3.38, s=1.455) did not (p-value=0.025).

The main issues raised in this section include the clarity of the petition process and the region's feeling that the criteria used in determining DFCs is uncertain. This could be due to the fact that the petition process has yet to be tested and that regions are not yet familiar with the criteria used in determining DFCs. Such processes are relatively new and may need some time to sink in and be applied before opinions can be formed. Regions were more likely to support the legislature's involvement in specifying criteria. Users shared this view when compared to providers. Such results indicate concern over the GCDs extensive power to decide which indicators will be of greatest importance for their DFCs. These indicators include stream flow, water levels, water quality, or land subsidence. Users worry that they will be restricted from pumping their current supplies and may prefer having the legislature get involved. Setting a standard could reduce the likelihood of GCDs discriminating certain users. Regions also may prefer set standards so that their planning efforts are less complicated. Accounting for each GCD's specific conditions could be a challenge.

All involved anticipate that litigation will increase as a result of the new DFC process. Another source of increased conflict besides clarity of process is the battle between science and local politics.

4.4 Science vs. Politics

Groundwater science is not as developed as for surface water and groundwater availability models (GAMs) have yet to gain high confidence. Model results often produce greater conflict and uncertainties. Some GCDs have consultants that run these models to test possible management strategies, while others depend on the TWDB which is currently overwhelmed with requests. Smaller, less established districts may not have the resources to have consultants quickly run their models which may force them to accept the lead of neighboring districts within their GMAs.

Other issues related to models include their overall inaccuracy to predict future conditions. According to (Frederick et al., 1997) models that estimate future climate changes are not accurate enough to provide useful hydrological information. The uncertainty associated with the prospect of climate change underlines the importance of keeping options open and building flexibility into water plans. Uncertainties in data, most significantly in distribution and intensity of recharge and withdrawals, significantly impacted the calibration and predictive modeling efforts (Rainwater et al., 2005).

Such uncertainties may add to the threat of local politics having greater influence in determining the DFCs. This may be detrimental to future groundwater management. When only four members are required to make a decision on a GCD board, it seems like power can play too great a role. Nunn asserts that no property system designed to achieve economic efficiency improvements "will be adopted which injures interested parties who are powerful enough…to keep it from being adopted" (Nunn, 1985).

This section was interested in discovering respondents' opinions on whether science (7) or politics (8) will dominate the determination of DFCs.

TABLE 7. Respondents' Opinion Regarding the Basis of DFC Determination.

Part 1 (M,sd)	*7-- GCD's determination of DFC's will be based on sound science	*8-- Local politics will dominate DFC determination
All Regions Statewide	3.05,1.043	2.36,1.095
GCDs in Region G	2.38,1.184	3.00,1.281
Total (Regions + GCDs	2.93,1.096	2.48,1.154

*Indicates a statistically significant (p-value <.05) difference between regions and GCDs.
1 = strongly agree → 3 = uncertain → 5 = strongly disagree

These 2 questions had highly significant variance between regions and GCDs with p-values of 0.000 and 0.004. GCDs feel more certain that DFCs will be based on sound science while Regions are more concerned that local politics will win over. After looking at regions statewide it is interesting to see how the results for each of the 16 regions compare. Only one Region (A) had more than 50% of members agreeing that science would dominate the determination of DFCs. This could be due to the fact that GCDs in this area have been established for a long period of time and the underlying Ogallala aquifer is one of the most well understood and managed aquifers in the state. Other regions with relatively high confidence in the use of science included Regions G, L, and O (see figure 8). None of the regions were found to have significantly different means.

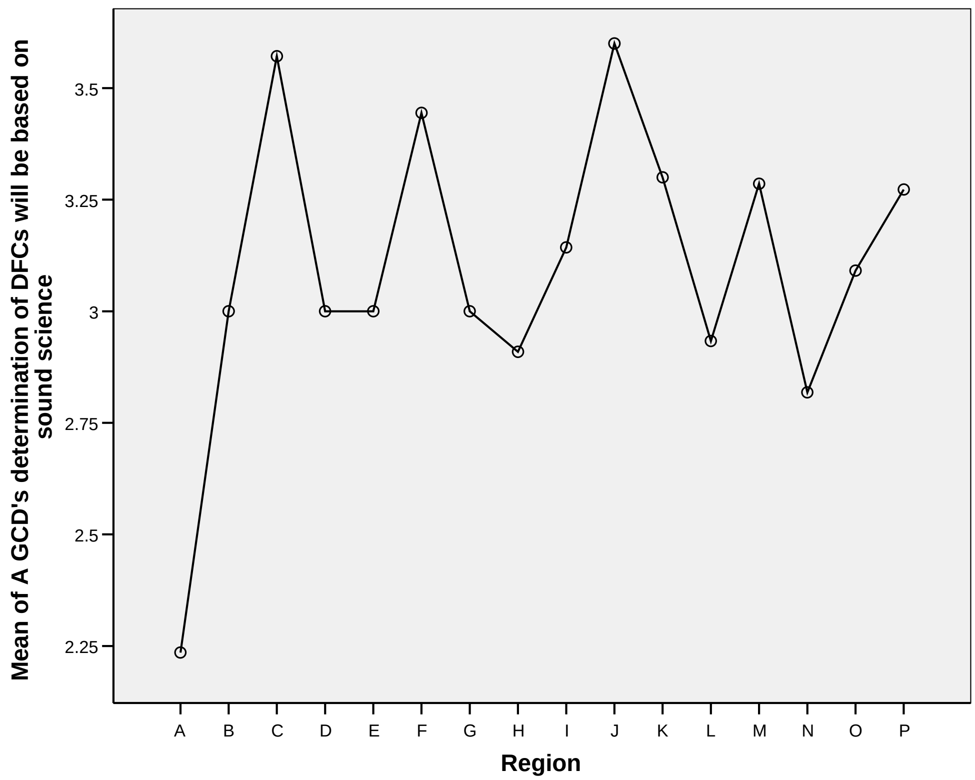


Figure 8. Regional View of whether DFCs will be Based on Sound Science.
1 = strongly agree → 3 = uncertain → 5 = strongly disagree

Then all 16 regions were compared in question 8 to see how they differed in their opinions over the impact of local politics on the determination of DFCs. Most regions agreed that local politics would dominate the decision but some had very high levels of agreement. Region C had 100% of its members agree that local politics would rule, and Regions D, F, and I followed close behind (see figure 9).

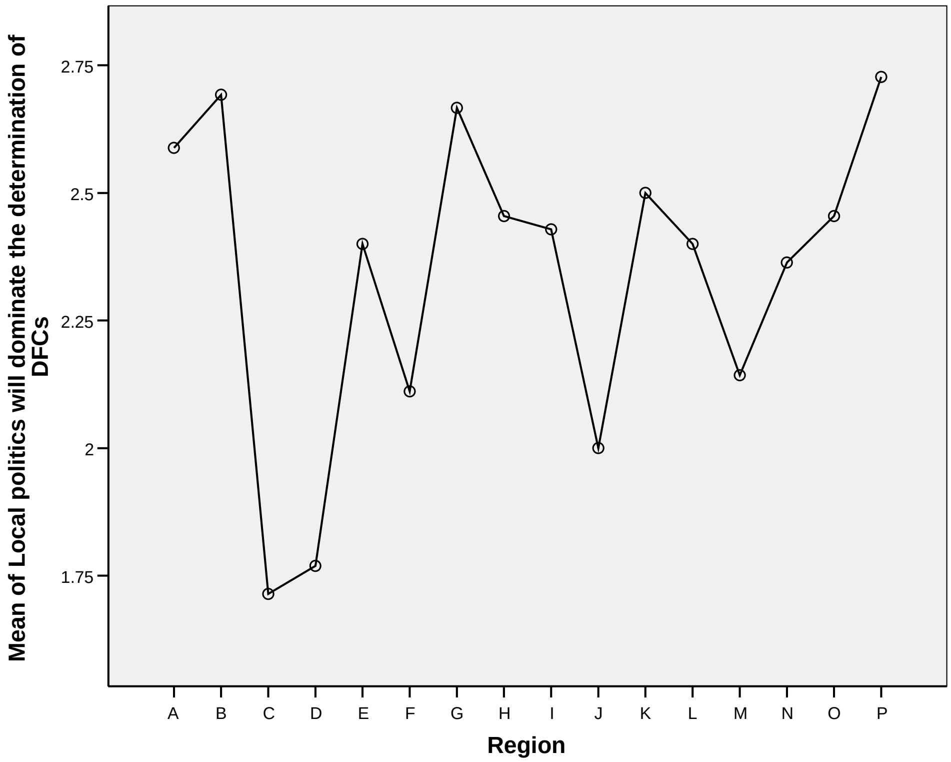


Figure 9. Regional Expectation that Politics will Dominate DFC Determination.
1 = strongly agree → 3 = uncertain → 5 = strongly disagree

One source on conflict between GCDs and Regions statewide could be their opposing views regarding science and politics. GCDs believe that science will dominate DFC determinations while Regions feel that local politics will play a bigger role. This shows that GCDs are optimistic that science will dominate even if regions may not agree. It is important that regions have faith in GCD's determinations so that regional water plans are compatible with district goals. It may take time to see the process through before regions can gain confidence in the district's ability to create acceptable and meaningful DFCs.

4.5 Resource Impact

Another area of interest is whether GCDs are the most appropriate entities to lead the DFC process and what impact the DFC process will have on groundwater itself. Having local GCDs responsible for determining DFCs can increase the opportunity for trust among locals. Working in small groups can help increase support for solutions. Groups of people who identify with one another are more likely to draw on trust, reciprocity, and reputation to develop norms that limit use (Ostrom et al., 1999). In Kansas, the Groundwater Management Districts (GMDs) showed that local decision making is the best way to fully account for local variability in water management (Sophocleous, 2000). (Emel and Roberts, 1995) found that community-organized regimes have greater potential for maintaining economic sustainability and encouraging conservation and (Zwingle, 1993) stated that “communities want to solve their problems but not using rules that apply to somebody else.” If rules are imposed by outsiders without consulting local participants, local users may engage in a game of “cops and robbers” with outside authorities (Ostrom et al., 1999).

The following table 8 summarizes results from 3 survey questions that considered whether GCDs are the most appropriate entity to lead the DFC process and, if so, whether they have sufficient financial resources to effectively manage the groundwater.

TABLE 8. Respondents’ Opinion of the DFC Process Functionality.

Part 1 (M,sd)	***4-- GCDs are the most appropriate entities to lead the DFC process**	**5—DFC process will lead to greater GW protection**	**6-- GCD's have the financial resources to implement DFC's**
All Regions Statewide	2.45,1.249	2.32,1.053	3.55,1.092
GCDs in Region G	2.05,1.260	2.25,1.276	3.23,1.209
Total (Regions + GCDs)	2.38,1.258	2.31,1.094	3.49,1.119

*Indicates a statistically significant (p-value <.05) difference between regions and GCDs.

1 = strongly agree → 3 = uncertain → 5 = strongly disagree

Both RWPG and GCD respondents agreed that GCDs are the most appropriate entities to lead the DFC process however GCD agreed significantly more. It isn’t surprising that GCDs would be more supportive of themselves. When RWPGs were compared individually, question 5 was the only one that raised significant disagreement. Even though the graph below (figure 10) shows several peaks in disagreement, only Region F (m=3.44, s=1.014) and L (m=1.80, s=1.082) were found to diverge with a p-value less than 0.05. Another difference was found using the t-test comparing years of service. This showed that members with ≥ 5 years of experience (m=2.18, s=1.059) thought the DFC process would lead to greater resource protection compared to those with less experience (m=2.54, s=1.029) with a p-value of .034.

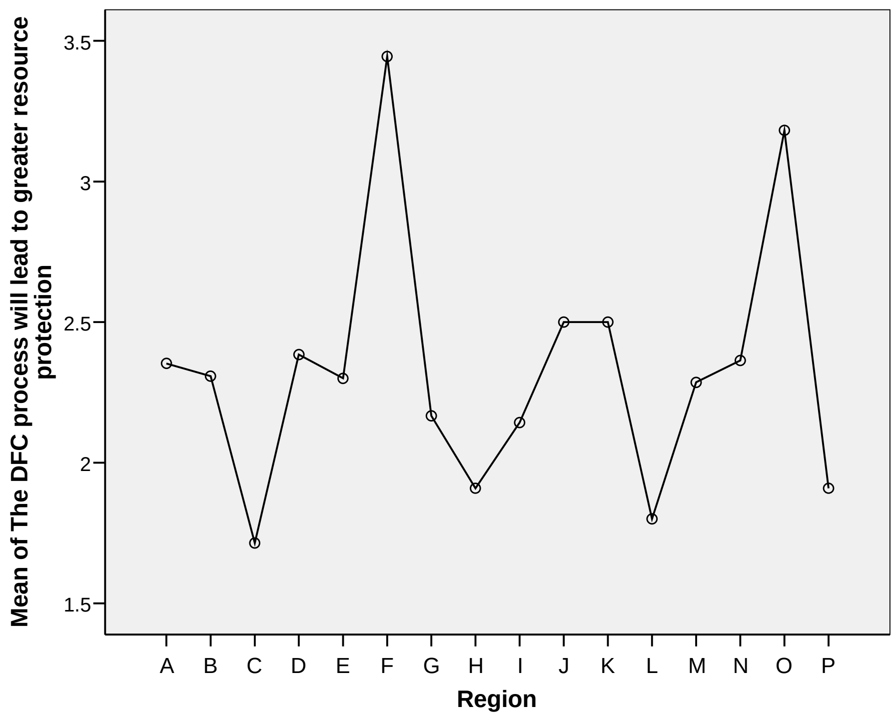


FIGURE 10. Regional Outlook on the DFCs' Potential to Protect Groundwater.
1 = strongly agree → 3 = uncertain → 5 = strongly disagree

As far as resource impact, all involved agreed on average that GCDs are the most appropriate entity to lead the DFC process and that it will lead to greater protections of resources. However their limited financial resources appear to be a constraint. Currently each GCD has different sources of funding. Some collect pumping fees, while others are tax-based. It is important that each district is not impaired to make the most informed decisions for their area. Otherwise they may be influenced by others with greater resources to impose their views. This could result in water marketers taking advantage of weaker districts by supporting less strict rules and regulations. They can hire consultants that support their claims of water availability and provide large sums of money to gain the district's favor. Hopefully such schemes can be realized within the GMA and rules can be jointly formed to aid struggling districts.

Overall the comprehensive monitoring occurring within GCDs and increased water modeling taking place in preparation for DFC decisions will strengthen the RWP process. Increased data collection and attention to specific aquifer conditions will aid planners in accounting for the future. Greater conflict may occur in the initial stages but this DFC process should eventually lead to greater protection and concern for the state's groundwater resources.

CHAPTER V

PROGRESS OF REGIONAL PLANNING SINCE 1997

In 1995-96, Texas experienced a drought that caused an economic loss of $5 billion to the state's economy. This certainly played a key role in getting the attention of legislators and the public on water issues. Recognizing that water is the single most important factor for the future economic viability of Texas, the sponsors drafted and filed Senate Bill 1-- the comprehensive water management bill (Brown, 1998). SB 1 significantly shifted water law and policy and served to decentralize, democratize, and strengthen the planning process (Kaiser et al., 2000).

Following passage of SB 1 by the 75th legislature in 1997, the TWDB initiated the regional water planning (RWP) process by creating 16 RWP areas (A→ P). See figure 13. Each RWPG is composed of members who represent the following interests: public, county, municipal, industry, agriculture, environment, small business, electric-generating utility, river authority, water district, and water utility. Several regions choose to include additional specific interests to their boards. Most planning groups consist of 15 to 24 members, with an average membership of 19 people. The regional water planning process was a grassroots effort that strongly encouraged the public to attend meetings and participate in the planning process. The TWDB maintains an area on their website with meeting information, as well as other planning related information and documents. Some of the planning groups have developed their own websites as well to help inform the public of their activities and progress. Over 3 years and $21 million were spent in developing the first set of Regional Water Plans and nearly 900 public meetings were held during that time (Mullican, 2003).

