Irrigation Demand In Texas

An Analysis of Methodologies To Predict Irrigation Trends

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EXECUTIVE SUMMARY

Use of surface water and groundwater for irrigation accounts for about two-thirds (2/3) of current water use in Texas. Thus, irrigation demand projections can greatly affect regional and overall statewide supply/demand scenarios.

This report analyzes projected irrigation demand in the 2002 Texas State Water Plan. It also examines the early irrigation water demand projections being made for the second round of regional water planning, which will lead to a revised State Water Plan in 2007.

The major findings are:

1. There are projected increases in irrigation demand for the year 2030 over 1984 to 2000 historic median use in ten regions (B, D, F, G, H, I, K, L, M, and P). In many cases, the projected increase in irrigation demand appears unrealistic.

2. If irrigation demand predictions in these regions are indeed over-stated, then there is significantly more water available to satisfy other needs than the 2002 State Water Plan contemplates.

3. The first round of regional planning projections for irrigation use did not include sufficient documentation of how conservation and other factors were incorporated into the demand estimates.

Based on these findings, Environmental Defense recommends that the Texas Water Development Board and the regional water planning groups take the following actions in the second round of regional planning, which is just getting underway:

1. Review the assumptions used to model projected irrigation demands and ensure that all key assumptions are clearly stated and discussed at the regional level;

2. Ensure that any adjustments that have the effect of increasing irrigation demand over 1984 to 2000 average median historic use are clearly justified using sound agricultural science and economic principles;

3. Where assumptions about future market conditions, land use trends or other factors affecting projected irrigation demand are uncertain, develop projected demands for a reasonable range of scenarios; and

4. Develop realistic and well-documented assumptions about application of irrigation conservation technologies and the effect adoption of such technologies will have on both projected demand and reduction of projected demand if adopted as a water management strategy.

INTRODUCTION

Under Senate Bill 1, adopted in 1997 by the Texas legislature, regional water planning groups (RWPGs) were tasked with developing water demand projections—and strategies to meet those projected demands—through the year 2050. The groups had a short time to complete this task, and funding for data collection to accurately characterize current and projected demand was extremely limited.

Despite these challenges, the RWPGs produced their plans on time. These plans were then compiled into the 2002 State Water Plan.[1]

Now that the dust has settled on the first round of planning, however, there is an opportunity to take a closer look at whether the demand projections are realistic. In a recent report, Save Water, Rivers and Money, the National Wildlife Federation (NWF) analyzed the **municipal** water demand projections of the 16 regional planning groups.[2] NWF's analysis found that many regions appear to have over-estimated baseline (e.g., year 2000) demand, and that more aggressive application of conservation over the 50-year planning horizon could have reduced statewide projected municipal demands by almost 1 million acre-feet/year.

This report analyzes whether the RWPG **irrigation** demand projections in the 2002 State Water Plan are realistic. Since irrigation accounts for about two-thirds (2/3) of water use statewide, changes in irrigation demand projections can greatly affect regional and overall statewide supply/demand scenario. The report also compares the results of our analysis with new regional irrigation demand projections released in January 2003 by the Texas Water Development Board (TWDB). These new projections, which are subject to review and revision by the RWPGs, are intended to be used as the basis of the demand scenarios as the RWPGs begin the second round of planning. This second round will culminate in a revised statewide water plan in 2007.

Our analysis included the following steps:

1. Examining the methodology used by TWDB to develop baseline and projected irrigation demand estimates for the first round of regional planning;
2. Examining how these projections were used and/or revised by each of the 16 RWPGs and how the regional projections compared to documented historic trends; and
3. Examining TWDB's methodology for developing the baseline and projected irrigation demands for the second round of regional planning.

[1] Water for Texas-2002, Texas Water Development Board (Austin, TX; 2002).
[2] Norman Johns, Save Water, Rivers and Money, National Wildlife Federation (Austin, TX; 2002), available at www.texaswatermatters.org.

REGIONAL PROJECTIONS

TWDB BASELINE IRRIGATED CROP ACREAGE AND WATER USE FOR ROUND 1 PLANS

For the first round of regional planning, the TWDB provided the RWPGs with baseline figures for estimated 2000 agricultural water demand based on the amount of irrigated acreage in each region. The estimates were calculated using historical acreage and water use estimates provided by the Texas Agricultural Statistics Service (TASS) and Natural Resources Conservation Service (NRCS) surveys.

Because the amount of irrigated acreage varies from year to year depending on climatic conditions the historical average use numbers were modified to reflect conditions during a "dry" year. Thus, TWDB baseline demand estimates show a relatively higher water use, reflecting dry conditions.

TWDB MODELING TO PREDICT IRRIGATION TRENDS

From this baseline figure, TWDB employed a computer model to predict irrigation trends in each region. This model is based on a number of factors relevant to overall irrigation trends in the state. The model used in the first round of the SB1 regional planning was originally used for the 1997 State Water Plan. The conditions included in the 1997 model were maintained for developing the regional water planning projections. A brief overview of the model is included below, and a full description from the 1997 State Water Plan is included in Appendix I.

The TWDB model included consideration of total irrigated acreage, crop-specific acreage, adoption rates for various types of irrigation technology, crop prices, water prices, federal crop subsidies and application rates of water. These constraints were used to develop three scenarios. These scenarios took into account alternative futures in Federal Farm Programs and conservation measures. The Board ultimately recommended that the RWPGs use the demand estimates based on "expected case" water conservation practices and no reduction in Federal Farm Program subsidies.

Though the model documentation in the 1997 State Water Plan makes reference to the inclusion of conservation—based on varying regional rates of adoption of different types of irrigation technology—it is unclear to what extent conservation was actually included in the projected irrigation demand figures. We were not able to find out how exactly how much conservation was built into the initial estimates nor could TWDB provide detailed documentation on the modeling procedure regarding this factor.

Regional Modifications for the First Round of Planning

Each of the 16 RWPGs was provided the opportunity to revise both the TWDB baseline and projected demands for their region.

Twelve of the sixteen regions (A, B, D, F, G, H, I, K, L M, O and P) modified the projected future irrigation demands. Nine of these regions revised the future projections to show higher projected demand that predicted by TWDB (B, D, F, G, H, I, K, L and P). Three of these regions lowered their demands below what was predicted by TWDB (A, O and M). Four of these regions used the TWDB projections (C, E, J and N).

Table 1 (on the following pages) shows how each region modified the projected irrigation demands for the year 2030. It also documents the difference between the projections before and after the regional modifications, and explains the reasons for the modifications as outlined in the regional plans.