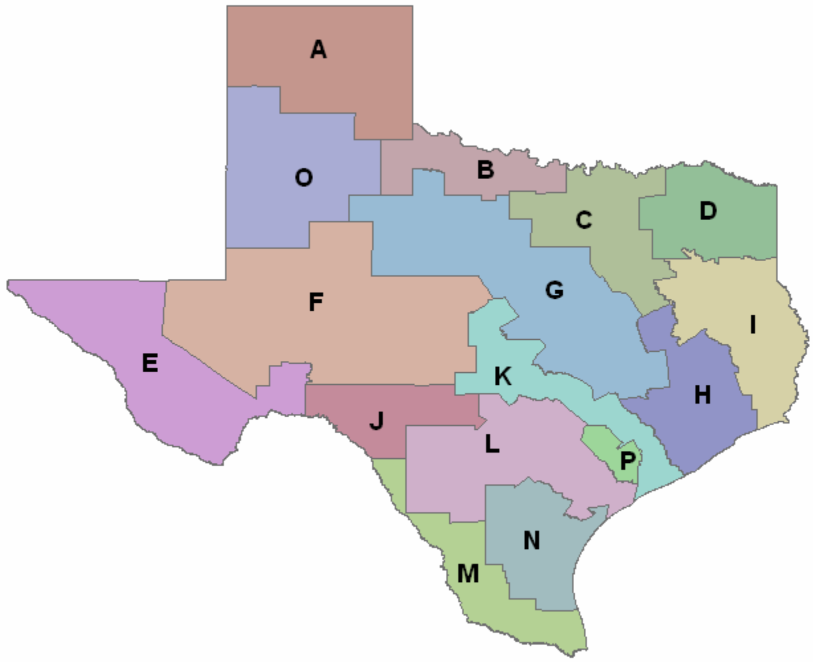


FIGURE 11. The 16 Regional Water Planning Groups

In 2002, the TWDB aggregated these 16 regional plans into the first state water plan prepared under this new planning process. This process was repeated and the second iteration of the state water plan was published in January of 2007. The SB1 regional water planning effort has been a tremendous success in Texas (Gooch T.C., 2003). The public has become more involved and more aware of the need to conserve water and the need to secure water supplies for the future. The planning process has served to bring major water suppliers to the table to discuss regional water management strategies which has encouraged regional cooperation in the development of new supplies.

Through the SB1 process, water suppliers have become aware of the water need projections and the estimated timing that new supplies might be needed to meet their future demands. While some suppliers already knew where they stood in relation to their supplies and water needs, SB1 was an eye-opening experience for many other water suppliers. The regional water planning process created an opportunity for improved cooperation, both between regions and among water suppliers. Another significant benefit of the SB1 planning process is the increased momentum to implement water management strategies and recommended water supply projects (Mullican 2003). The TWDB claims in their 2007 plan that the new bottom-up approach has resulted in greater public education, awareness, and participation. Brody (2003) confirms that mutual learning through citizen participation often enhances the planning process and leads to a more desirable outcome that meets the needs of all parties.

This chapter analyzes the opinions of RWPG members statewide and GCDs in Region G on the progress that has been made over the past 10 years in regards to (1) the awareness of water issues, (2) the level of support for water supply strategies, (3) funding, and (4) communication with local agencies. . All questions were measured on a 5-point Likert scale based on the level of agreement from 1=strongly agree to 5=strongly disagree. A response of 3 indicated that respondents were ambivalent or unsure of their agreement with the statement.

Five levels of analysis were undertaken for each question. This format will be followed throughout this chapter. Only statistically significant differences are reported at each level for each question. If no differences were found, they are not reported. First, responses between RWPGs and GCDs are reported based on t-tests. Second, responses between regions are reported based on analysis of variance (ANOVA). Thirdly, responses between RWPG interest groups are analyzed using the ANOVA process. The 11 interest groups were also categorized into 2 groups: users and providers. These groups will be compared using a t-test. Fourthly, RWPG responses based on years of service are reported based on t-tests. Two categories were used for years of service: less than 5 years and greater than 5 years. Lastly, a t-test compared the opinions of RWPG and GCD members in central Texas designated as Region G, but no significant differences were found.

5.1 Awareness

Improving public and legislator awareness of water issues was one of the justifications for the regional water planning process. Awareness is a predicate to financial and political support for water projects. When policy makers have a high degree of awareness they are more likely to become involved in developing and implementing effective solutions to problems (De Young, 1993; Heath, 2002). Three questions in the survey were used to gauge whether awareness of water issues has improved. One was directed at the public (question 1), one at state legislators (3) and one at local elected officials (5).

Regional water planning officials indicated that awareness of water issues among the public and state and local elected officials has improved after 10 years and 2 state water plans (see table 9). Responses to question one showed that RWP officials agreed more strongly than GCDs that the public is more aware of water issues with a p-value of 0.022. When regions were compared individually using an ANOVA test, Region A and Region N had significantly divergent means with a p-value of 0.026. Both agreed that the public had a greater awareness but Region A felt more strongly that awareness has improved. The following graph (figure 12) summarizes responses to question 1 for all 16 regions. Lower values indicate greater agreement.

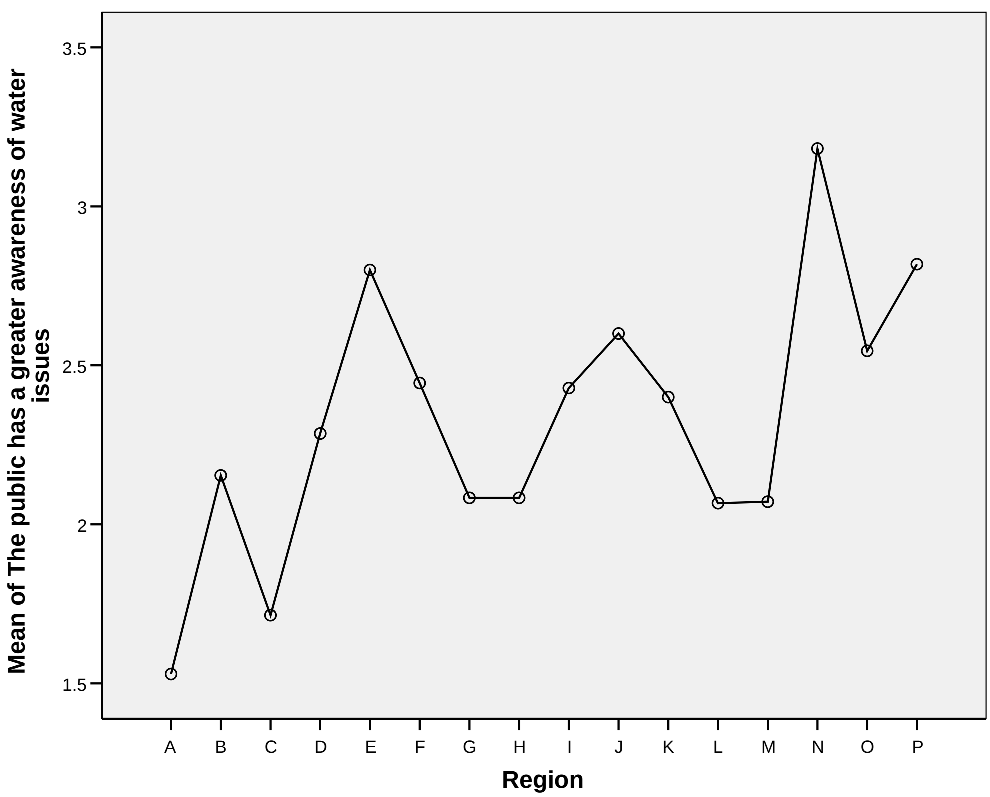


FIGURE 12. Regional Opinion of Public Awareness.
1 = strongly agree → 3 = uncertain → 5 = strongly disagree

TABLE 9. Respondents' Opinion of Water Issue Awareness.

Part 2 (M.sd)	*1—public has greater awareness	3—state legislators are more aware of water issues	5—locally elected officials are more aware
GCDs in Region G	2.71,1.167	2.41,1.204	2.17,1.093
Regions Statewide	2.19,1.185	2.15,1.065	2.15,1.013
Total	2.37,1.190	2.20,1.094	2.16,1.025

*Indicates a statistically significant (p-value < .05) difference between GCDs and Regions.

1 = strongly agree → 3 = uncertain → 5 = strongly disagree

Question three, regarding state legislators, also had some interesting results. ANOVA tests (see figure 13) between interest groups showed that electric utilities (m=1.14, s=0.378) agreed 100% that legislators are better aware of water issues. On the other hand, small businesses agreed less strongly (m=2.71, s=1.263) and water utilities disagreed (m=3.40, s=1.047).

Electric utilities like TXU, for example, use large amounts of water and have invested a lot of money in well fields and cooling lakes. Their power has allowed them to play an important role in policy formation. They agree that legislators are better aware since they have been well served and continue to make their interests known. On the other hand, less powerful water districts are more likely to be affected by new state provisions rather than aid in their formation. The survey reinforces the fact that water district representatives have less faith in legislators having a complete awareness of water issues. Legislators seem to be aware of issues from those with power to have their voice heard but others are likely to be placed on hold.

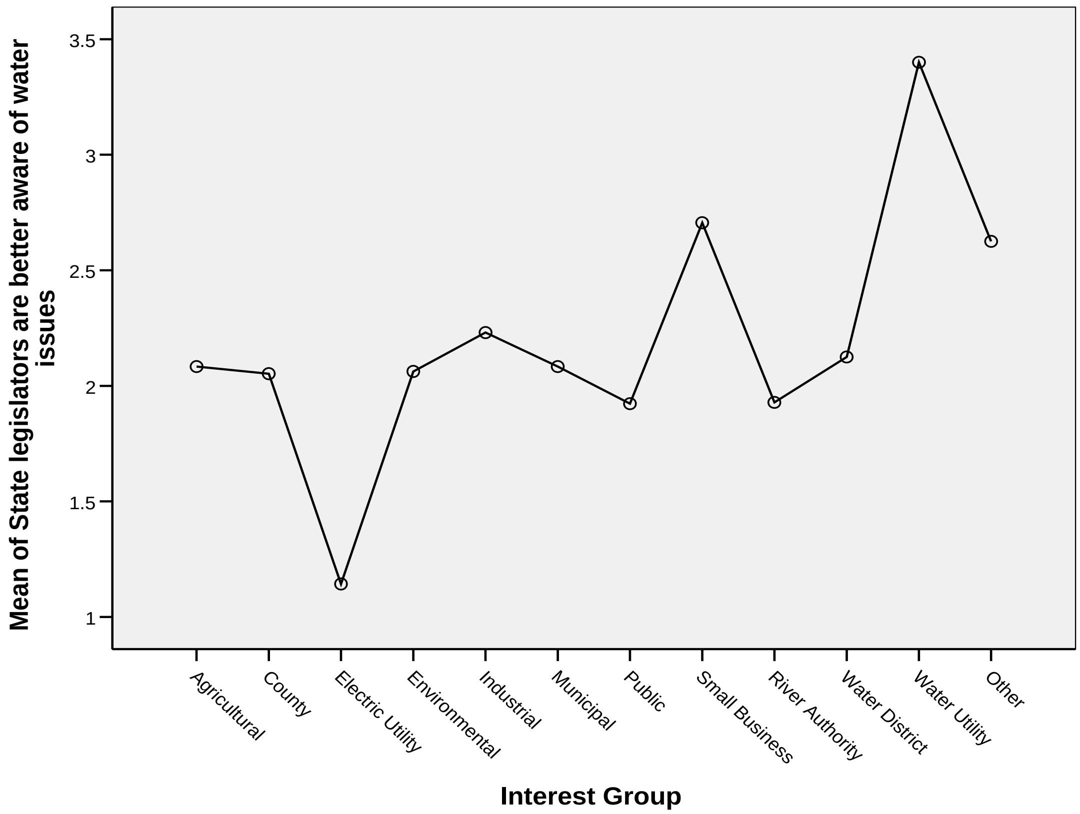


FIGURE 13. Interest Groups' Opinion of Water Issue Awareness among State Legislators.

1 = strongly agree → 3 = uncertain → 5 = strongly disagree

Another difference for question three occurred when Region G was compared to the GCDs within its boundaries. Region G (m=1.58, s=0.515) felt that state legislators are better aware of water issues compared to GCDs (m=2.41, s=0.961). No significant differences occurred for question five.

5.2 Support

This section of the survey was interested in measuring the level of public support for water projects and certain strategies. However we are only able to measure the opinions of regional and GCD members as to whether they think public support has improved. It seems as though after two state water plans that the public should have a greater understanding of water issues and therefore be more supportive of new water projects and management strategies. Five questions were aimed at discovering how public support has progressed in the eyes of planning officials.

TABLE 10. Respondents' Opinion of Project Support.

Part 2 (M.sd)	2—public support for funding projects increased	9—state-wide public support for reservoirs improved	10—local support for reservoirs improved	11—local support for water transfers improved	12—public support for regional projects improved
GCDs in Region G	3.12,1.269	3.07,1.034	3.08,1.095	3.58,0.958	3.02,0.961
Regions Statewide	2.92,0.972	3.40,1.011	3.29,1.120	3.36,1.103	2.74,1.053
Total	2.96,1.032	3.34,1.020	3.25,1.117	3.40,1.079	2.79,1.041

1 = strongly agree → 3 = uncertain → 5 = strongly disagree

The regional ANOVA for question 12 showed that Region P did not feel that public support for regional projects has improved compared to Regions A, B, G, and M. The results are displayed below in table 11 and figure 14.

TABLE 11. Regions with Significantly Divergent Opinions that Public Support for Regional Projects has Improved.

Question 12	
Regions	**p-value**
A & P	.012
B & P	.002
G & P	.000
M & P	.046

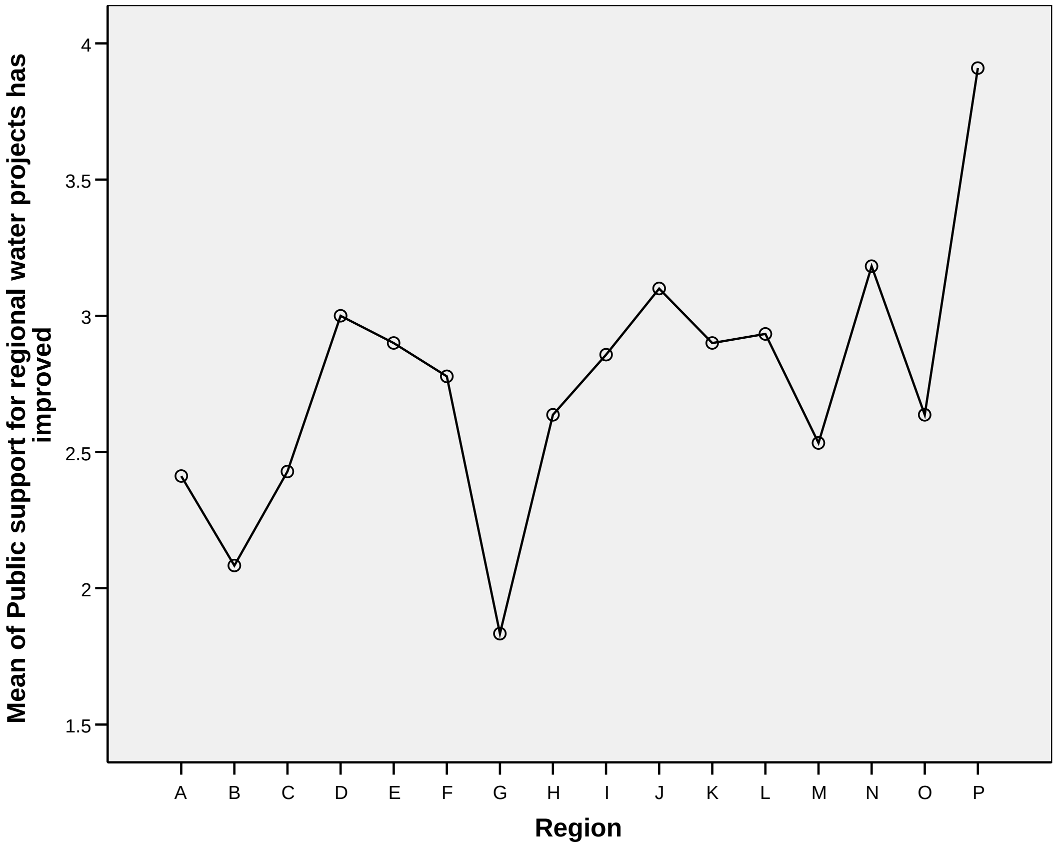


FIGURE 14. Regional View of Public Support for Projects.

1 = strongly agree → 3 = uncertain → 5 = strongly disagree

A very significant difference was found in the t-test between the GCDs and Region G specifically. Region G (m=1.83, s=0.835) thought public support for regional projects has improved compared GCDs (m=3.02, s=0.961) who did not. This conclusion had a p-value of 0.000.

The middle 3 questions 9-11 in table 10 dealt with support for water transfers and reservoir projects. Increased public support for reservoir projects was tested in question 9 and 10. Question 10 also showed some significant variance among specific regions which can be seen in figure 15 and table 12. Regions D and L both disagreed significantly more than Region A & B that local support for reservoirs has improved.