TWDB then approved the regional modifications for use in developing the first round of regional plans.

Table 1: Comparison of TWDB Initial and Final 2002 Plan Irrigation Demands for Year 2030

Region	2030 Original TWDB Irrigation projection (acft/year)[3]	2030 Revised Irrigation projection (acft/year)	Explanation of Irrigation Demand Modifications
Region A	1,645,031	1,522,985	The TWDB methodology was designed to reflect a "dry year." Region A modified its irrigation demand projections to reflect more average conditions. The Region used a model developed by TAES and TAEX to estimate the amount of irrigation water pumped in a county in a year, using planted acreage and long term averages for rainfall and evapotranspiration (PET) by county. This resulted in the projected demands being revised downward from the original TWDB projections.
Region B	61,477	95,522	Region B used its own projections for irrigation water demand. The major difference is the irrigation water projections for Wichita County.
Region C	5,306	5,306	Region C used TWDB projections.
Region D	11,009	12,637	Region D used TWDB projections as the default values except where "better, more current information" was available. [4]
Region E	313,274	313,274	TWDB projections were used.
Region F	324,603	630,636	Region F revised TWDB projections to arrive at six different scenarios based on historical data. The scenario chosen was based on the maximum irrigation volume used in the region between 1990 and 1997.[5] The final figures used by the group are substantially larger than those proposed by TWDB. The projections are reduced by 1% of the 2000 figure per decade from 2010 through 2050[6]; these reductions represent the amounts of water conservation assumed in the 1997 consensus-based projections.[7]
Region G	185,506	185,547	Projections were made from "TWDB or approved revision". Details of how these figures were revised could not be located.
Region H	378,908	474,102	Region H did not adopt TWDB irrigation projections. The TWDB projections assumed expected case water conservation practices and no reduction in federal farm program subsidies, and were based on projected future rice prices for 1996-2000. Revised estimates took into account data/conditions since 1996 when the TWDB irrigation study was made.[8] The revised estimates were higher than TWDB projections.

[3] Projections were taken from the Regional Planning document for each respective region. The majority of the figures were available in Chapter 2 of the Regional Plan. Please contact the author if you want the exact pagination reference for each figure.
[4] Region D plan, Chapter 2, p. 61.
[5] Region F plan, chapter 2, p. 2-45.
[6] Region F plan, Table 2-15.
[7] Region F plan, chapter 2, p. 2-52.
[8] The revision took into account revised economic estimates (for the mid-late 1990s, rice showed more profitability than projected), projected improvements in rice disease resistance (which could reduce costs of production), projected increases in rice yield, and the proportion of people in Texas expected to eat rice.

Table 1 Continued: Comparison of TWDB Initial and Final 2002 Plan Irrigation Demands for Year 2030

Region	2030 TWDB Irrigation projection (acft/year)[9]	2030 Revised Irrigation projection (acft/year)	Explanation of Irrigation Demand Modifications
Region I	123,272	302,800	The region's projections were based on an increase over the planning period in irrigated rice production acreage.
Region J	10,109	10,109	TWDB projections appear to have been used.
Region K	470,439	517,895	TWDB irrigation projections were used as the default projections, except in cases where more current information was submitted.
Region L	529,577	563,609	TWDB projections were modified upward to account for irrigation canal losses in Bexar, Calhoun, and Dimmit Counties, and were modified upward for double cropping in Atascosa, Frio and Wilson counties.
Region M	1,246,206	1,190,919	The Region used TWDB projections, except where improved or more current information was available. Decreases in irrigated acreages are predicted to occur due to projected expansion of urban areas to 2050.
Region N	10,026	10,026	TWDB irrigation projections were used.
Region O	3,171,805	2,750,835	The TWDB irrigation projections were not used. Region O thought the TWDB methodology used too many dry years, and thus showed an inflated demand.[10]
Region P	156,966	227,911	TWDB irrigation projections were not used. Reasons cited by the Regional Group included (1) rice prices have remained higher than previously projected, (2) water supply is not an obvious limiting factor, (3) there is not the competition for land that is seen in other regions, (4) the Group questioned the allocation of water in the split in Wharton County.[11] Also, original TWDB projections did not take into consideration channel losses – it was assumed that the majority of irrigation water, being groundwater, was sent via pipes, which is not entirely true.

[9] Projections were taken from the Regional Planning document for each respective region. The majority of the figures were available in Chapter 2 of the Regional Plan. Please contact the author if you want the exact pagination reference for each figure.
[10] Projected irrigation water demands were based on "average" precipitation conditions, rather than "below average" conditions, as calculations under the latter conditions would have placed a drought condition irrigation water demand upon the source of supply (Ogallala Aquifer) 100% of the time. This would have led to over-estimates of the amount of water withdrawn from the aquifer and of the amount of water needed for irrigation. Region O plan, p. 2-18.
[11] Region P Regional Water Plan, Task 2, Section IV.

Agricultural Demand Projections for the Current Round of Regional Planning

For the current round of regional planning, TWDB took the estimated irrigated use from the year 2000, and projected future demand based on the trends that were developed by each region during the last round of planning. This means the starting point for each region may be higher or lower than the 2000 irrigation use figure from the first round of planning, depending on the modifications the region made to the TWDB numbers in the first round of planning. Thus, while the regional trends are the same as those that were determined by each region in the last round of planning (i.e. slope of line is the same), the projected irrigation water use in most cases is very different from the use projected in the last round of planning.

Table 2 (on the following page) compares projected irrigation 2030 use to (1) original TWDB projections; (2) projections as modified by each region for the 2002 water plan; and (3) new TWDB projections for the second round of regional planning.

Figures 1 and 2 (in Appendix II) are maps that show the county-by-county difference between median historic irrigation water use between the years 1984 to 2000 and projected 2030 irrigation water use.

Region-specific trends are shown in Figures 3-18 (in Appendix II), including:

- Historical irrigation water use from 1984 to 2000
- Projected irrigation trends as adopted in the last round of planning
- Draft irrigation trends as supplied by TWDB to the regions in the current round of planning.