TABLE 12. Regions with Significantly Divergent Opinions that Local Support for Reservoirs has Improved.

Question 10	
Regions	**p-value**
A & D	.036
A & L	.029
B & D	.032
B & L	.026
G & D	.015
G & L	.012

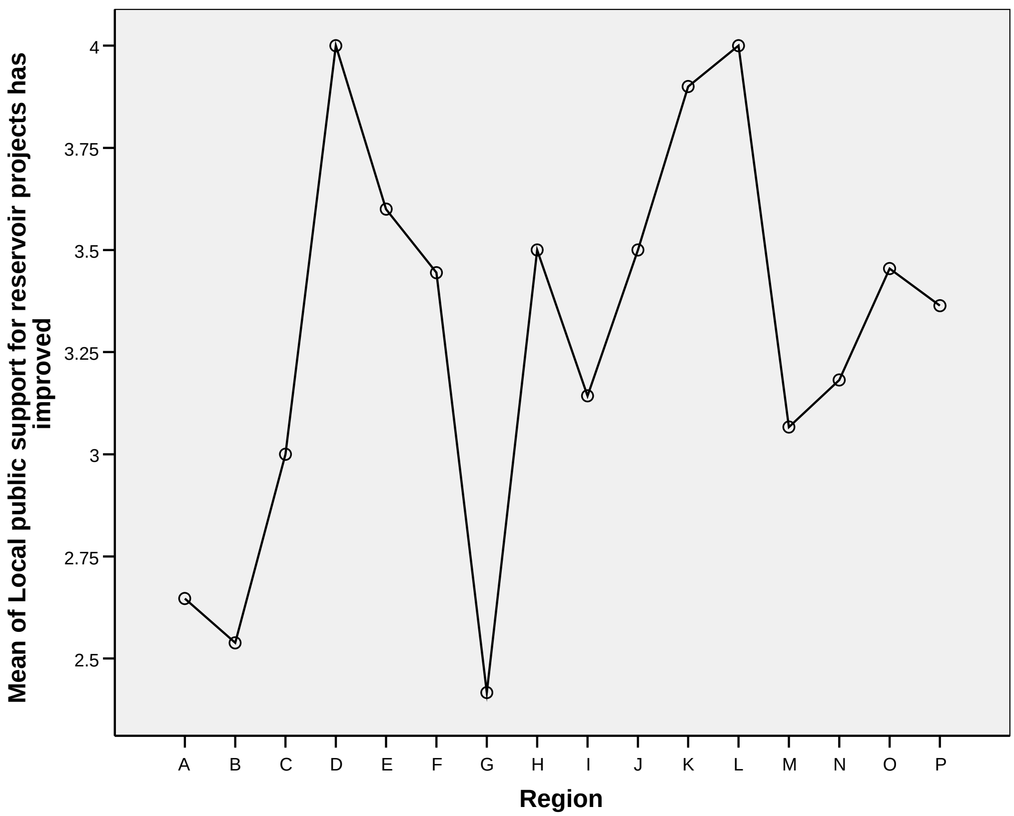


FIGURE 15. Regional Groups' Assessment of Local Support for Reservoirs.

1 = strongly agree → 3 = uncertain → 5 = strongly disagree

The t-test comparing experience levels for question 10 showed significant differences between those regional members with less than 5 years (m=3.12, 1.139) and ≥ 5 years (m=3.50, s=1.110). So, more experienced members thought that support for water transfers was even lower than those with less experience.

Overall, regional water planning groups and GCDs were relatively uncertain whether public support for regional water projects has changed. Although a very significant difference was found between Region G specifically and GCDs. Region G strongly agreed compared to the GCDs within the region that public support for regional water projects has increased. This shows that there may be potential conflict between these groups over future strategies. Regional planning members of Region G seem to be under the impression that their strategies have strong public support while the responses from the GCDs within this region prove otherwise. In order for regional water planning to have greater support in the future it may be necessary to allow GCDs a greater opportunity to voice their concerns over recommended strategies.

As far as support for reservoirs and water transfers, both strategies were found to have less public support after the past 2 planning cycles. With the recent improvement in awareness, the public may now realize the environmental consequences of reservoirs and water transfers and therefore be less likely to support such strategies. This may require some regional water planning groups to consider alternate options to meet future needs.

5.3 Funding

Along with goals of increasing awareness and support the regional water planning process also anticipated state and local funding to improve as well. It is interesting to see the opinions of regions statewide and individually, GCDs, and interest groups. The following table 13, organizes the results from the 3 questions geared towards funding.

TABLE 13. Respondents' Opinion of Regional Project Funding.

Part 2 (M.sd)	*4—state funding for water projects increased	*6—local funding for water projects increased	*13—state financial support for regional projects hasn't changed
GCDs in Region G	3.43,1.035	3.27,1.119	2.38,1.192
Regions Statewide	2.99,0.981	2.98,0.929	2.73,1.066
Total	3.07,1.002	3.04,0.970	2.67,1.095

*Indicates a statistically significant (p-value < .05) difference between GCDs and Regions.

1 = strongly agree → 3 = uncertain → 5 = strongly disagree

The first 2 questions looked at the opinions of whether state and local funding for water projects has increased. Both had significant differences between groups. Regions in both cases agree more strongly that funding has improved compared to GCDs. P-values for these 2 questions were 0.007 and 0.047 respectively. For the final statement (13) both groups agreed but GCDs agreed more. Another significant difference was calculated between users and providers which had a p-value of .0001. Providers were found to agree (m=2.40, s=1.074) more than users (m=3.01, s=1.006).

Regions seemed uncertain whether funding has improved over the past 10 years. GCDs, on the other hand believe that state and local funding have decreased and were more likely to agree that state financial support has not changed. Such results are expected since complaining of limited funds to accomplish mandated objectives is a constant issue. Also the high levels of uncertainty could be attributed to the lack of knowledge to accurately judge whether funding has improved or not.

5.4 Communication and Cooperation

The regional water planning process has attempted to facilitate communication and cooperation by bringing all interests groups together. This way all concerns can be addressed and solved together. The goal is to create a plan that takes each groups interest into account and have strategies that are acceptable with everyone. With an average of 20 members on each planning board it is possible to have everyone express their views to the group, listen to others, and discuss solutions. Cooperation has been shown to disintegrate as the number of players increases and communication between them decreases (Roberts and Emel, 1992). The following table 14 shows how respondents feel cooperation and communication have evolved over the years.

TABLE 14. Respondents' Opinion of Communication and Cooperation.

Part 2 (M.sd)	7—communication between local agencies improved	8—cooperation between local agencies improved
GCDs in Region G	2.15,0.989	2.40,0.982
Regions Statewide	2.23,0.965	2.46,1.013
Total	2.21,0.968	2.45,1.006

1 = strongly agree → 3 = uncertain → 5 = strongly disagree

These last 2 questions attempted to measure the attitudes regarding communication and cooperation between local water agencies. The results above show that both regions and GCDs agree that that communication and cooperation have improved. A significant difference occurred between Region A and D. Both regions agreed that communication has improved but Region A agreed more strongly on average with a p-value of .026. The graph (figure 16) below summarizes the results of question 7 for all 16 regions.

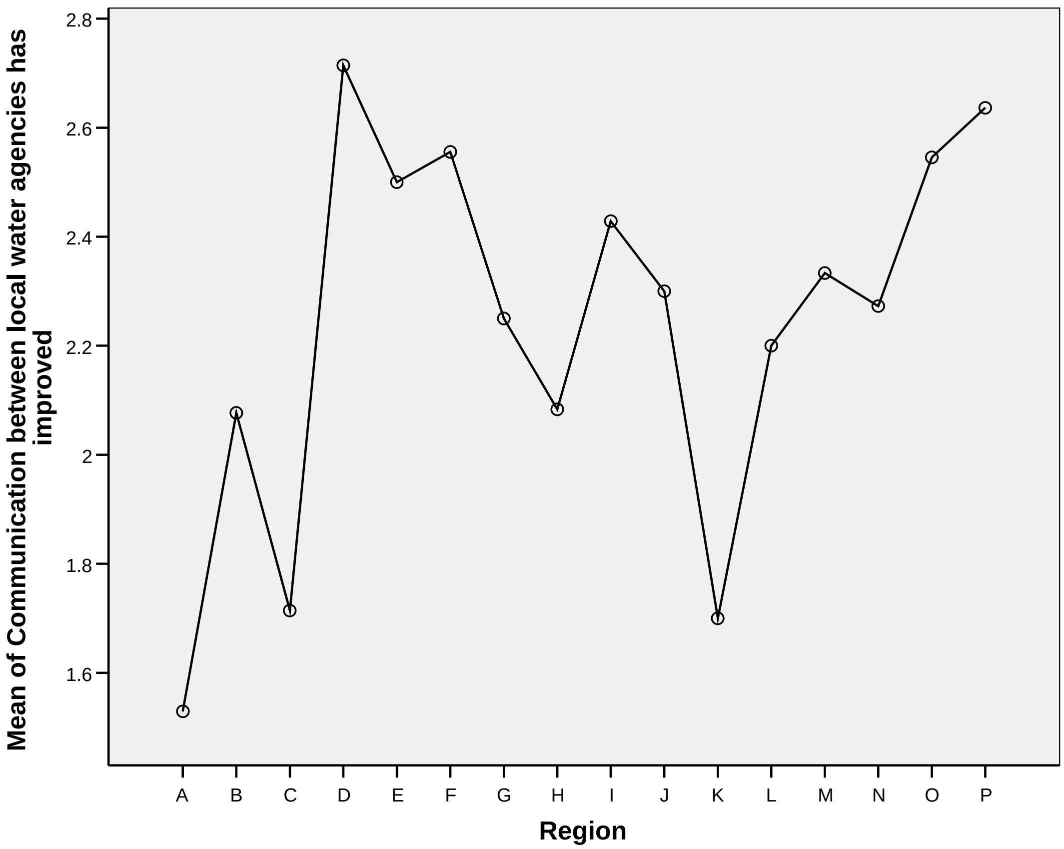


FIGURE 16. Regional Groups' Opinion of Communication and Cooperation.
1 = strongly agree → 3 = uncertain → 5 = strongly disagree

Additional ANOVA tests demonstrated that environmental and water district groups both had different opinions as seen in figures 17a and 17b, and table 15. On average water districts felt that communication and cooperation have improved more than environmentalists. There were 83% of water districts and 38% of environmental representatives who thought communication improved. In addition, 75% of water districts and 31% of environmental representatives thought cooperation improved. Now to compare users and providers, t-tests showed some variance for question 7. Both users (m=2.43, s=1.031) andpProviders (m=2.01, s=0.961) agree that communication has improved but providers were more optimistic.

TABLE 15. Significant Variance among Interest Groups in Regards to Communication and Cooperation.

#	Interest groups (M, sd)		p-value
7	Environment (2.88, 0.885)	Water District (1.88, 1.035)	0.049
8	Environment (3.06, 0.929)	Water District (2.00, 0.933)	0.046

1 = strongly agree → 3 = uncertain → 5 = strongly disagree

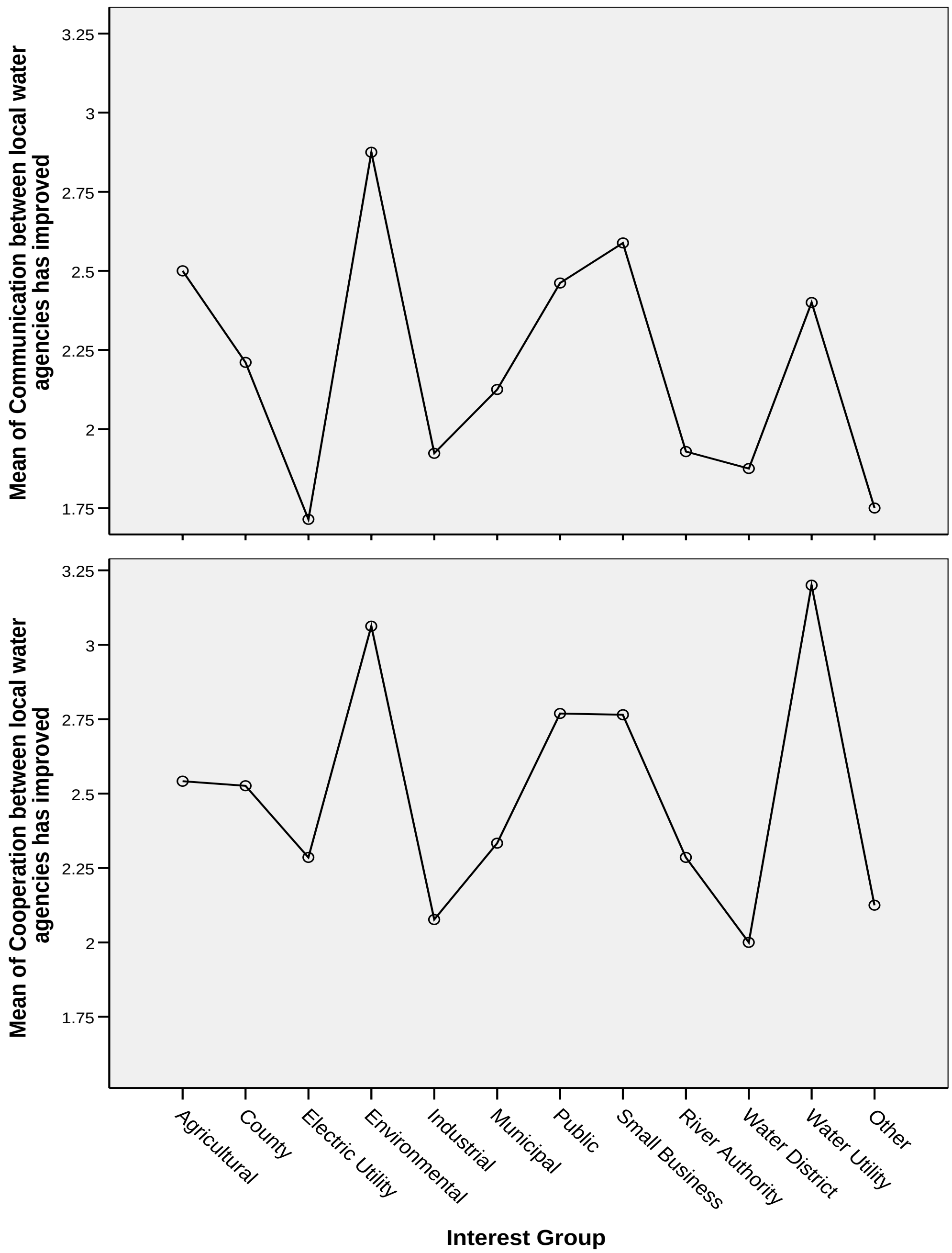


FIGURE 17a and 17b. Interest Groups' Opinion of Communication and Cooperation.

1 = strongly agree → 3 = uncertain → 5 = strongly disagree

All respondents generally agreed that communication and cooperation have improved as a result of the regional water planning process. Water districts were the most supportive while environmentalists were the least. This is most likely due to the fact that their agenda has not been realized or given enough attention. Future state water plans could attempt to place a greater focus on environmental needs.

CHAPTER VI
CONCLUSIONS

This thesis examined opinions of regional water planning group members and groundwater conservation district board members related to changes in the regional water planning process and the impact of the regional planning process on education, communication, political and financial support for water projects. Three research questions were posed in this thesis:

- What will be the impact on regional water planning and water management strategies when GCDs determine groundwater availability?
- Will less groundwater be available for urban water uses when GCDs determine availability?
- What is the impact of the regional water planning process in regards to awareness of water issues, availability of state and local funding, and public support for water projects.

The changes proposed in the regional water planning process wherein GCDs will determine groundwater availability will be implemented for the 2012 water plan. Therefore, it is important to ascertain what impact this might have on future water plans.

6.1 Impact on Regional Water Planning

Overall there was a great deal of uncertainty which is expected since the process has not yet occurred. Regional water planning officials indicated that the new process would not weaken regional planning and all respondents agreed that GCDs are the most appropriate entity to lead the process. Then, on an even more positive note, both agreed that having GCDs determine DFCs would lead to greater resource protection. However they all believe that additional financial resources are needed to accomplish their goals.

The role of science versus local politics in determining DFCs had some interesting variance between regions and GCDs as well as among RWPGs. Regions felt local politics would play a stronger role in determining DFCs, while GCDs were more confident in the use of sound science. Furthermore, those regions where GCDs had a longer history and larger geographical area trusted that science would overcome local politics. Regions A, G, L, and O all had high confidence in the use of science compared to Regions C, M, and P. Region C confirmed their feelings with a 100% affirmation that local politics would dominate. Regions D and I also agreed strongly. All 3 of these regions are located in north-east Texas, so the threat of water exporting to meet the needs of neighboring cities may be influencing their opinions.