TABLE 2: COMPARISON OF IRRIGATION DEMAND PROJECTIONS

	Comparison of 2002 State Water Plan Projections to TWDB Projections from 1997 Census figures (positive indicates 2002 plan estimates exceed the 1997 estimates)			*Comparison of TWDB projections for 2nd round of planning to 2002 State Water Plan Projections (positive indicates second round of planning estimates exceed 2002 projections)*		
	Year			*Year*		
Region	*2000*	*2030*	*2050*	*2000*	*2030*	*2050*
A Total	-263,919	-122,046	-36,185	626,586	626,586	626,586
B Total	34,877	34,045	33,361	-38,294	-36,593	-35,422
C Total	12	12	12	34,771	34,169	33,895
D Total	1,217	1,628	1,340	2,920	2,692	2,822
E Total	0	0	0	195,103	180,703	172,812
F Total	305,637	306,033	305,637	-269,027	-262,966	-258,931
G Total	46	41	38	36,334	32,904	30,876
H Total	39,313	95,194	121,351	-240,558	-233,892	-233,293
I Total	122,038	179,529	185,717	-206,000	-224,193	-223,445
J Total	0	0	0	6,948	6,120	5,628
K Total	61,508	47,456	43,624	-117,538	-103,738	-96,147
L Total	31,887	34,134	33,469	-312,821	-271,189	-248,591
M Total	138,260	-55,287	36,571	-815,077	-629,833	-633,010
N Total	0	0	0	6,662	5,300	4,834
O Total	-463,211	-420,970	-395,533	1,160,010	1,025,950	946,131
P Total	38,748	64,566	79,918	-49,061	-68,252	-80,024
STATE TOTAL	***46,411***	***164,333***	***409,319***	***20,958***	***83,768***	***14,721***

This analysis points to at least three important findings.

FINDING 1

Projected regional irrigation demands for the first round of planning exceed the 1984-2000 median use in ten regions (B, D, F, G, H, I, K, L, M and P).

Figures 1 and 2 (in Appendix II) show the counties where 2030 projected irrigation use is higher than the 1984-2000 historic median use.

Some of these projections are counter-intuitive. For example, in El Paso County and the Lower Rio Grande Valley, urbanization and sale of agricultural water rights to municipal use are strong trends that would seem to portend a decline, not an increase, over historical irrigation use, especially by the year 2030. The only way irrigation water use would increase in the face of these trends would be for water use efficiency to *decrease* or for farmers to expand irrigation of more water intensive crops. Both of these scenarios are highly unlikely, given restrictions on water availability in both regions and the current efforts, particularly in the Lower Rio Grande Valley, to greatly improve irrigation efficiencies.

In other areas, such as the central coastal plain and along the Neches (Region I) and Trinity (Region H), projections *significantly* exceed the 1984-2000 historic median (100 to over 200%). Assuming irrigation efficiency and the crop mix stayed about the same, increased irrigation use would mean **more** not less acreage farmed in 2030 than during the last couple of decades. Given possible future changes in agricultural subsidies and price supports, growing municipal demand for water, international trade factors, an aging farming population and offers from municipal or other users to buy agricultural water, it seems doubtful that such significant ***increases*** in irrigation use will actually occur, even in these wetter regions of the state.[12]

Region F is also showing large increases in projected irrigation use over the next 30 years.

[12] See, e.g., Ric Jensen, "What is the Future of Rice Irrigation?" in Water Research, vol. 25, no. 4 (College Station, Texas A&M University, Texas Water Resources Institute), available at http://twri.tamu.edu/twripubs/WtrResrc/v25n4/text-1.html. Rice acreage in Texas has declined from a peak of about 600,000 acres to just over 200,000 acres. This is not to discount the importance of rice growing to the rural economies and livelihoods in these regions—it is merely to note that a large expansion in irrigated rice acreage does not seem likely to occur.

Even in the Panhandle region, where the Ogallala aquifer is declining rapidly and farmers are mostly growing cotton and sorghum or other crops that depend on large federal farm subsidies, some counties are projected to see a significant increase in irrigation water use by 2030, as compared to the historic median from the last two decades. Again, this seems unlikely to actually occur.

As TWDB noted in its description of the irrigation projection model:

> *"Irrigated acreage development peaked in Texas in 1974 with 8.6 million acres of irrigated cropland. Since that time, irrigated acreage has declined by more than 2.5 million acres, with a corresponding decline in on-farm water use of more than 3.0 million acre-feet. There are a number of factors associated with this declining trend, including more acreage being set aside for compliance with federal farm programs, poor economic conditions in the agricultural sector during the last ten years, a decline in the number and size of farms, technological advancements in crop production, advancement and implementation of more water efficient irrigation systems, and better irrigation management practices."* (Texas Water Development Board, 1997 State Water Plan, Appendix III).

These realities seem to be better reflected in other areas of the state, as shown in Figures 1 and 2 (in Appendix II).

FINDING 2

If, in fact, irrigation demand predictions in these regions are over-stated, then there is significantly more water available to satisfy other needs than the 2002 State Water plan contemplates.

Table 2 provides an estimate of how much water might be available.

This analysis implies that there is an important opportunity in the second round of regional planning: **more realistic irrigation use projections may identify significant amounts of water that can be used to meet municipal, manufacturing and environmental water needs**. This is particularly important in the El Paso area and along the coast where freshwater inflows are needed to protect bays and estuaries. Using existing supplies can avoid the need for expensive new reservoirs, pipelines or desalination projects.

FINDING 3

The first round projections do not include sufficient documentation of how conservation and other factors were incorporated into the demand estimation. Without clear documentation and discussion of these assumptions, it is difficult for the RWPG members and the public to verify the accuracy or assess the rationale for the projections.

RECOMMENDATIONS

The second round of regional water planning now underway provides an opportunity to develop more realistic irrigation demand projections. In order to accomplish this, the Texas Water Development Board and the regional water planning groups should:

- Review the assumptions used to model projected irrigation demands and ensure that all key assumptions are clearly stated and discussed at the regional level;
- Ensure that any adjustments that have the effect of increasing irrigation demand over 1984 to 2000 average median historic use are clearly justified using sound agricultural science and economic principles[13];
- Where assumptions about future market conditions, land use trends or other factors affecting projected irrigation demand are uncertain, develop projected demands for a reasonable range of scenarios; and
- Develop realistic and well-documented assumptions about application of irrigation conservation technologies and the effect adoption of such technologies will have on both projected demand and reduction of projected demand if adopted as a water management strategy.

In addition, TWDB should work with irrigation districts, farmers, agricultural extension agents, the U.S. Department of Agriculture's Natural Resource Conservation Service and others to increase metering of irrigation water use. Increased metering would provide both a more accurate basis for making water demand projections and, as several studies have shown, help farmers reduce water use by 10 to 20%.[14]

[13] The approach taken by Regions A and O provides useful models in this regard.
[14] Guy Fipps, Potential Water Savings in Irrigated Agriculture for The Rio Grande Planning Region—Final Report , Texas A&M University System (College Station, TX; 2000), Table VI-1.