Another difference in opinions occurred in the section analyzing process clarity. GCDs feel that the process in clearer than RWPGs which makes sense since they are directly dealing with the new process and have been attending GMA meetings where issues and concerns are discussed among several GCDs. Both agree that the criteria used in determining DFCs are uncertain. Even so, GCDs disagree that the legislature should specify these criteria but regions don't have a strong opinion either way. Since both did agree that future litigation would increase it could be beneficial to set some clearer standards for GCDs to follow in determining the DFCs of their aquifers.

6.2 Changes in Groundwater Availability for Urban Uses

An important concern is whether there will be less groundwater available for future water uses when GCDs determine availability. When a GCD creates their desired future condition for a specific aquifer, their rules may prevent any further development once a critical water level is reached. If cities and urban areas face increased restrictions they may be forced to search for alternate sources. Regional water planners will also need to account for GCD restrictions and may have to research other management strategies to meet future demand. If alternate supplies are not economically feasible then it is possible that future growth may be limited due to a lack of sufficient water supply.

Regions agreed more than GCDs that less groundwater would be available for future use. Another difference occurred between Agricultural and Industrial interests. Agricultural representatives disagreed more than industries that cities would lose access to groundwater in the future. There was high uncertainty overall as to whether the RWPGs' strategies would decrease, but all agreed that water transfers would be more restricted in the future. This may require RWPGs to look for other means of meeting future needs. GCD restrictions are not the only ones to blame for restricting transfers since public since there has also been reduced public support as well as more extensive procedures to implementing such projects.

6.3 Impact of the RWP Process on the Awareness of Water Issues, Funding Availability and Public Support for Water Projects

Part 2 of the survey focused on the progress of the regional planning process over the past 10 years. The first section (5.1) revealed that on average all respondents felt that the public's, legislators', and locally elected officials' awareness has improved. Still there were some statistically significant variants within regions and interest groups. Region A agreed that awareness has improved while Region N did not. Furthermore electric utility representatives agreed more on average than water districts. Section 5.2 then looked at opinions regarding public support. Public support for regional projects on average was thought to have improved. However, the GCDs in Region G were significantly less optimistic than Region G members. Other differences were found when regions were compared individually. Region P thought public support had not improved as much as did Region A, B, and G. Overall public support for reservoirs and water transfers has not appeared to have improved. Again, there was variance among regions. Region A, B, and G felt public support for reservoirs had improved more than Region D and L.

Section 5.3 was interested in the participants' thoughts on funding. On average, regions were relatively uncertain while GCDs disagreed that funding has improved over the years. Finally in section 5.4, there was an overall feeling from both groups that communication and cooperation have improved. Further analysis of variance discovered some differences between regions and interest groups. Region A agreed more on average than Region D which was more uncertain. Then Environmental interests felt that communication/cooperation has not improved as much as water districts believe it has.

6.4 Limitations

In order to find significant differences between groups it's necessary to have large sample sizes. Due to the small response rate from Region G, it was difficult to compare this region to the GCDs within it. Only two statements were found to have significant differences between these groups. A greater number of significant differences could have been observed if a larger group of regions were compared to these 10 GCDs. Another sample size issue occurred for comparisons between regions. Only 3 statements resulted in significant differences when the 16 regions were compared to each other. This could have been greater if the regions were grouped into wider areas. Lastly, time restraints prevented the project to consider all 87 GCDs so the opinions of GCDs discussed can only be traced back to those 10 districts overlapping region G.

Other limitations are due to possible biases stemming from the Likert scale method. Respondents may avoid using extreme response categories, or they may be more likely to agree with statements as presented. Also they could be trying to portray themselves or their organization in a favorable light.

6.5 Future Study

Future research could be conducted after the DFC process has had a chance to be realized. It would be interesting to see how opinions change 5 years from now when another state water plan is published using groundwater availability numbers from GCDs. In future surveys, it may be desirable to capture the opinions of all GCDs within Texas and compare them within GMAs or by aquifer boundaries. Also it will be interesting to see by how much groundwater availability changes statewide and how that may affect management strategies in future state water plans.

REFERENCES

Brody, S. D., 2003. Are We Learning to Make Better Plans? A Longitudinal Analysis of Plan Quality Associated with Natural Hazards. *Journal of Planning Education and Research* 23(2):191-201.

Brown, J. E. B., 1998. Senate Bill 1: We've Never Changed Texas Water Law this Way Before. *Tex. Envtl. L.J.* 28:152-165.

Brumbelow, K., 2007. Water Availability Modeling in Texas. Department of Civil Engineering, Texas A&M University, College Station.

Castle, E. N., 1978. Property rights and the political economy of resource scarcity. *American Journal of Agricultural Economics* 60:1-9.

De Young, R., 1993. Changing Behavior and Making it Stick: The Conceptualization and Management of Conservation Behavior. *Environment and Behavior* 25(4):485-505.

Eckstein, G., 2006. Precious, Worthless, or Immeasurable: The Value and Ethic of Water. Texas Water Law, Continuing Legal Education (CLE) International, September 28-29, 2006, Austin, Texas.

Ellis, G. M., and J.A. Houston, 2002. Senate Bill 2: "Step Two" Towards Effective Water Resource Management and Development for Texas. *Tex. Envtl. L.J.* 32:53-72.

Emel, J., and R. Roberts, 1995. Institutional Form and Its Effect on Environmental Change: The Case of Groundwater in the Southern High Plains. *Annals of the Association of American Geographers* 85(4) 664-683.

Frederick, K. D., D.C. Manor, and E.Z. Stakhiv, 1997. Water Resources Planning Principles and Evaluation Criteria for Climate Change: Summary and Conclusions." *Climatic Change* 37:291-313.

Giordano, M., 2003. The Geography of the Commons: The Role of Scale and Space. *Annals of the Association of American Geographers* 93(2):365-375.

Godschalk, D. S., B., 1981. "Making Waves: Public Participation in State Water Planning." *Journal of Applied Behavioral Science* 17(4):597-614

Gooch T.C., S.W. Griffin, and W.F. Mullican III, 2003. Texas Statewide Water Planning: The Regional Water Planning Concept. World Water Congress 2004:

Critical Transitions in Water and Environmental Resources Management, World Water and Environmental Resources Congress 2004, Gerald Sehlke, Donald F. Hayes, David K. Stevens - Editors, June 27 – July 1, 2004, Salt Lake City, Utah, USA

Heath, K., and B. Mitchell, 2002. Education for Efficiency Initiatives in the Regional Municipality of Waterloo, Ontario: Measuring Current Effectiveness to Improve Future Success. *Canadian Water Resources Journal* 27(3):317-333.

Jacobs, K. L., and J.M. Holway, 2004. Managing for Sustainability in an Arid Climate: Lessons Learned from 20 Years of Groundwater Management in Arizona, USA. *Hydrogeology Journal* 12(1):52-65.

Kaiser, R.A., 2006. Fundamentals of Texas Water Law. Texas Water Law Conference, Continuing Legal Education (CLE) International, September 28-29, 2006, Austin, Texas.

Kaiser, R.A., 2005. Solving the Texas Water Puzzle: Market-Based Allocation of Water. Texas Public Policy Foundation Research Report, March 2005, Austin, Texas.

Kaiser, R.A., B.J. Lesikar, C.S. Shafer, and J.R. Gerston, 2000. Water Management Strategies: Ranking the Options. Texas A&M University System Research Report, January 2000, College Station, Texas.

Kluge, K., 2007. Why do we need the 2007 state water plan? Texas Water Development Board, *Texas Water 17(1).*

Mullican, W. F. I., 2003. Water, is it the Oil of the 21st Century? Submitted to the Subcommittee on Water Resources and Environment Committee on Transportation and Infrastructure. United Stated House of Representatives, Washington, D.C.

Muthukumar, K., 2005. A Decision Support System to Develop Sustainable Groundwater Management Policies for a Multi-county Single Aquifer System. Texas Water Research Institute, College Station, Texas.

Nunn, S.C., 1985. The Political Economy of Institutional Change: A Distribution Criterion for Acceptance of Groundwater Rules. *Natural Resources Journal* 25:867-892.

Ostrom, E., J. Burger, C.B. Field, R.B. Norgaard, and D. Policansky, 1999. Revisiting the Commons: Local Lessons, Global Challenges. *Science* 278-282.

Pound, M., 1963. *The Spirit of the Common Law*. Beacon Press, Boston.

Rainwater, K., J. Stovall, S. Frailey, and L. Urban, 2005. Transboundary Impacts on Regional Ground Water Modeling in Texas. *Ground Water* 43(5):706-716.

Roberts, R. S., and J. Emel, 1992. Uneven Development and the Tragedy of the Commons - Competing Images for Nature-Society Analysis. *Economic Geography* 68(3):249-271.

Shapiro, D. L., 1965. The Choice of Rulemaking or Adjudication in the Development of Administrative Policy. *Harvard Law Review* 78:921-952.

Sledge, B. L., 2006. Groundwater Conservation Districts in Texas: A Review of Chapter 36 and Recent Amendments. Texas Water Law, Continuing Legal Education (CLE) International, September 28-29, 2006, Austin, Texas.

Sophocleous, M., 2000. From Safe Yield to Sustainable Development of Water Resources--the Kansas Experience. *Journal of Hydrology* 235:27-43.

Spray, K. L., 1986. Impact of Surface-Water and Groundwater Withdrawal on Discharge and Channel Morphology Along the Arkansas River, Lakin to Dodge City, Kansas, University of Kansas, Lawrence.

Syme, G. J., and B.E. Nancarrow, 1992. Predicting Public Involvement in Urban Water Management and Planning. Environment and Behavior 24(6):738-758.

TCCRI, 2007. *Open Markets will Meet Texas' Water Needs. Texas Conservative Coalition Research Institute*. Limited Government Series, March 6, 2007, 1-20.

TWDB, 2007a. The Drought in Perspective, 1996-1998. Texas Water Development Board, http://www.twdb.state.tx.us/data/drought/DroughtinPerspective.asp, accessed March, 2007.

TWDB, 2007b. 2007 State Water Plan: Water for Texas. Texas Water Development Board, Austin, Texas, GP-8-1, Volume 2:1-392.

Weber, M., 1947. *Theory of Social and Economic Organization.* Oxford University Press, New York.

Zwingle, E., 1993. Ogallala Aquifer: Wellspring of the High Plains. *National Geographic* 183(3):80-109.

APPENDIX A

SURVEY

PART I. REGIONAL WATER PLANNING & GROUNDWATER DISTRICTS

In 2005, the Texas legislature determined that groundwater conservation districts (GCD's) would establish the aquifer's desired future conditions (DFC's). A desired future condition will determine how much groundwater can be pumped from the aquifer. Regional water planning groups must use the GCD's determination of desired future conditions in establishing water availability for regional plans. We are interested in what impact this might have on the regional planning process. Please circle your level of agreement with the following statements.

	Strongly Agree →		Uncertain →		Strongly Disagree
1. The new desired future conditions (DFC) process will weaken the regional water planning process	1	2	3	4	5
2. RWPGs' choice of management strategies will decrease	1	2	3	4	5
3. The process for GCD's establishing DFC's is clear.	1	2	3	4	5
4. GCDs are the most appropriate entities to lead the DFC process.	1	2	3	4	5
5. The DFC process will lead to greater protection for groundwater resources	1	2	3	4	5
6. GCD's have the financial resources to implement DFC's	1	2	3	4	5
7. A GCD's determination of DFC's will be based on sound science	1	2	3	4	5
8. Local politics will dominate the determination of DFC's	1	2	3	4	5
9. Less groundwater will be available for future use if GCD's determine DFC's	1	2	3	4	5
10. The petition process for resolving conflicts over DFC's is clear	1	2	3	4	5
11. The criteria to be used by GCD's in determining DFC's is uncertain	1	2	3	4	5
12. The legislature should specify the criteria to be used by GCD's in determining DFC's	1	2	3	4	5
13. GCDs could use DFC's to restrict economic growth	1	2	3	4	5
14. GCD's could use DFC's to restrict population growth	1	2	3	4	5
15. GCD's could use DFC's to restrict water transfers	1	2	3	4	5
16. Cities and urban areas will lose access to groundwater as a result of the DFC process	1	2	3	4	5
17. Litigation over groundwater rights will increase because of the DFC process	1	2	3	4	5

PART 2. IMPACT OF REGIONAL WATER PLANNING PROCESS

After 10 years and 2 state water plans we are interested in your thoughts on the impact of the regional water planning process. Please circle your level of agreement with each of the following statements about the impact of the regional water planning process.

BECAUSE OF THE REGIONAL WATER PLANNING PROCESS	Strongly Agree →		Uncertain →		Strongly Disagree
1. The public has a greater awareness of water issues	1	2	3	4	5
2. Public support for funding water projects has significantly increased	1	2	3	4	5
3. State legislators are better aware of water issues	1	2	3	4	5
4. State funding for water projects has increased	1	2	3	4	5
5. Local elected officials are better aware of water issues	1	2	3	4	5
6. Local funding has increased for water projects	1	2	3	4	5
7. Communication between local water agencies has improved	1	2	3	4	5
8. Cooperation between water local agencies has improved	1	2	3	4	5
9. State-wide public support for reservoir projects has improved	1	2	3	4	5
10. Local public support for reservoir projects has improved	1	2	3	4	5
11. Local public support for water transfers has improved	1	2	3	4	5
12. Public support for regional water projects has improved	1	2	3	4	5
13. State financial support for local water projects has not changed	1	2	3	4	5

GENERAL INFORMATION

The following questions are asked for statistical purposes and will not be used to identify you individually.

How long have you been a member of the regional planning group? (Please circle)

0-2 years   3-4 years   5-6 years   7-8 years   9-10 years

What interest group do you represent? (Please circle)

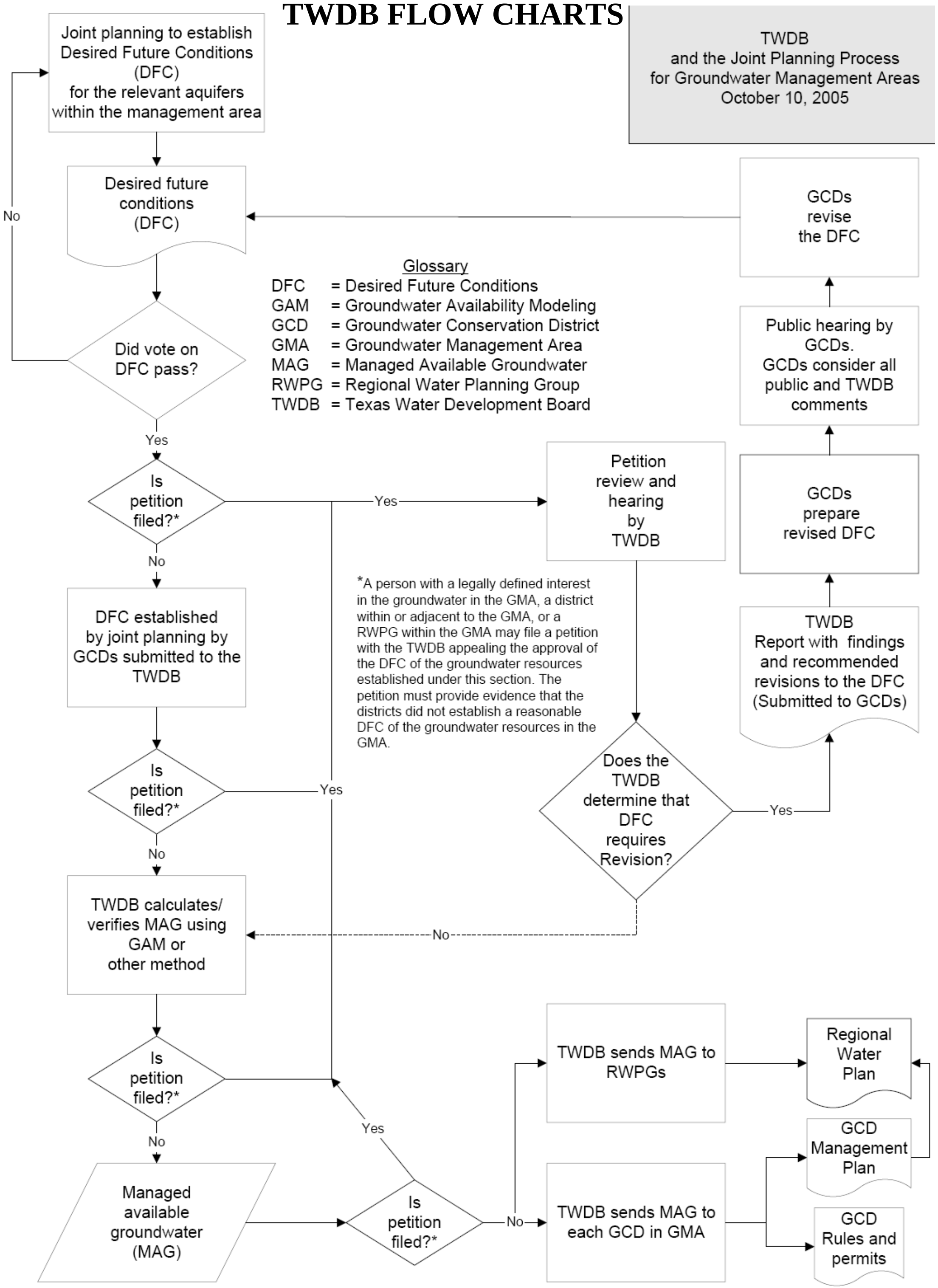
Agriculture   County   Electric Utility   Environmental   Industrial