Appendix I – 1997 Texas State Water Plan Excerpt

The following pages include an excerpt from the 1997 Texas State Water Plan, as referred to in the body of this report, that explains the irrigation demand model used in that plan.

Texas, water for mining purposes represents less than one percent of the total water use in Texas. Due to the relatively small quantity of water used in this industry, only one scenario was developed for the mining water use projections.

A number of data sources were used in the development of the mining water use projections. These data sources included published information from the U.S. Bureau of Mines, published reports and information from the Bureau of Economic Geology, annual reports from the Texas Railroad Commission, mineral tax reports from the Texas Comptroller of Public Accounts, and water use information provided by the Board's annual water use survey.

Irrigation Water Use

The Board, with technical assistance from staff of Texas A&M University, developed a linear programming model for use in evaluating and assessing the many factors affecting irrigation water use for the Texas agricultural sector. Linear programming models are based on mathematical techniques for systematically determining solutions for maximizing or minimizing values of linear functions under various variable (resource) constraints. Several types of variables are used in the modeling procedure for determining future irrigation uses by geographical region. More specifically, these variables include crop prices, crop yields, production costs, water costs, and six types of irrigation delivery system costs. These data are crop-specific and reflect the major crops grown within the major agricultural regions in Texas. As part of the revenue stream, Federal farm payments, in the form of deficiency payments, for specific crops and land-set-aside requirements for compliance with Federal farm programs were included in the modeling procedure.

In addition to the variables used in the analysis, specific resource constraints were included to reflect historical acreage, cropping patterns, and water use which correspond to each agricultural region in the state. Constraints developed for each agricultural region included total irrigated acreage, crop-specific acreage, irrigation technology adoption, and the amount of water that could be applied over a specific time. Once the most profitable combination of irrigated and dryland production was estimated, along with the quantities of water required for that level of production, the regional projections were distributed to each county by apportioning a county's share of the regional acreage and water use.

Three forecast scenarios were selected from many scenarios for presentation in the Water Plan (see Exhibit 2-8). Scenario II was selected by the Technical Advisory Committee as the recommended scenario for water supply plan-

Exhibit 2-8
Irrigation Water Use Forecasting Scenarios

Three growth-related scenarios were defined for forecasting irrigation water use that included:

- No new water conservation practices and no reduction in Federal farm program subsidies.
- Expected case water conservation practices and no reduction in Federal farm program subsidies.
- Advanced case water conservation practices and reduction in Federal farm program subsidies by 1/2.

ning purposes. Scenario II includes changes over time in crop prices, crop yields, and production costs, Federal farm payments are held constant over the planning period, and an expected case irrigation technology is assumed.

The model incorporates more efficient water-conserving irrigation technology over time as it becomes economical to do so. In fact in some cases, advanced water conservation measures, such as Low Energy Precision Application (LEPA) irrigation systems, were brought on so quickly by the model (looking purely at economics), it did not well mirror the reality of the recent spread of such technology. The significant capital cost of such irrigation systems, high levels of farm debt, land suitability, lack of knowledge by some farmers of such systems, reticence to change, and other factors have slowed the proliferation of such water-efficient irrigation technology.

For the expected case irrigation forecasts, the rate of implementation of advanced conservation technology was slowed somewhat to reflect these institutional impediments. For the expected case irrigation forecasts, the rate of implementation of advanced conservation technology was slowed to reflect these institutional impediments by allowing a fixed percentage of irrigated acreage to be converted to more efficient technology for each decade. The conversion rate to more efficient technology was determined by irrigation specialists familiar with the irrigation characteristics of each area.

Major data sources used to develop the irrigation water use projections included regional crop budgets prepared by Texas A&M University, Texas historical crop statistics prepared by the Texas Agricultural Statistics Service, surveys of irrigation in Texas prepared through a cooperative effort by the Board, Texas State Soil and Water Conservation Board, and the U.S. Natural Resources Conservation Services, projected crop prices and yields prepared by the Food and Agricultural Policy Institute at the University of Iowa and University of Missouri-Columbia, projected energy prices prepared by the U.S. Department of Energy, and a number of other research publications.

Federal farm programs and policies play a major role in the actions of individual farmers and the decisions that are made in relation to food and fiber production. Changes in farm program policies and payments, set-a-side requirements, quotas, and other policies could deviate from the underlying assumptions of the consensus irrigation water use projections. The consensus planning staff will continue to monitor changes of Federal farm policies and programs in order to maintain an up-to- date series of projections for the Texas irrigated agricultural sector.

Livestock Water Use

Estimating free-range livestock water consumption is a straightforward procedure that consists of calculating water consumption per livestock unit and the total number of livestock. The Texas Agricultural Extension Service provided information on water use rates, calculated as gallons per head per day for each type of livestock including cattle and calves, poultry, sheep and lambs, and hogs and pigs. The Texas Agricultural Statistics Service provided current and historical numbers of livestock by type and county. Water use rates were then applied to the number of livestock by type and county. For those counties where the number of livestock was unavailable, historical livestock

Figure 1 – Projected Irrigation Water Use in Year 2030
Relative to the Historic Median of Irrigation Water Use

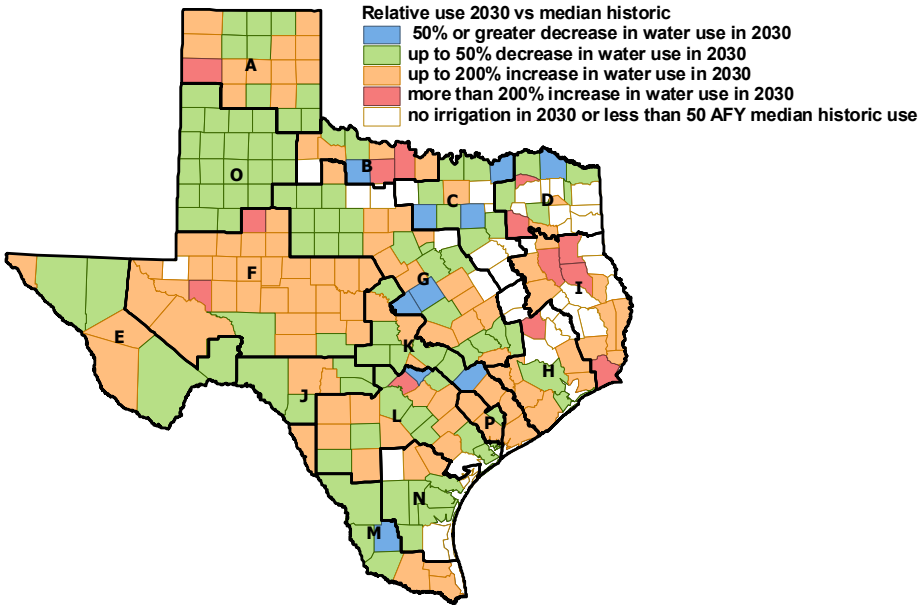


Figure 2 – Projected Change in Irrigation Water Use in
2030 Compared to Historic Median Irrigation Water Use