Municipal   Public   Small Business   River Authority   Water District

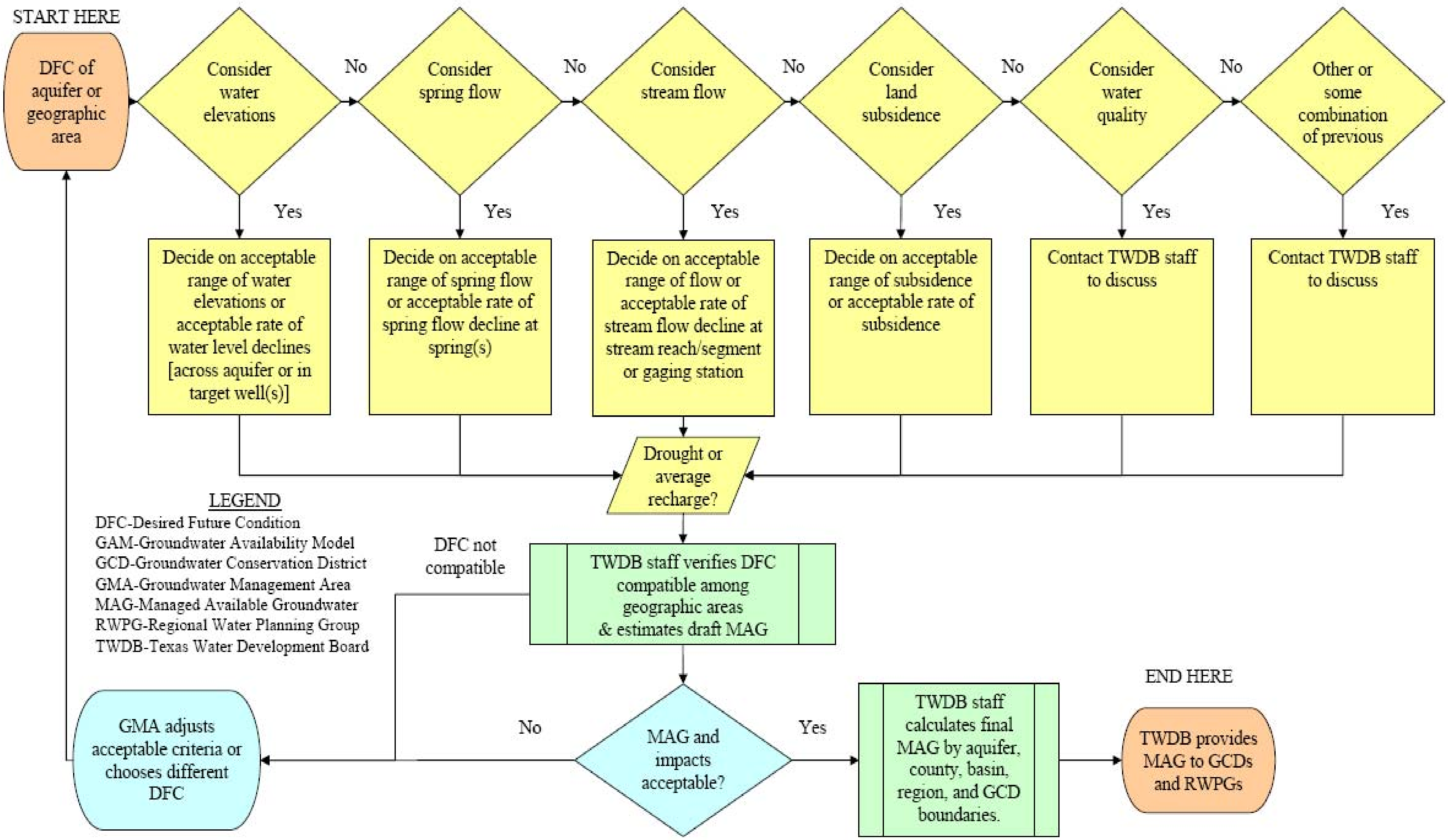
Water Utility   Other_____________

APPENDIX B

TWDB FLOW CHARTS



Desired Future Condition Matrix



APPENDIX C

SPSS OUTPUT

All Regions v. GCDs

	GCD_v_Region group membership	N	Mean	Std. Deviation	Std. Error Mean
III_1 DFC process will weaken the regional water planning process	1 GCD	41	3.32	1.150	0.180
	2 Regions	182	3.35	1.256	0.093
III_2 RWPGs choice of management strategies will decrease	1 GCD	38	3.21	1.044	0.169
	2 Regions	179	2.99	1.134	0.085
III_3 The DFC process for GCDs establishing DFCs is clear	1 GCD	40	2.70	1.091	0.172
	2 Regions	177	3.17	1.100	0.083
III_4 GCDs are the most appropriate entities to lead the DFC process	1 GCD	40	2.05	1.260	0.199
	2 Regions	181	2.45	1.249	0.093
III_5 The DFC process will lead to greater resource protection	1 GCD	40	2.25	1.276	0.202
	2 Regions	181	2.32	1.053	0.078
III_6 GCDs have the financial resources to implement DFCs	1 GCD	40	3.23	1.209	0.191
	2 Regions	181	3.55	1.092	0.081
III_7 A GCD's determination of DFCs will be based on sound science	1 GCD	39	2.38	1.184	0.190
	2 Regions	180	3.05	1.043	0.078
III_8 Local politics will dominate the determination of DFCs	1 GCD	40	3.00	1.281	0.203
	2 Regions	181	2.36	1.095	0.081
III_9 Less groundwater will be available if GCDs determine DFCs	1 GCD	40	3.35	1.272	0.201
	2 Regions	180	2.97	1.195	0.089
III_10 The petition process for resolving conflicts over DFCs is clear	1 GCD	40	3.28	0.905	0.143
	2 Regions	181	3.32	0.917	0.068
III_11 The criteria for determining DFCs is uncertain	1 GCD	40	3.00	0.934	0.148
	2 Regions	178	2.48	1.069	0.080
III_12 The legislature should specify the criteria	1 GCD	40	3.73	1.320	0.209
	2 Regions	180	3.04	1.392	0.104
III_13 GCDs could use DFCs to restrict economic growth	1 GCD	40	3.10	1.172	0.185
	2 Regions	179	2.65	1.233	0.092
III_14 GCDs could use DFCs to restrict population growth	1 GCD	40	3.10	1.215	0.192
	2 Regions	180	2.77	1.250	0.093
III_15 GCDs could use DFCs to restrict water transfers	1 GCD	40	2.58	1.174	0.186
	2 Regions	180	2.29	1.111	0.083
III_16 Cities and urban areas will lose access to groundwater as a result of DFCs	1 GCD	40	3.23	1.271	0.201
	2 Regions	180	3.13	1.193	0.089
III_17 Litigation over groundwater rights will increase because of the DFC process	1 GCD	40	2.25	1.149	0.182
	2 Regions	181	2.50	1.124	0.084
IV_1 The public has a greater awareness of water issues	1 GCD	41	2.71	1.167	0.182
	2 Regions	183	2.29	1.185	0.088
IV_2 Public support for funding water projects had significantly increased	1 GCD	41	3.12	1.269	0.198
	2 Regions	184	2.92	0.972	0.072
IV_3 State legislators are better aware of water issues	1 GCD	41	2.41	1.204	0.188
	2 Regions	184	2.15	1.065	0.079
IV_4 State funding for water projects has increased	1 GCD	40	3.43	1.035	0.164
	2 Regions	183	2.99	0.981	0.072
IV_5 Local elected officials are better aware of water issues	1 GCD	41	2.17	1.093	0.171
	2 Regions	184	2.15	1.013	0.075

IV_6 Local funding has increased for water projects	1 GCD	41	3.27	1.119	0.175
	2 Regions	183	2.98	0.929	0.069
IV_7 Communication between local water agencies has improved	1 GCD	41	2.15	0.989	0.154
	2 Regions	184	2.23	0.965	0.071
IV_8 Cooperation between local water agencies has improved	1 GCD	40	2.40	0.982	0.155
	2 Regions	184	2.46	1.013	0.075
IV_9 Statewide public support for reservoir projects has improved	1 GCD	41	3.07	1.034	0.162
	2 Regions	183	3.40	1.011	0.075
IV_10 Local public support for reservoir projects has improved	1 GCD	40	3.08	1.095	0.173
	2 Regions	184	3.29	1.120	0.083
IV_11 Local public support for water transfers has improved	1 GCD	40	3.58	0.958	0.151
	2 Regions	184	3.36	1.103	0.081
IV_12 Public support for regional water projects has improved	1 GCD	41	3.02	0.961	0.150
	2 Regions	182	2.74	1.053	0.078
IV_13 State financial support for local projects hasn't changed	1 GCD	40	2.38	1.192	0.188
	2 Regions	184	2.73	1.066	0.079

Region to Region

		N	Mean	Std. Deviation	Std. Error
III_1 DFC process will weaken the regional water planning process	1 A	17	3.94	1.197	0.290
	2 B	13	3.08	0.862	0.239
	3 C	7	3.86	1.464	0.553
	4 D	13	2.69	1.032	0.286
	5 E	10	2.90	1.524	0.482
	6 F	9	2.56	1.509	0.503
	7 G	12	3.00	1.279	0.369
	8 H	12	3.25	1.055	0.305
	9 I	7	3.71	1.254	0.474
	10 J	10	3.30	1.337	0.423
	11 K	10	3.90	0.876	0.277
	12 L	15	3.60	1.454	0.375
	13 M	14	3.36	1.151	0.308
	14 N	11	3.73	1.272	0.384
	15 O	11	3.09	1.300	0.392
	16 P	11	3.64	1.206	0.364
	Total	182	3.35	1.256	0.093
III_2 RWPGs choice of management strategies will decrease	1 A	17	3.47	0.943	0.229
	2 B	13	2.92	1.188	0.329
	3 C	6	3.50	0.548	0.224
	4 D	13	2.08	0.760	0.211
	5 E	10	3.30	1.059	0.335
	6 F	9	2.44	1.236	0.412
	7 G	12	2.92	1.311	0.379
	8 H	11	2.91	0.944	0.285
	9 I	7	2.86	1.069	0.404
	10 J	9	3.00	1.225	0.408
	11 K	10	3.60	1.075	0.340
	12 L	15	2.93	1.387	0.358
	13 M	14	3.14	1.027	0.275

	14 N	11	2.91	1.221	0.368
	15 O	11	2.45	0.934	0.282
	16 P	11	3.55	1.214	0.366
	Total	179	2.99	1.134	0.085
III_3 The DFC process for GCDs establishing DFCs is clear	1 A	16	2.69	1.352	0.338
	2 B	13	2.69	0.947	0.263
	3 C	7	2.86	1.345	0.508
	4 D	13	3.62	1.121	0.311
	5 E	9	3.22	1.394	0.465
	6 F	9	3.44	1.333	0.444
	7 G	12	3.08	1.240	0.358
	8 H	11	3.00	0.632	0.191
	9 I	7	3.00	0.577	0.218
	10 J	10	4.00	0.943	0.298
	11 K	10	4.00	1.054	0.333
	12 L	15	3.00	1.134	0.293
	13 M	14	3.14	0.363	0.097
	14 N	10	3.10	0.876	0.277
	15 O	11	3.18	1.079	0.325
	16 P	10	3.00	1.247	0.394
	Total	177	3.17	1.100	0.083
III_4 GCDs are the most appropriate entities to lead the DFC process	1 A	17	1.82	1.074	0.261
	2 B	13	2.54	1.050	0.291
	3 C	7	3.00	1.528	0.577
	4 D	13	3.00	1.291	0.358
	5 E	10	2.40	1.350	0.427
	6 F	9	3.33	1.414	0.471
	7 G	12	2.50	1.168	0.337
	8 H	11	2.27	0.647	0.195
	9 I	7	2.86	0.690	0.261
	10 J	10	2.70	1.889	0.597
	11 K	10	1.80	1.033	0.327
	12 L	15	2.13	1.187	0.307
	13 M	14	2.50	1.019	0.272
	14 N	11	2.45	1.293	0.390
	15 O	11	2.55	1.695	0.511
	16 P	11	2.18	1.079	0.325
	Total	181	2.45	1.249	0.093
III_5 The DFC process will lead to greater resource protection	1 A	17	2.35	1.272	0.308
	2 B	13	2.31	0.751	0.208
	3 C	7	1.71	0.756	0.286
	4 D	13	2.38	0.768	0.213
	5 E	10	2.30	1.059	0.335
	6 F	9	3.44	1.014	0.338
	7 G	12	2.17	1.030	0.297
	8 H	11	1.91	0.831	0.251
	9 I	7	2.14	0.690	0.261
	10 J	10	2.50	0.707	0.224
	11 K	10	2.50	1.434	0.453
	12 L	15	1.80	1.082	0.279
	13 M	14	2.29	0.825	0.221

	14 N	11	2.36	1.206	0.364
	15 O	11	3.18	1.168	0.352
	16 P	11	1.91	0.944	0.285
	Total	181	2.32	1.053	0.078
III_6 GCDs have the financial resources to implement DFCs	1 A	17	3.12	1.364	0.331
	2 B	13	3.46	1.050	0.291
	3 C	7	3.71	0.756	0.286
	4 D	13	3.38	1.261	0.350
	5 E	10	4.00	1.054	0.333
	6 F	9	3.67	1.414	0.471
	7 G	12	3.50	1.087	0.314
	8 H	11	3.55	0.688	0.207
	9 I	7	3.57	0.787	0.297
	10 J	10	4.20	1.033	0.327
	11 K	10	3.50	0.972	0.307
	12 L	15	3.60	1.121	0.289
	13 M	14	3.57	0.938	0.251
	14 N	11	3.45	1.036	0.312
	15 O	11	3.27	1.191	0.359
	16 P	11	3.73	1.348	0.407
	Total	181	3.55	1.092	0.081
III_7 A GCD's determination of DFCs will be based on sound science	1 A	17	2.24	0.903	0.219
	2 B	13	3.00	0.707	0.196
	3 C	7	3.57	0.787	0.297
	4 D	13	3.00	0.816	0.226
	5 E	9	3.00	1.414	0.471
	6 F	9	3.44	1.424	0.475
	7 G	12	3.00	1.206	0.348
	8 H	11	2.91	1.044	0.315
	9 I	7	3.14	0.690	0.261
	10 J	10	3.60	1.174	0.371
	11 K	10	3.30	1.059	0.335
	12 L	15	2.93	1.163	0.300
	13 M	14	3.29	0.611	0.163
	14 N	11	2.82	0.874	0.263
	15 O	11	3.09	1.300	0.392
	16 P	11	3.27	1.009	0.304
	Total	180	3.05	1.043	0.078
III_8 Local politics will dominate the determination of DFCs	1 A	17	2.59	1.064	0.258
	2 B	13	2.69	1.032	0.286
	3 C	7	1.71	0.488	0.184
	4 D	13	1.77	0.599	0.166
	5 E	10	2.40	1.350	0.427
	6 F	9	2.11	1.269	0.423
	7 G	12	2.67	1.371	0.396
	8 H	11	2.45	0.934	0.282
	9 I	7	2.43	0.787	0.297
	10 J	10	2.00	1.155	0.365
	11 K	10	2.50	1.434	0.453
	12 L	15	2.40	1.056	0.273
	13 M	14	2.14	1.231	0.329