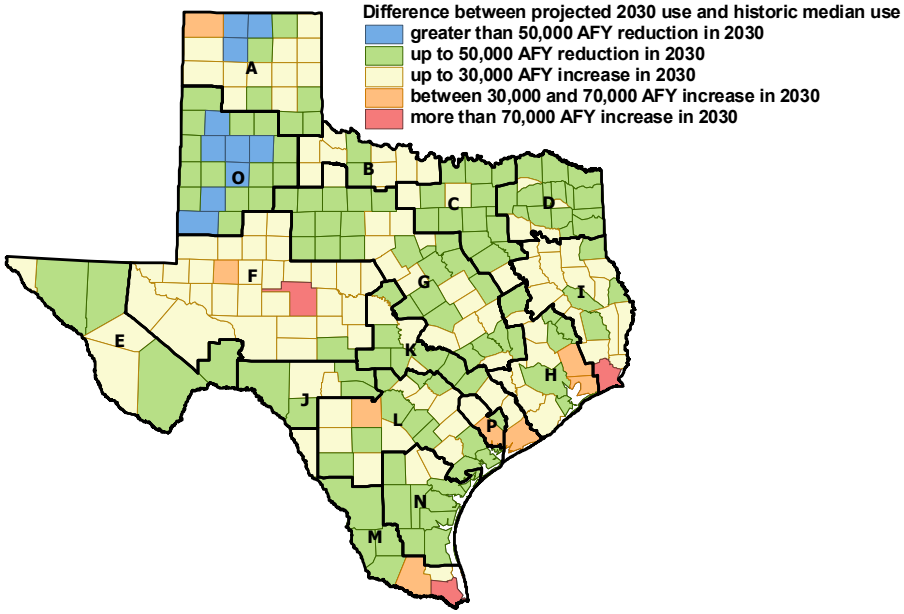


Figure 3 - Region A

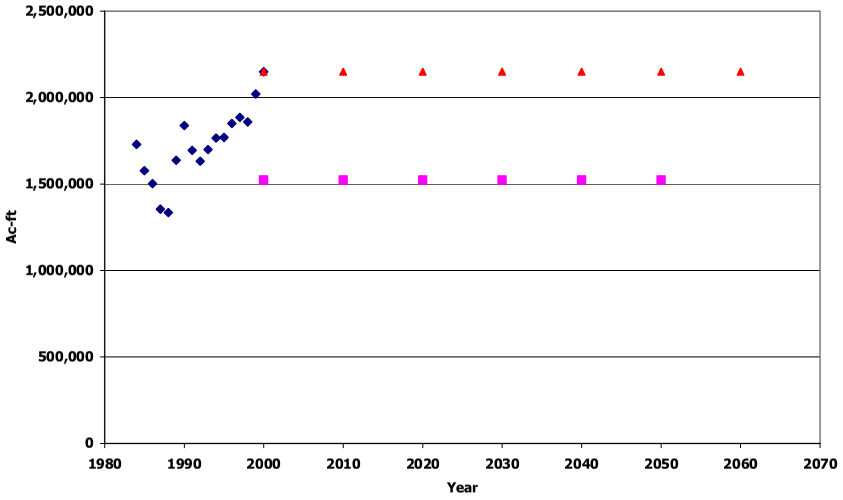


Figure 4 - Region B

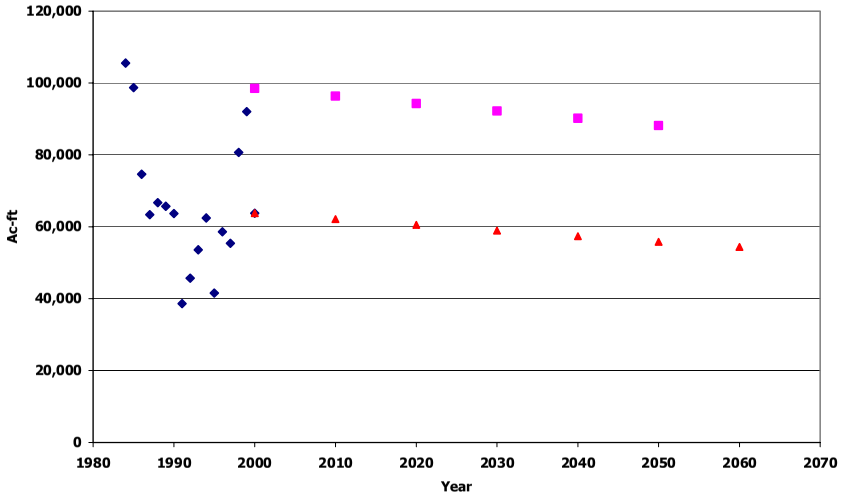


Figure 5 - Region C

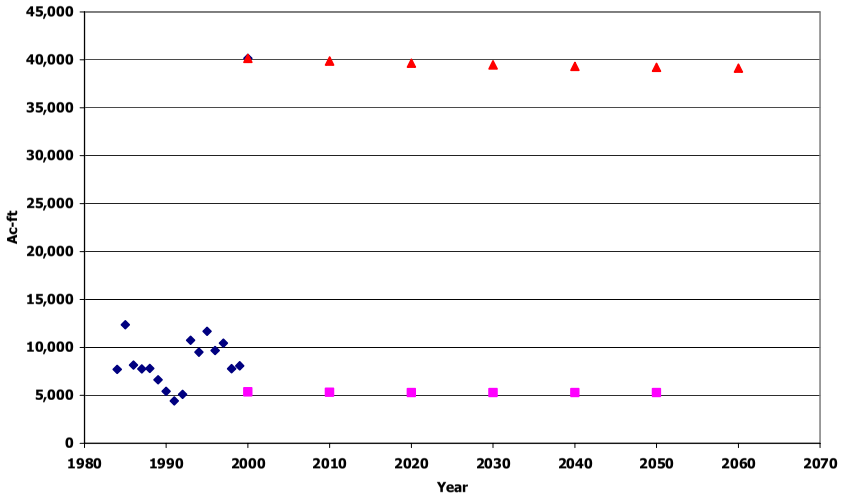
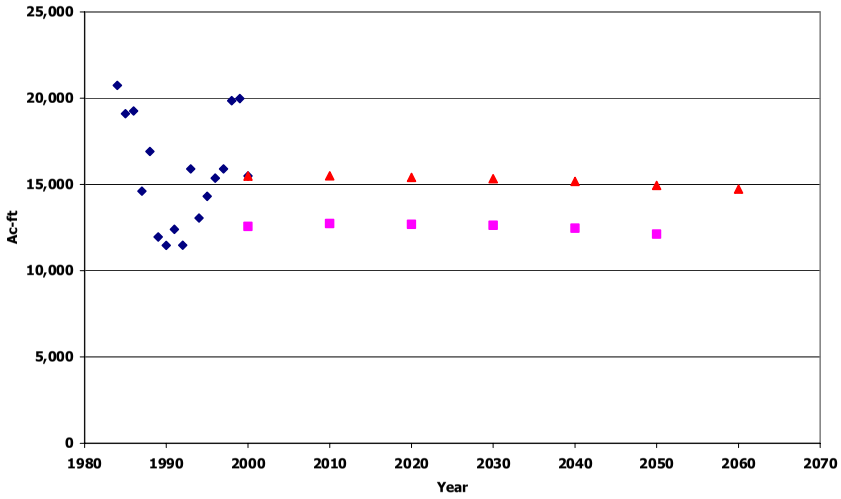


Figure 6 - Region D