	14 N	11	2.36	0.924	0.279
	15 O	11	2.45	1.214	0.366
	16 P	11	2.73	1.104	0.333
	Total	181	2.36	1.095	0.081
III_9 Less ground water will be available if GCDs determine DFCs	1 A	17	3.35	1.169	0.284
	2 B	13	3.00	0.816	0.226
	3 C	7	2.57	1.397	0.528
	4 D	13	2.85	1.345	0.373
	5 E	10	2.60	1.075	0.340
	6 F	9	2.67	1.500	0.500
	7 G	12	2.83	1.193	0.345
	8 H	11	2.64	1.120	0.338
	9 I	7	3.14	1.069	0.404
	10 J	10	2.90	1.287	0.407
	11 K	10	3.20	1.033	0.327
	12 L	15	2.60	1.404	0.363
	13 M	14	2.71	0.994	0.266
	14 N	11	3.45	1.036	0.312
	15 O	10	2.90	1.370	0.433
	16 P	11	3.91	1.136	0.343
	Total	180	2.97	1.195	0.089
III_10 The petition process for resolving conflicts over DFCs is clear	1 A	17	3.12	1.219	0.296
	2 B	13	3.23	0.599	0.166
	3 C	7	3.71	0.951	0.360
	4 D	13	3.69	1.182	0.328
	5 E	10	3.30	1.418	0.448
	6 F	9	3.44	1.014	0.338
	7 G	12	3.25	0.866	0.250
	8 H	11	3.45	0.820	0.247
	9 I	7	3.29	0.488	0.184
	10 J	10	3.60	0.843	0.267
	11 K	10	3.00	0.816	0.258
	12 L	15	3.27	1.100	0.284
	13 M	14	3.00	0.392	0.105
	14 N	11	3.27	0.647	0.195
	15 O	11	3.18	0.603	0.182
	16 P	11	3.64	1.027	0.310
	Total	181	3.32	0.917	0.068
III_11 The criteria for determining DFCs is uncertain	1 A	17	2.65	1.115	0.270
	2 B	12	2.50	1.168	0.337
	3 C	7	1.71	0.756	0.286
	4 D	13	2.00	0.913	0.253
	5 E	10	2.40	1.265	0.400
	6 F	9	2.89	1.453	0.484
	7 G	12	3.25	1.357	0.392
	8 H	10	2.60	0.843	0.267
	9 I	7	2.86	0.690	0.261
	10 J	10	2.00	0.816	0.258
	11 K	9	2.56	0.726	0.242
	12 L	15	2.47	1.246	0.322
	13 M	14	2.36	0.929	0.248

	14 N	11	2.09	0.701	0.211
	15 O	11	2.64	1.027	0.310
	16 P	11	2.64	1.120	0.338
	Total	178	2.48	1.069	0.080
III_12 The legislature should specify the criteria	1 A	17	3.76	1.033	0.250
	2 B	13	3.38	1.325	0.368
	3 C	7	3.14	1.574	0.595
	4 D	13	2.31	1.251	0.347
	5 E	10	2.80	1.619	0.512
	6 F	9	2.44	1.590	0.530
	7 G	12	3.00	1.706	0.492
	8 H	11	2.82	1.328	0.400
	9 I	7	3.29	1.113	0.421
	10 J	10	2.60	1.265	0.400
	11 K	10	3.40	1.174	0.371
	12 L	15	3.07	1.280	0.330
	13 M	13	2.23	1.423	0.395
	14 N	11	2.91	1.136	0.343
	15 O	11	3.73	1.555	0.469
	16 P	11	3.55	1.440	0.434
	Total	180	3.04	1.392	0.104
III_13 GCDs could use DFCs to restrict economic growth	1 A	17	2.94	1.197	0.290
	2 B	13	3.23	1.363	0.378
	3 C	7	2.71	1.113	0.421
	4 D	13	2.31	1.109	0.308
	5 E	10	2.40	1.350	0.427
	6 F	9	2.11	1.364	0.455
	7 G	12	2.42	1.379	0.398
	8 H	11	2.73	1.191	0.359
	9 I	7	2.71	0.756	0.286
	10 J	10	2.50	0.972	0.307
	11 K	10	3.00	1.491	0.471
	12 L	15	2.13	0.990	0.256
	13 M	12	2.58	1.311	0.379
	14 N	11	3.00	1.265	0.381
	15 O	11	2.82	1.401	0.423
	16 P	11	2.82	1.328	0.400
	Total	179	2.65	1.233	0.092
III_14 GCDs could use DFCs to restrict population growth	1 A	17	2.94	1.088	0.264
	2 B	13	3.31	1.316	0.365
	3 C	7	3.00	1.000	0.378
	4 D	13	2.31	1.109	0.308
	5 E	10	3.00	1.333	0.422
	6 F	9	2.11	1.364	0.455
	7 G	12	2.42	1.379	0.398
	8 H	11	2.82	1.079	0.325
	9 I	7	3.00	0.816	0.309
	10 J	10	2.60	1.075	0.340
	11 K	10	2.80	1.619	0.512
	12 L	15	2.60	1.242	0.321
	13 M	13	2.69	1.316	0.365

	14 N	11	3.27	1.348	0.407
	15 O	11	2.73	1.489	0.449
	16 P	11	2.82	1.328	0.400
	Total	180	2.77	1.250	0.093
III_15 GCDs could use DFCs to restrict water transfers	1 A	17	2.18	0.951	0.231
	2 B	13	3.00	1.225	0.340
	3 C	7	1.86	0.690	0.261
	4 D	13	1.77	0.439	0.122
	5 E	10	2.00	1.054	0.333
	6 F	9	1.89	0.782	0.261
	7 G	12	2.42	1.443	0.417
	8 H	11	2.27	1.009	0.304
	9 I	7	2.57	0.787	0.297
	10 J	10	2.50	0.972	0.307
	11 K	10	2.70	1.703	0.539
	12 L	15	2.33	1.291	0.333
	13 M	13	2.38	1.044	0.290
	14 N	11	2.64	1.286	0.388
	15 O	11	2.27	1.191	0.359
	16 P	11	1.73	0.905	0.273
	Total	180	2.29	1.111	0.083
III_16 Cities and urban areas will lose access to ground water as a result of DFCs	1 A	17	3.59	1.121	0.272
	2 B	13	3.38	1.121	0.311
	3 C	7	3.29	1.254	0.474
	4 D	13	3.00	1.291	0.358
	5 E	10	3.00	1.414	0.447
	6 F	9	2.67	1.581	0.527
	7 G	12	3.33	1.231	0.355
	8 H	11	2.45	0.820	0.247
	9 I	7	2.86	0.900	0.340
	10 J	10	3.70	1.059	0.335
	11 K	10	3.00	0.943	0.298
	12 L	15	2.93	1.438	0.371
	13 M	13	2.54	0.877	0.243
	14 N	11	3.36	1.120	0.338
	15 O	11	3.36	1.362	0.411
	16 P	11	3.45	1.128	0.340
	Total	180	3.13	1.193	0.089
III_17 Litigation over ground water rights will increase because of the DFC process	1 A	17	2.65	1.272	0.308
	2 B	13	2.77	1.166	0.323
	3 C	7	1.86	0.690	0.261
	4 D	13	2.00	1.000	0.277
	5 E	10	2.50	1.354	0.428
	6 F	9	2.33	1.323	0.441
	7 G	12	2.42	1.311	0.379
	8 H	11	2.45	0.934	0.282
	9 I	7	3.00	0.577	0.218
	10 J	10	2.50	1.354	0.428
	11 K	10	2.40	1.174	0.371
	12 L	15	2.47	0.990	0.256
	13 M	14	2.36	1.082	0.289

	14 N	11	2.55	1.214	0.366
	15 O	11	3.36	0.924	0.279
	16 P	11	2.27	1.009	0.304
	Total	181	2.50	1.124	0.084
IV_1 The public has a greater awareness of water issues	1 A	17	1.53	0.943	0.229
	2 B	13	2.15	1.068	0.296
	3 C	7	1.71	0.951	0.360
	4 D	14	2.29	1.139	0.304
	5 E	10	2.80	1.317	0.416
	6 F	9	2.44	1.014	0.338
	7 G	12	2.08	1.165	0.336
	8 H	12	2.08	0.900	0.260
	9 I	7	2.43	1.512	0.571
	10 J	10	2.60	1.350	0.427
	11 K	10	2.40	1.174	0.371
	12 L	15	2.07	1.223	0.316
	13 M	14	2.07	0.917	0.245
	14 N	11	3.18	1.328	0.400
	15 O	11	2.55	1.368	0.413
	16 P	11	2.82	1.250	0.377
	Total	183	2.29	1.185	0.088
IV_2 Public support for funding water projects had significantly increased	1 A	17	2.47	0.717	0.174
	2 B	13	2.38	1.044	0.290
	3 C	7	2.86	1.069	0.404
	4 D	14	3.07	1.328	0.355
	5 E	10	3.20	0.919	0.291
	6 F	9	3.00	0.866	0.289
	7 G	12	2.92	0.900	0.260
	8 H	12	2.92	0.793	0.229
	9 I	7	2.57	1.272	0.481
	10 J	10	3.10	0.876	0.277
	11 K	10	3.30	1.059	0.335
	12 L	15	3.13	0.640	0.165
	13 M	15	2.73	1.033	0.267
	14 N	11	3.45	0.820	0.247
	15 O	11	2.82	1.079	0.325
	16 P	11	3.09	1.044	0.315
	Total	184	2.92	0.972	0.072
IV_3 State legislators are better aware of water issues	1 A	17	1.65	0.702	0.170
	2 B	13	1.85	0.899	0.249
	3 C	7	2.14	0.690	0.261
	4 D	14	2.57	1.604	0.429
	5 E	10	2.70	1.252	0.396
	6 F	9	2.56	1.236	0.412
	7 G	12	1.58	0.515	0.149
	8 H	12	1.75	0.452	0.131
	9 I	7	2.29	1.254	0.474
	10 J	10	2.10	1.197	0.379
	11 K	10	2.30	1.059	0.335
	12 L	15	1.93	0.961	0.248
	13 M	15	2.27	1.100	0.284

	14 N	11	2.36	0.809	0.244
	15 O	11	2.18	0.874	0.263
	16 P	11	2.73	1.489	0.449
	Total	184	2.15	1.065	0.079
IV_4 State funding for water projects has increase d	1 A	17	3.00	0.866	0.210
	2 B	13	2.77	0.725	0.201
	3 C	6	2.83	0.983	0.401
	4 D	14	3.29	1.204	0.322
	5 E	10	3.20	1.229	0.389
	6 F	9	3.56	0.882	0.294
	7 G	12	3.08	1.311	0.379
	8 H	12	2.75	0.965	0.279
	9 I	7	2.57	0.787	0.297
	10 J	10	2.20	1.033	0.327
	11 K	10	3.20	1.135	0.359
	12 L	15	3.27	0.704	0.182
	13 M	15	2.73	0.961	0.248
	14 N	11	2.82	0.603	0.182
	15 O	11	3.18	0.874	0.263
	16 P	11	3.27	1.009	0.304
	Total	183	2.99	0.981	0.072
IV_5 Local elected officials are better aware of water issues	1 A	17	1.53	0.717	0.174
	2 B	13	1.85	0.801	0.222
	3 C	7	1.86	0.900	0.340
	4 D	14	2.14	0.949	0.254
	5 E	10	2.80	1.317	0.416
	6 F	9	2.00	0.500	0.167
	7 G	12	2.00	1.206	0.348
	8 H	12	2.08	0.669	0.193
	9 I	7	2.14	0.690	0.261
	10 J	10	2.00	1.155	0.365
	11 K	10	2.60	1.075	0.340
	12 L	15	2.07	0.799	0.206
	13 M	15	2.47	1.187	0.307
	14 N	11	2.55	1.214	0.366
	15 O	11	2.36	1.286	0.388
	16 P	11	2.27	1.104	0.333
	Total	184	2.15	1.013	0.075
IV_6 Local funding has increase d for water projects	1 A	17	2.65	0.786	0.191
	2 B	13	2.85	0.987	0.274
	3 C	7	2.57	0.535	0.202
	4 D	14	3.29	1.326	0.354
	5 E	10	3.30	1.059	0.335
	6 F	8	3.00	1.195	0.423
	7 G	12	2.92	1.165	0.336
	8 H	12	2.83	0.937	0.271
	9 I	7	2.86	0.690	0.261
	10 J	10	3.00	1.247	0.394
	11 K	10	3.40	0.699	0.221
	12 L	15	2.73	0.594	0.153
	13 M	15	2.93	0.799	0.206

	14 N	11	3.18	0.751	0.226
	15 O	11	3.00	0.894	0.270
	16 P	11	3.36	0.809	0.244
	Total	183	2.98	0.929	0.069
IV_7 Communication between local water agencies has improved	1 A	17	1.53	0.717	0.174
	2 B	13	2.08	0.862	0.239
	3 C	7	1.71	0.756	0.286
	4 D	14	2.71	1.490	0.398
	5 E	10	2.50	1.269	0.401
	6 F	9	2.56	1.333	0.444
	7 G	12	2.25	1.055	0.305
	8 H	12	2.08	0.793	0.229
	9 I	7	2.43	0.535	0.202
	10 J	10	2.30	0.949	0.300
	11 K	10	1.70	0.483	0.153
	12 L	15	2.20	0.561	0.145
	13 M	15	2.33	0.816	0.211
	14 N	11	2.27	0.786	0.237
	15 O	11	2.55	0.934	0.282
	16 P	11	2.64	1.027	0.310
	Total	184	2.23	0.965	0.071
IV_8 Cooperation between local water agencies has improved	1 A	17	1.88	0.928	0.225
	2 B	13	2.08	0.954	0.265
	3 C	7	2.29	1.113	0.421
	4 D	14	3.00	1.414	0.378
	5 E	10	2.60	1.265	0.400
	6 F	9	2.67	1.225	0.408
	7 G	12	2.42	1.084	0.313
	8 H	12	2.25	0.452	0.131
	9 I	7	2.57	0.787	0.297
	10 J	10	2.50	1.179	0.373
	11 K	10	2.10	0.738	0.233
	12 L	15	2.53	0.915	0.236
	13 M	15	2.27	0.799	0.206
	14 N	11	3.09	0.831	0.251
	15 O	11	2.55	0.934	0.282
	16 P	11	2.91	0.944	0.285
	Total	184	2.46	1.013	0.075
IV_9 Statewide public support for reservoir projects has improved	1 A	17	2.82	1.015	0.246
	2 B	13	3.15	0.801	0.222
	3 C	7	2.86	1.069	0.404
	4 D	14	3.64	1.550	0.414
	5 E	10	3.40	1.075	0.340
	6 F	9	3.78	0.833	0.278
	7 G	12	3.25	1.138	0.329
	8 H	11	3.45	0.820	0.247
	9 I	7	3.00	1.000	0.378
	10 J	10	3.50	0.850	0.269
	11 K	10	3.80	0.919	0.291
	12 L	15	3.67	0.724	0.187
	13 M	15	3.67	0.976	0.252

	14 N	11	3.27	0.905	0.273
	15 O	11	3.45	0.934	0.282
	16 P	11	3.55	1.128	0.340
	Total	183	3.40	1.011	0.075
IV_10 Local public support for reservoir projects has improved	1 A	17	2.65	0.931	0.226
	2 B	13	2.54	1.127	0.312
	3 C	7	3.00	1.291	0.488
	4 D	14	4.00	1.414	0.378
	5 E	10	3.60	0.966	0.306
	6 F	9	3.44	1.130	0.377
	7 G	12	2.42	1.165	0.336
	8 H	12	3.50	0.674	0.195
	9 I	7	3.14	1.069	0.404
	10 J	10	3.50	0.850	0.269
	11 K	10	3.90	0.738	0.233
	12 L	15	4.00	0.756	0.195
	13 M	15	3.07	1.100	0.284
	14 N	11	3.18	1.079	0.325
	15 O	11	3.45	1.036	0.312
	16 P	11	3.36	1.206	0.364
	Total	184	3.29	1.120	0.083
IV_11 Local public support for water transfers has improved	1 A	17	3.24	1.091	0.265
	2 B	13	3.38	0.961	0.266
	3 C	7	2.43	0.976	0.369
	4 D	14	3.07	1.269	0.339
	5 E	10	3.70	1.160	0.367
	6 F	9	3.44	1.333	0.444
	7 G	12	3.00	1.206	0.348
	8 H	12	3.25	0.866	0.250
	9 I	7	3.86	0.690	0.261
	10 J	10	4.00	1.054	0.333
	11 K	10	3.80	1.229	0.389
	12 L	15	3.33	1.113	0.287
	13 M	15	3.00	0.926	0.239
	14 N	11	2.82	0.874	0.263
	15 O	11	3.82	1.079	0.325
	16 P	11	4.00	1.000	0.302
	Total	184	3.36	1.103	0.081
IV_12 Public support for regional water projects has improved	1 A	17	2.41	0.870	0.211
	2 B	12	2.08	0.669	0.193
	3 C	7	2.43	1.397	0.528
	4 D	14	3.00	1.240	0.331
	5 E	10	2.90	0.994	0.314
	6 F	9	2.78	0.667	0.222
	7 G	12	1.83	0.835	0.241
	8 H	11	2.64	0.924	0.279
	9 I	7	2.86	0.690	0.261
	10 J	10	3.10	1.197	0.379
	11 K	10	2.90	1.101	0.348
	12 L	15	2.93	0.961	0.248
	13 M	15	2.53	1.125	0.291