◆ **Historic irrigation use** ■ **Projected demand in 2002 plan** ▲ **Revised 2006 irrigation projection**

Figure 7 - Region E

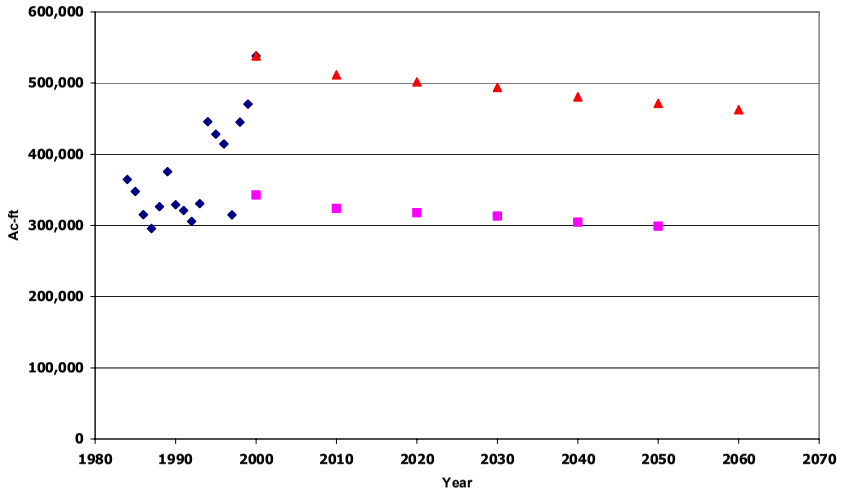


Figure 8 - Region F

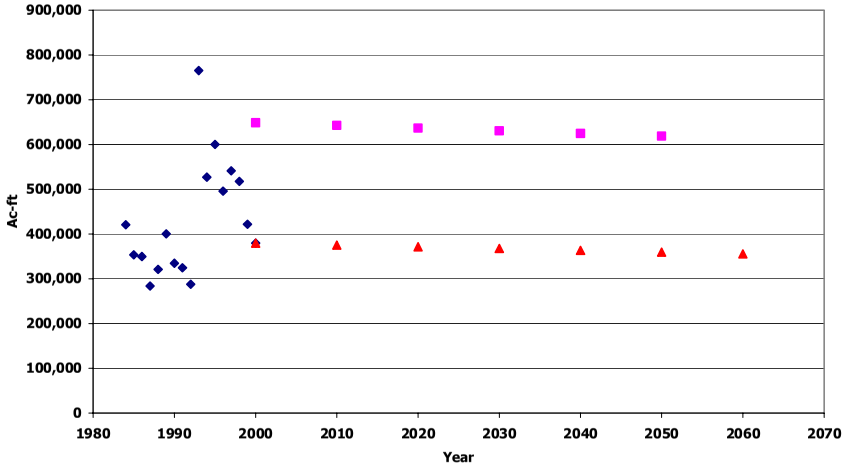


Figure 9 - Region G

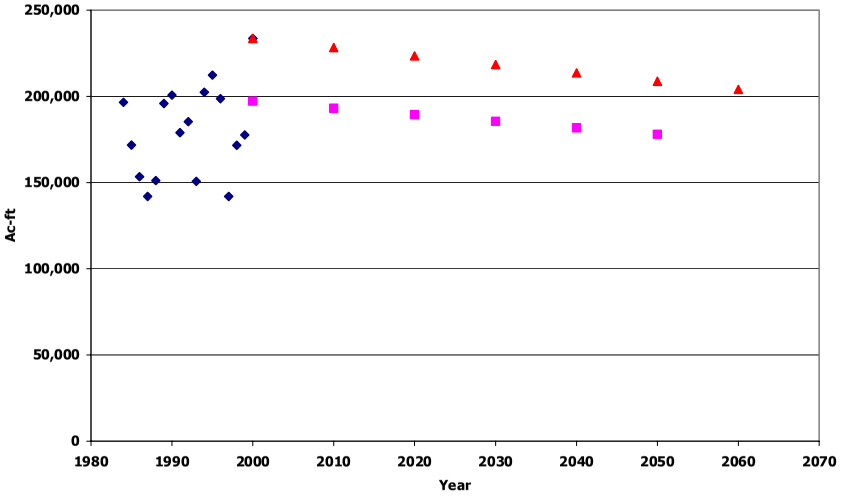
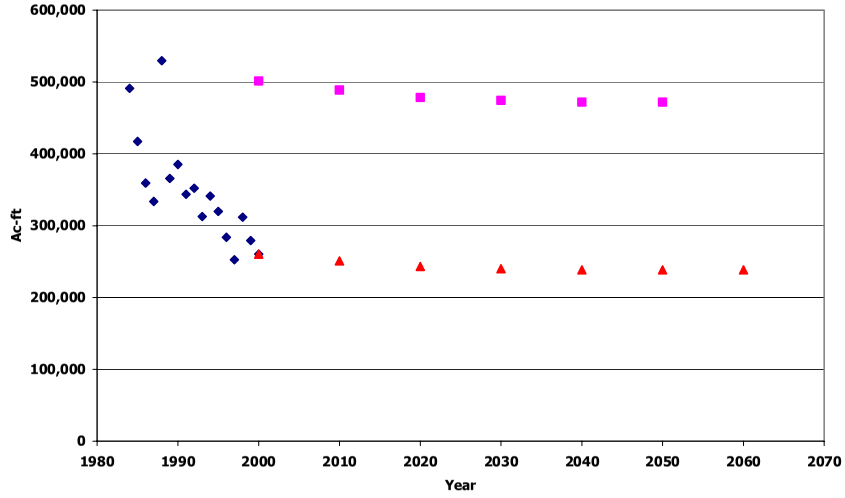