	14 N	11	3.18	0.982	0.296
	15 O	11	2.64	0.924	0.279
	16 P	11	3.91	0.944	0.285
	Total	182	2.74	1.053	0.078
IV_13 State financial support for local projects hasn't change d	1 A	17	2.53	0.717	0.174
	2 B	13	2.54	1.127	0.312
	3 C	7	2.71	0.488	0.184
	4 D	14	2.86	1.292	0.345
	5 E	10	2.50	1.269	0.401
	6 F	9	2.22	0.972	0.324
	7 G	12	2.75	1.288	0.372
	8 H	12	2.83	1.030	0.297
	9 I	7	3.29	0.756	0.286
	10 J	10	3.10	1.197	0.379
	11 K	10	3.00	1.054	0.333
	12 L	15	2.40	0.986	0.254
	13 M	15	2.73	0.961	0.248
	14 N	11	3.09	0.831	0.251
	15 O	11	2.82	1.471	0.444
	16 P	11	2.73	1.272	0.384
	Total	184	2.73	1.066	0.079

Interest Group to Interest Group

		N	Mean	Std. Deviation	Std. Error
III_1 DFC process will weaken the regional water planning process	1 Agricultural	24	3.54	1.215	0.248
	2 County	18	3.44	1.149	0.271
	3 Electric Utility	7	3.43	1.134	0.429
	4 Environmental	16	3.81	1.109	0.277
	5 Industrial	12	3.42	1.621	0.468
	6 Municipal	24	2.83	1.129	0.231
	7 Public	13	3.08	1.188	0.329
	8 Small Business	17	3.29	1.263	0.306
	9 River Authority	14	2.79	0.975	0.261
	10 Water District	24	3.54	1.382	0.282
	11 Water Utility	5	3.80	1.789	0.800
	12 Other	8	3.75	1.389	0.491
	Total	182	3.35	1.256	0.093
III_2 RWPGs choice of management strategies will decrease	1 Agricultural	24	3.25	1.032	0.211
	2 County	18	2.83	0.857	0.202
	3 Electric Utility	7	3.14	0.900	0.340
	4 Environmental	16	3.44	1.315	0.329
	5 Industrial	12	3.00	1.414	0.408
	6 Municipal	24	2.54	1.215	0.248
	7 Public	13	2.62	0.870	0.241
	8 Small Business	17	3.18	1.286	0.312
	9 River Authority	14	2.36	0.929	0.248

	10 Water District	22	3.36	1.093	0.233
	11 Water Utility	4	3.25	1.500	0.750
	12 Other	8	3.13	0.835	0.295
	Total	179	2.99	1.134	0.085
III_3 The DFC process for GCDs establishing DFCs is clear	1 Agricultural	22	3.14	1.125	0.240
	2 County	18	3.22	0.808	0.191
	3 Electric Utility	7	2.71	0.951	0.360
	4 Environmental	16	3.13	0.957	0.239
	5 Industrial	11	3.27	0.905	0.273
	6 Municipal	23	3.52	1.039	0.217
	7 Public	13	3.31	1.109	0.308
	8 Small Business	17	3.12	1.269	0.308
	9 River Authority	14	3.36	1.008	0.269
	10 Water District	23	2.78	1.347	0.281
	11 Water Utility	5	3.00	1.414	0.632
	12 Other	8	3.25	1.389	0.491
	Total	177	3.17	1.100	0.083
III_4 GCDs are the most appropriate entities to lead the DFC process	1 Agricultural	24	2.38	1.345	0.275
	2 County	18	2.17	1.200	0.283
	3 Electric Utility	7	2.43	0.976	0.369
	4 Environmental	16	2.25	1.183	0.296
	5 Industrial	12	3.00	1.414	0.408
	6 Municipal	24	2.63	1.056	0.215
	7 Public	13	2.62	1.193	0.331
	8 Small Business	17	2.59	1.326	0.322
	9 River Authority	14	2.71	1.069	0.286
	10 Water District	23	1.96	1.331	0.277
	11 Water Utility	5	3.60	1.673	0.748
	12 Other	8	2.13	1.126	0.398
	Total	181	2.45	1.249	0.093
III_5 The DFC process will lead to greater resource protection	1 Agricultural	24	2.46	1.179	0.241
	2 County	18	2.00	0.970	0.229
	3 Electric Utility	7	2.00	1.155	0.436
	4 Environmental	16	2.19	0.911	0.228
	5 Industrial	12	2.75	0.866	0.250
	6 Municipal	24	2.54	1.179	0.241
	7 Public	13	1.92	0.862	0.239
	8 Small Business	17	2.24	0.970	0.235
	9 River Authority	14	2.64	1.082	0.289
	10 Water District	23	2.04	0.976	0.204
	11 Water Utility	5	3.00	1.225	0.548
	12 Other	8	2.50	1.195	0.423
	Total	181	2.32	1.053	0.078
III_6 GCDs have the financial resources to implement DFCs	1 Agricultural	24	3.63	1.135	0.232
	2 County	18	3.33	0.970	0.229
	3 Electric Utility	7	3.57	0.787	0.297
	4 Environmental	16	3.69	1.078	0.270
	5 Industrial	12	3.50	1.168	0.337
	6 Municipal	24	3.92	0.881	0.180
	7 Public	13	3.23	1.166	0.323
	8 Small Business	17	3.59	1.278	0.310

	9 River Authority	14	3.43	1.016	0.272
	10 Water District	23	3.22	1.278	0.266
	11 Water Utility	5	4.20	1.304	0.583
	12 Other	8	3.75	0.886	0.313
	Total	181	3.55	1.092	0.081
III_7 A GCD's determination of DFCs will be based on sound science	1 Agricultural	23	3.00	1.000	0.209
	2 County	18	2.78	0.943	0.222
	3 Electric Utility	7	3.43	0.535	0.202
	4 Environmental	16	2.81	1.167	0.292
	5 Industrial	12	3.42	0.669	0.193
	6 Municipal	24	3.25	0.737	0.150
	7 Public	13	3.54	1.127	0.312
	8 Small Business	17	3.24	1.033	0.250
	9 River Authority	14	3.29	1.204	0.322
	10 Water District	23	2.43	1.199	0.250
	11 Water Utility	5	3.40	1.517	0.678
	12 Other	8	2.75	0.886	0.313
	Total	180	3.05	1.043	0.078
III_8 Local politics will dominate the determination of DFCs	1 Agricultural	24	2.46	0.932	0.190
	2 County	18	2.33	1.138	0.268
	3 Electric Utility	7	2.00	0.577	0.218
	4 Environmental	16	2.25	1.000	0.250
	5 Industrial	12	2.17	0.835	0.241
	6 Municipal	24	2.00	0.834	0.170
	7 Public	13	1.92	1.115	0.309
	8 Small Business	17	2.65	1.367	0.331
	9 River Authority	14	2.57	1.158	0.309
	10 Water District	23	2.57	1.343	0.280
	11 Water Utility	5	2.80	1.643	0.735
	12 Other	8	2.88	0.991	0.350
	Total	181	2.36	1.095	0.081
III_9 Less groundwater will be available if GCDs determine DFCs	1 Agricultural	24	3.50	1.103	0.225
	2 County	18	2.67	1.188	0.280
	3 Electric Utility	7	3.00	1.000	0.378
	4 Environmental	16	3.06	1.436	0.359
	5 Industrial	12	2.33	0.888	0.256
	6 Municipal	24	2.83	1.167	0.238
	7 Public	13	2.54	1.198	0.332
	8 Small Business	16	3.25	1.238	0.310
	9 River Authority	14	2.64	0.929	0.248
	10 Water District	23	3.17	1.403	0.293
	11 Water Utility	5	3.20	1.095	0.490
	12 Other	8	3.13	0.991	0.350
	Total	180	2.97	1.195	0.089
III_10 The petition process for resolving conflicts over DFCs is clear	1 Agricultural	24	3.42	0.881	0.180
	2 County	18	2.83	0.707	0.167
	3 Electric Utility	7	3.43	0.535	0.202
	4 Environmental	16	3.31	0.873	0.218
	5 Industrial	12	3.17	0.718	0.207
	6 Municipal	24	3.42	0.881	0.180
	7 Public	13	3.46	0.660	0.183

	8 Small Business	17	3.41	1.121	0.272
	9 River Authority	14	3.71	0.825	0.221
	10 Water District	23	3.17	1.114	0.232
	11 Water Utility	5	3.20	1.483	0.663
	12 Other	8	3.38	1.188	0.420
	Total	181	3.32	0.917	0.068
III_11 The criteria for determining DFCs is uncertain	1 Agricultural	23	2.52	0.947	0.198
	2 County	18	2.83	0.786	0.185
	3 Electric Utility	7	1.86	0.690	0.261
	4 Environmental	14	2.57	1.222	0.327
	5 Industrial	12	2.83	0.937	0.271
	6 Municipal	24	2.08	1.018	0.208
	7 Public	13	2.15	0.899	0.249
	8 Small Business	17	2.47	1.068	0.259
	9 River Authority	14	2.86	1.027	0.275
	10 Water District	23	2.61	1.340	0.279
	11 Water Utility	5	2.80	1.789	0.800
	12 Other	8	2.00	0.926	0.327
	Total	178	2.48	1.069	0.080
III_12 The legislature should specify the criteria	1 Agricultural	24	3.04	1.334	0.272
	2 County	18	3.17	1.249	0.294
	3 Electric Utility	7	3.00	1.155	0.436
	4 Environmental	16	3.00	1.265	0.316
	5 Industrial	12	2.00	0.953	0.275
	6 Municipal	24	3.42	1.472	0.300
	7 Public	13	2.38	1.446	0.401
	8 Small Business	17	3.00	1.458	0.354
	9 River Authority	14	3.07	1.328	0.355
	10 Water District	23	3.57	1.502	0.313
	11 Water Utility	5	3.20	1.789	0.800
	12 Other	7	2.71	1.496	0.565
	Total	180	3.04	1.392	0.104
III_13 GCDs could use DFCs to restrict economic growth	1 Agricultural	24	2.75	1.152	0.235
	2 County	18	2.78	1.114	0.263
	3 Electric Utility	7	2.57	0.976	0.369
	4 Environmental	15	2.93	1.280	0.330
	5 Industrial	12	2.33	1.231	0.355
	6 Municipal	24	2.25	1.452	0.296
	7 Public	13	2.38	1.193	0.331
	8 Small Business	17	2.82	1.510	0.366
	9 River Authority	14	2.57	1.158	0.309
	10 Water District	23	2.78	1.126	0.235
	11 Water Utility	5	3.20	1.643	0.735
	12 Other	7	2.86	0.900	0.340
	Total	179	2.65	1.233	0.092
III_14 GCDs could use DFCs to restrict population growth	1 Agricultural	24	2.96	1.197	0.244
	2 County	18	2.72	1.179	0.278
	3 Electric Utility	7	2.86	0.690	0.261
	4 Environmental	15	2.93	1.223	0.316
	5 Industrial	12	2.42	1.240	0.358
	6 Municipal	24	2.33	1.465	0.299

	7 Public	13	2.69	1.182	0.328
	8 Small Business	17	2.94	1.519	0.369
	9 River Authority	14	2.64	1.151	0.308
	10 Water District	23	2.87	1.180	0.246
	11 Water Utility	5	3.20	1.643	0.735
	12 Other	8	3.25	1.165	0.412
	Total	180	2.77	1.250	0.093
III_15 GCDs could use DFCs to restrict water transfers	1 Agricultural	24	2.54	1.141	0.233
	2 County	18	2.17	0.985	0.232
	3 Electric Utility	7	2.00	0.816	0.309
	4 Environmental	15	2.53	0.990	0.256
	5 Industrial	12	2.00	0.853	0.246
	6 Municipal	24	1.63	0.875	0.179
	7 Public	13	2.31	1.032	0.286
	8 Small Business	17	2.41	1.326	0.322
	9 River Authority	14	2.21	1.122	0.300
	10 Water District	23	2.65	1.265	0.264
	11 Water Utility	5	2.20	1.304	0.583
	12 Other	8	2.88	1.246	0.441
	Total	180	2.29	1.111	0.083
III_16 Cities and urban areas will lose access to groundwater as a result of DFCs	1 Agricultural	24	3.67	0.816	0.167
	2 County	18	2.94	1.211	0.286
	3 Electric Utility	7	3.14	1.215	0.459
	4 Environmental	15	3.20	1.424	0.368
	5 Industrial	12	2.33	0.888	0.256
	6 Municipal	24	2.58	1.139	0.232
	7 Public	13	3.31	1.182	0.328
	8 Small Business	17	3.71	1.047	0.254
	9 River Authority	14	2.50	0.941	0.251
	10 Water District	23	3.43	1.376	0.287
	11 Water Utility	5	3.80	1.643	0.735
	12 Other	8	3.00	0.535	0.189
	Total	180	3.13	1.193	0.089
III_17 Litigation over groundwater rights will increase because of the DFC process	1 Agricultural	24	2.92	0.881	0.180
	2 County	18	2.39	0.850	0.200
	3 Electric Utility	7	2.14	0.900	0.340
	4 Environmental	16	2.63	1.310	0.328
	5 Industrial	12	2.17	1.193	0.345
	6 Municipal	24	2.04	1.042	0.213
	7 Public	13	2.00	1.080	0.300
	8 Small Business	17	2.53	1.068	0.259
	9 River Authority	14	2.43	0.852	0.228
	10 Water District	23	2.91	1.443	0.301
	11 Water Utility	5	3.40	1.342	0.600
	12 Other	8	2.50	1.069	0.378
	Total	181	2.50	1.124	0.084
IV_1 The public has a greater awareness of water issues	1 Agricultural	24	2.29	1.122	0.229
	2 County	19	2.37	1.257	0.288
	3 Electric Utility	7	2.29	0.756	0.286
	4 Environmental	16	2.75	1.183	0.296
	5 Industrial	13	2.08	1.188	0.329