Figure 10 - Region H



◆ **Historic irrigation use** ■ **Projected demand in 2002 plan** ▲ **Revised 2006 irrigation projection**

Figure 11 - Region I

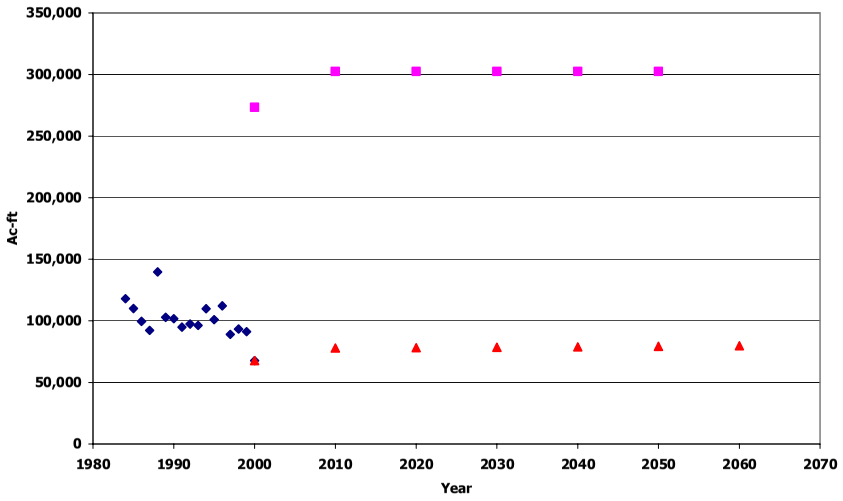


Figure 12 - Region J

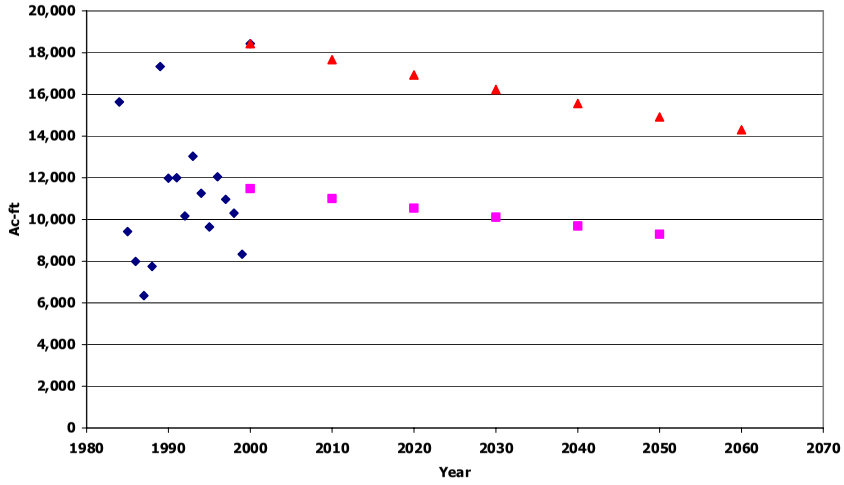


Figure 13 - Region K

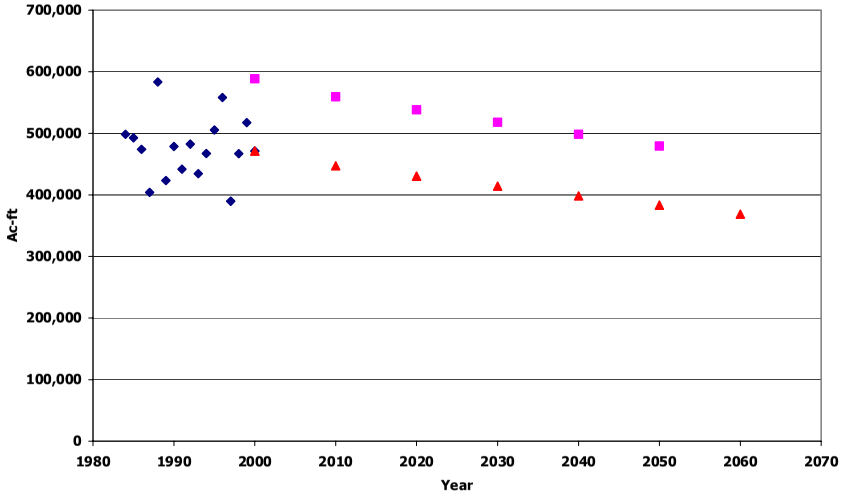
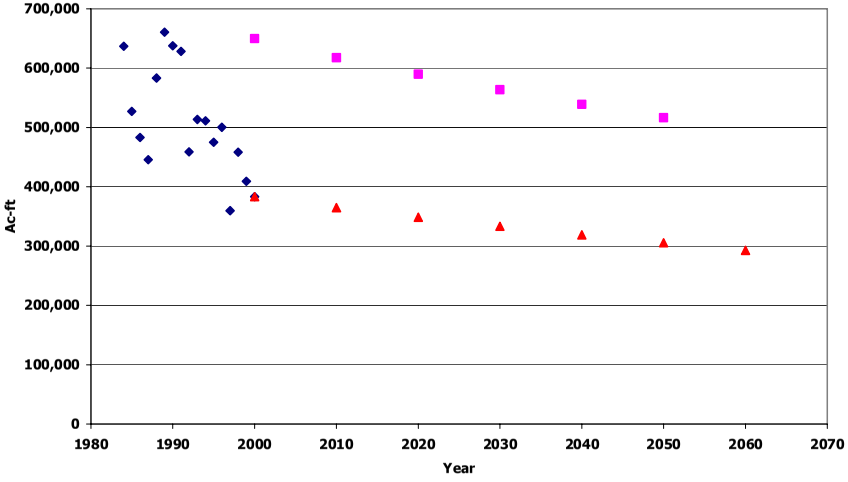