	6 Municipal	24	2.21	1.141	0.233
	7 Public	13	1.92	0.954	0.265
	8 Small Business	17	2.53	1.068	0.259
	9 River Authority	13	2.23	1.423	0.395
	10 Water District	24	1.92	1.100	0.225
	11 Water Utility	5	3.40	1.817	0.812
	12 Other	8	2.38	1.506	0.532
	Total	183	2.29	1.185	0.088
IV_2 Public support for funding water projects had significantly increased	1 Agricultural	24	2.96	0.999	0.204
	2 County	19	2.68	0.820	0.188
	3 Electric Utility	7	2.71	0.951	0.360
	4 Environmental	16	3.13	0.885	0.221
	5 Industrial	13	2.69	1.182	0.328
	6 Municipal	24	3.00	1.022	0.209
	7 Public	13	2.92	0.862	0.239
	8 Small Business	17	2.76	0.752	0.182
	9 River Authority	14	3.29	0.994	0.266
	10 Water District	24	2.75	0.989	0.202
	11 Water Utility	5	3.80	1.304	0.583
	12 Other	8	3.00	1.195	0.423
	Total	184	2.92	0.972	0.072
IV_3 State legislators are better aware of water issues	1 Agricultural	24	2.08	1.018	0.208
	2 County	19	2.05	0.621	0.143
	3 Electric Utility	7	1.14	0.378	0.143
	4 Environmental	16	2.06	0.998	0.249
	5 Industrial	13	2.23	1.235	0.343
	6 Municipal	24	2.08	1.060	0.216
	7 Public	13	1.92	0.954	0.265
	8 Small Business	17	2.71	1.263	0.306
	9 River Authority	14	1.93	0.997	0.267
	10 Water District	24	2.13	1.191	0.243
	11 Water Utility	5	3.40	1.140	0.510
	12 Other	8	2.63	0.916	0.324
	Total	184	2.15	1.065	0.079
IV_4 State funding for water projects has increased	1 Agricultural	24	3.00	0.659	0.135
	2 County	19	2.84	0.765	0.175
	3 Electric Utility	7	2.43	0.535	0.202
	4 Environmental	16	2.63	0.806	0.202
	5 Industrial	13	2.92	1.256	0.348
	6 Municipal	24	3.54	0.833	0.170
	7 Public	13	2.69	0.947	0.263
	8 Small Business	17	3.41	1.176	0.285
	9 River Authority	14	3.07	0.917	0.245
	10 Water District	23	2.87	1.217	0.254
	11 Water Utility	5	3.60	1.342	0.600
	12 Other	8	2.50	0.756	0.267
	Total	183	2.99	0.981	0.072
IV_5 Local elected officials are better aware of water	1 Agricultural	24	2.08	0.974	0.199
	2 County	19	2.16	0.958	0.220
	3 Electric Utility	7	1.86	0.690	0.261
	4 Environmental	16	2.06	0.680	0.170

issues	5 Industrial	13	1.69	1.109	0.308
	6 Municipal	24	2.25	0.989	0.202
	7 Public	13	2.31	1.182	0.328
	8 Small Business	17	2.47	1.231	0.298
	9 River Authority	14	1.86	0.864	0.231
	10 Water District	24	2.04	1.042	0.213
	11 Water Utility	5	3.20	1.304	0.583
	12 Other	8	2.50	0.926	0.327
	Total	184	2.15	1.013	0.075
IV_6 Local funding has increased for water projects	1 Agricultural	24	3.08	0.717	0.146
	2 County	19	3.21	0.918	0.211
	3 Electric Utility	7	2.86	0.690	0.261
	4 Environmental	16	3.19	0.981	0.245
	5 Industrial	13	2.54	0.967	0.268
	6 Municipal	24	2.71	0.955	0.195
	7 Public	13	3.08	0.641	0.178
	8 Small Business	17	3.18	0.883	0.214
	9 River Authority	14	3.00	0.784	0.210
	10 Water District	23	2.96	1.224	0.255
	11 Water Utility	5	3.00	1.581	0.707
	12 Other	8	2.88	0.835	0.295
	Total	183	2.98	0.929	0.069
IV_7 Communication between local water agencies has improved	1 Agricultural	24	2.50	0.978	0.200
	2 County	19	2.21	0.631	0.145
	3 Electric Utility	7	1.71	0.488	0.184
	4 Environmental	16	2.88	0.885	0.221
	5 Industrial	13	1.92	0.862	0.239
	6 Municipal	24	2.13	0.947	0.193
	7 Public	13	2.46	0.967	0.268
	8 Small Business	17	2.59	1.278	0.310
	9 River Authority	14	1.93	0.616	0.165
	10 Water District	24	1.88	1.035	0.211
	11 Water Utility	5	2.40	1.517	0.678
	12 Other	8	1.75	0.463	0.164
	Total	184	2.23	0.965	0.071
IV_8 Cooperation between local water agencies has improved	1 Agricultural	24	2.54	0.977	0.199
	2 County	19	2.53	0.697	0.160
	3 Electric Utility	7	2.29	0.951	0.360
	4 Environmental	16	3.06	0.929	0.232
	5 Industrial	13	2.08	0.954	0.265
	6 Municipal	24	2.33	1.049	0.214
	7 Public	13	2.77	1.166	0.323
	8 Small Business	17	2.76	1.200	0.291
	9 River Authority	14	2.29	0.726	0.194
	10 Water District	24	2.00	0.933	0.190
	11 Water Utility	5	3.20	1.483	0.663
	12 Other	8	2.13	0.991	0.350
	Total	184	2.46	1.013	0.075
IV_9 Statewide public support	1 Agricultural	24	3.21	1.141	0.233
	2 County	19	3.26	0.872	0.200
	3 Electric Utility	7	3.14	0.690	0.261

for reservoir projects has improved	4 Environmental	16	3.88	1.025	0.256
	5 Industrial	13	2.92	1.256	0.348
	6 Municipal	24	3.33	0.963	0.197
	7 Public	13	3.23	0.927	0.257
	8 Small Business	16	3.56	1.094	0.273
	9 River Authority	14	3.50	0.855	0.228
	10 Water District	24	3.67	1.049	0.214
	11 Water Utility	5	3.80	0.837	0.374
	12 Other	8	3.25	0.886	0.313
	Total	183	3.40	1.011	0.075
IV_10 Local public support for reservoir projects has improved	1 Agricultural	24	3.08	1.176	0.240
	2 County	19	3.00	1.155	0.265
	3 Electric Utility	7	3.29	0.756	0.286
	4 Environmental	16	3.69	1.014	0.254
	5 Industrial	13	3.00	1.414	0.392
	6 Municipal	24	3.04	1.367	0.279
	7 Public	13	3.23	0.927	0.257
	8 Small Business	17	3.59	1.064	0.258
	9 River Authority	14	3.64	0.745	0.199
	10 Water District	24	3.33	1.167	0.238
	11 Water Utility	5	4.00	0.707	0.316
	12 Other	8	3.25	0.886	0.313
	Total	184	3.29	1.120	0.083
IV_11 Local public support for water transfers has improved	1 Agricultural	24	3.29	1.083	0.221
	2 County	19	3.32	0.946	0.217
	3 Electric Utility	7	3.00	1.000	0.378
	4 Environmental	16	3.50	1.033	0.258
	5 Industrial	13	2.62	0.870	0.241
	6 Municipal	24	3.08	1.316	0.269
	7 Public	13	3.62	0.961	0.266
	8 Small Business	17	3.88	0.993	0.241
	9 River Authority	14	3.79	0.802	0.214
	10 Water District	24	3.29	1.268	0.259
	11 Water Utility	5	3.80	0.837	0.374
	12 Other	8	3.50	1.414	0.500
	Total	184	3.36	1.103	0.081
IV_12 Public support for regional water projects has improved	1 Agricultural	24	2.92	0.881	0.180
	2 County	19	2.95	0.970	0.223
	3 Electric Utility	7	2.14	0.690	0.261
	4 Environmental	16	3.31	0.873	0.218
	5 Industrial	13	2.08	1.038	0.288
	6 Municipal	23	2.39	1.158	0.241
	7 Public	12	3.33	0.985	0.284
	8 Small Business	17	2.82	0.883	0.214
	9 River Authority	14	2.79	0.893	0.239
	10 Water District	24	2.42	1.248	0.255
	11 Water Utility	5	3.60	1.140	0.510
	12 Other	8	2.50	0.926	0.327
	Total	182	2.74	1.053	0.078
IV_13 State financial	1 Agricultural	24	3.00	0.659	0.135
	2 County	19	2.53	0.841	0.193

		N	Mean	Std. Deviation	Std. Error Mean
support for local projects hasn't changed	3 Electric Utility	7	2.71	1.113	0.421
	4 Environmental	16	2.94	1.063	0.266
	5 Industrial	13	3.00	1.354	0.376
	6 Municipal	24	2.38	1.056	0.215
	7 Public	13	3.08	1.256	0.348
	8 Small Business	17	3.24	1.091	0.265
	9 River Authority	14	2.21	1.051	0.281
	10 Water District	24	2.42	1.018	0.208
	11 Water Utility	5	3.00	1.581	0.707
	12 Other	8	2.75	1.035	0.366
	Total	184	2.73	1.066	0.079

Users v. Providers

	user_provider	N	Mean	Std. Deviation	Std. Error Mean
III_1 DFC process will weaken the regional water planning process	1.00 Users	76	3.51	1.249	0.143
	2.00 Providers	67	3.15	1.282	0.157
III_2 RWPGs choice of management strategies will decrease	1.00 Users	76	3.22	1.184	0.136
	2.00 Providers	64	2.83	1.189	0.149
III_3 The DFC process for GCDs establishing DFCs is clear	1.00 Users	73	3.11	1.061	0.124
	2.00 Providers	65	3.18	1.198	0.149
III_4 GCDs are the most appropriate entities to lead the DFC process	1.00 Users	76	2.50	1.281	0.147
	2.00 Providers	66	2.48	1.268	0.156
III_5 The DFC process will lead to greater resource protection	1.00 Users	76	2.36	1.029	0.118
	2.00 Providers	66	2.42	1.110	0.137
III_6 GCDs have the financial resources to implement DFCs	1.00 Users	76	3.61	1.108	0.127
	2.00 Providers	66	3.59	1.123	0.138
III_7 A GCD's determination of DFCs will be based on sound science	1.00 Users	75	3.12	0.972	0.112
	2.00 Providers	66	2.98	1.130	0.139
III_8 Local politics will dominate the determination of DFCs	1.00 Users	76	2.37	1.018	0.117
	2.00 Providers	66	2.38	1.174	0.144
III_9 Less groundwater will be available if GCDs determine DFCs	1.00 Users	75	3.12	1.208	0.139
	2.00 Providers	66	2.94	1.201	0.148
III_10 The petition process for resolving conflicts over DFCs is clear	1.00 Users	76	3.36	0.875	0.100
	2.00 Providers	66	3.38	1.004	0.124
III_11 The criteria for determining DFCs is uncertain	1.00 Users	73	2.51	1.015	0.119
	2.00 Providers	66	2.48	1.218	0.150
III_12 The legislature should specify the criteria	1.00 Users	76	2.86	1.303	0.150
	2.00 Providers	66	3.38	1.455	0.179
III_13 GCDs could use DFCs to restrict economic growth	1.00 Users	75	2.72	1.247	0.144
	2.00 Providers	66	2.58	1.302	0.160
III_14 GCDs could use DFCs to restrict population growth	1.00 Users	75	2.85	1.238	0.143
	2.00 Providers	66	2.65	1.318	0.162
III_15 GCDs could use DFCs to restrict water transfers	1.00 Users	75	2.37	1.088	0.126
	2.00 Providers	66	2.15	1.167	0.144
III_16 Cities and urban areas will lose access to groundwater as a result of DFCs	1.00 Users	75	3.32	1.141	0.132
	2.00 Providers	66	2.95	1.294	0.159

III_17 Litigation over groundwater rights will increase because of the DFC process	1.00 Users	76	2.58	1.086	0.125
	2.00 Providers	66	2.53	1.243	0.153
IV_1 The public has a greater awareness of water issues	1.00 Users	77	2.40	1.103	0.126
	2.00 Providers	66	2.20	1.268	0.156
IV_2 Public support for funding water projects had significantly increased	1.00 Users	77	2.88	0.946	0.108
	2.00 Providers	67	3.03	1.044	0.128
IV_3 State legislators are better aware of water issues	1.00 Users	77	2.16	1.125	0.128
	2.00 Providers	67	2.16	1.136	0.139
IV_4 State funding for water projects has increased	1.00 Users	77	2.95	0.958	0.109
	2.00 Providers	66	3.21	1.060	0.130
IV_5 Local elected officials are better aware of water issues	1.00 Users	77	2.08	0.997	0.114
	2.00 Providers	67	2.16	1.039	0.127
IV_6 Local funding has increased for water projects	1.00 Users	77	3.01	0.866	0.099
	2.00 Providers	66	2.88	1.060	0.130
IV_7 Communication between local water agencies has improved	1.00 Users	77	2.43	1.031	0.118
	2.00 Providers	67	2.01	0.961	0.117
IV_8 Cooperation between local water agencies has improved	1.00 Users	77	2.60	1.042	0.119
	2.00 Providers	67	2.27	1.009	0.123
IV_9 Statewide public support for reservoir projects has improved	1.00 Users	76	3.37	1.118	0.128
	2.00 Providers	67	3.52	0.959	0.117
IV_10 Local public support for reservoir projects has improved	1.00 Users	77	3.32	1.141	0.130
	2.00 Providers	67	3.34	1.162	0.142
IV_11 Local public support for water transfers has improved	1.00 Users	77	3.32	1.069	0.122
	2.00 Providers	67	3.36	1.190	0.145
IV_12 Public support for regional water projects has improved	1.00 Users	77	2.77	0.972	0.111
	2.00 Providers	66	2.58	1.164	0.143
IV_13 State financial support for local projects hasn't changed	1.00 Users	77	3.01	1.006	0.115
	2.00 Providers	67	2.40	1.074	0.131

Region G v. GCDs

	membership	N	Mean	Std. Deviation	Std. Error Mean
III_1 DFC process will weaken the regional water planning process	1 GCD	41	3.32	1.150	0.180
	3 Region G	12	3.00	1.279	0.369
III_2 RWPGs choice of management strategies will decrease	1 GCD	38	3.21	1.044	0.169
	3 Region G	12	2.92	1.311	0.379
III_3 The DFC process for GCDs establishing DFCs is clear	1 GCD	40	2.70	1.091	0.172
	3 Region G	12	3.08	1.240	0.358
III_4 GCDs are the most appropriate entities to lead the DFC process	1 GCD	40	2.05	1.260	0.199
	3 Region G	12	2.50	1.168	0.337
III_5 The DFC process will lead to greater resource protection	1 GCD	40	2.25	1.276	0.202
	3 Region G	12	2.17	1.030	0.297
III_6 GCDs have the financial resources to implement DFCs	1 GCD	40	3.23	1.209	0.191
	3 Region G	12	3.50	1.087	0.314
III_7 A GCD's determination of DFCs will be based on sound science	1 GCD	39	2.38	1.184	0.190
	3 Region G	12	3.00	1.206	0.348
III_8 Local politics will dominate the determination of DFCs	1 GCD	40	3.00	1.281	0.203
	3 Region G	12	2.67	1.371	0.396
III_9 Less groundwater will be	1 GCD	40	3.35	1.272	0.201

available if GCDs determine DFCs	3 Region G	12	2.83	1.193	0.345
III_10 The petition process for resolving conflicts over DFCs is clear	1 GCD	40	3.28	0.905	0.143
	3 Region G	12	3.25	0.866	0.250
III_11 The criteria for determining DFCs is uncertain	1 GCD	40	3.00	0.934	0.148
	3 Region G	12	3.25	1.357	0.392
III_12 The legislature should specify the criteria	1 GCD	40	3.73	1.320	0.209
	3 Region G	12	3.00	1.706	0.492
III_13 GCDs could use DFCs to restrict economic growth	1 GCD	40	3.10	1.172	0.185
	3 Region G	12	2.42	1.379	0.398
III_14 GCDs could use DFCs to restrict population growth	1 GCD	40	3.10	1.215	0.192
	3 Region G	12	2.42	1.379	0.398
III_15 GCDs could use DFCs to restrict water transfers	1 GCD	40	2.58	1.174	0.186
	3 Region G	12	2.42	1.443	0.417
III_16 Cities and urban areas will lose access to groundwater as a result of DFCs	1 GCD	40	3.23	1.271	0.201
	3 Region G	12	3.33	1.231	0.355
III_17 Litigation over groundwater rights will increase because of the DFC process	1 GCD	40	2.25	1.149	0.182
	3 Region G	12	2.42	1.311	0.379
IV_1 The public has a greater awareness of water issues	1 GCD	41	2.71	1.167	0.182
	3 Region G	12	2.08	1.165	0.336
IV_2 Public support for funding water projects had significantly increased	1 GCD	41	3.12	1.269	0.198
	3 Region G	12	2.92	0.900	0.260
IV_3 State legislators are better aware of water issues	1 GCD	41	2.41	1.204	0.188
	3 Region G	12	1.58	0.515	0.149
IV_4 State funding for water projects has increased	1 GCD	40	3.43	1.035	0.164
	3 Region G	12	3.08	1.311	0.379
IV_5 Local elected officials are better aware of water issues	1 GCD	41	2.17	1.093	0.171
	3 Region G	12	2.00	1.206	0.348
IV_6 Local funding has increased for water projects	1 GCD	41	3.27	1.119	0.175
	3 Region G	12	2.92	1.165	0.336
IV_7 Communication between local water agencies has improved	1 GCD	41	2.15	0.989	0.154
	3 Region G	12	2.25	1.055	0.305
IV_8 Cooperation between local water agencies has improved	1 GCD	40	2.40	0.982	0.155
	3 Region G	12	2.42	1.084	0.313
IV_9 Statewide public support for reservoir projects has improved	1 GCD	41	3.07	1.034	0.162
	3 Region G	12	3.25	1.138	0.329
IV_10 Local public support for reservoir projects has improved	1 GCD	40	3.08	1.095	0.173
	3 Region G	12	2.42	1.165	0.336
IV_11 Local public support for water transfers has improved	1 GCD	40	3.58	0.958	0.151
	3 Region G	12	3.00	1.206	0.348
IV_12 Public support for regional water projects has improved	1 GCD	41	3.02	0.961	0.150
	3 Region G	12	1.83	0.835	0.241
IV_13 State financial support for local projects hasn't changed	1 GCD	40	2.38	1.192	0.188
	3 Region G	12	2.75	1.288	0.372

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