Figure 14 - Region L



◆ **Historic irrigation use** ■ **Projected demand in 2002 plan** ▲ **Revised 2006 irrigation projection**

Figure 15 - Region M

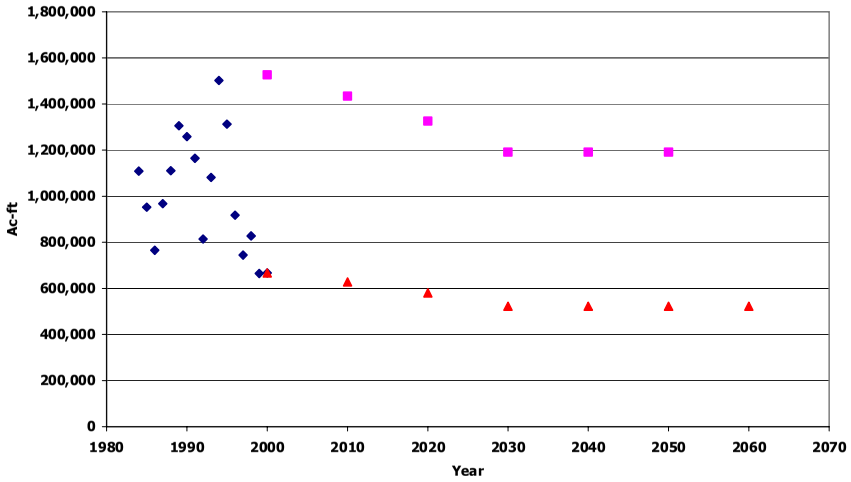


Figure 16 - Region N

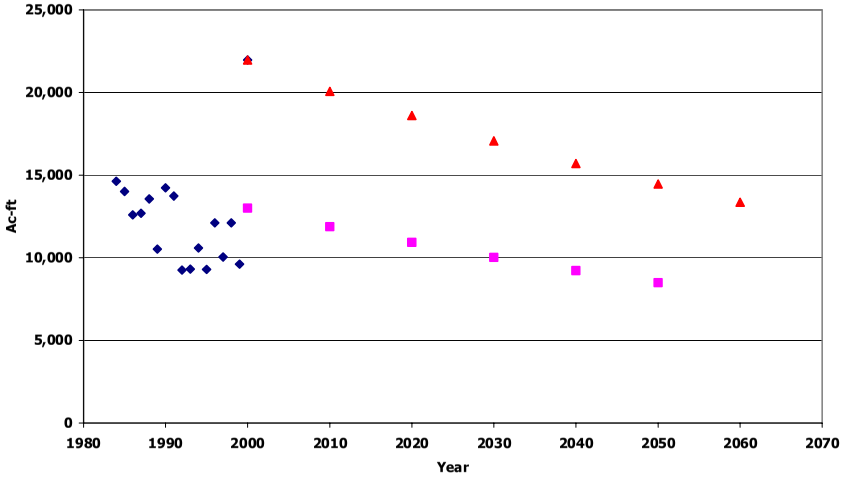


Figure 17 - Region O

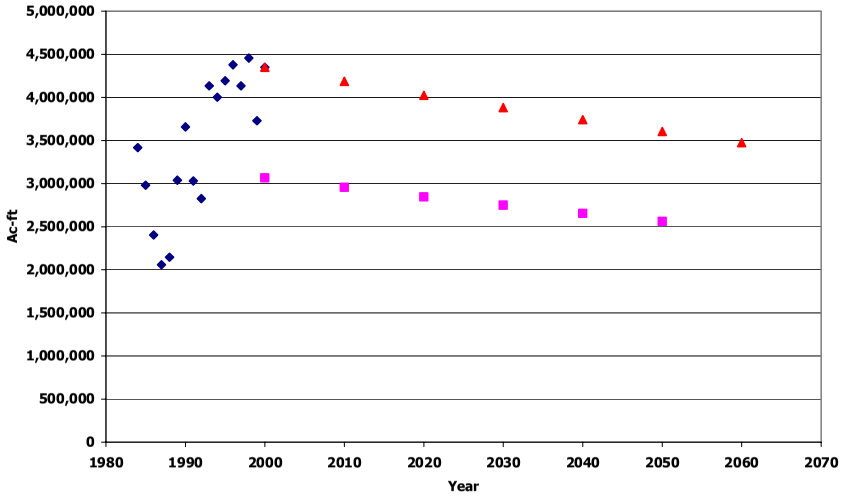
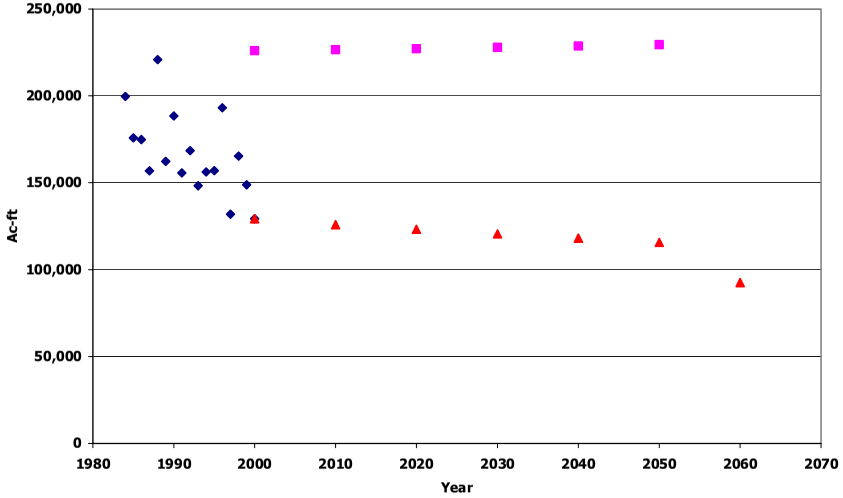


Figure 18 - Region P



◆ **Historic irrigation use** ■ **Projected demand in 2002 plan** ▲ **Revised 2006 irrigation projection**

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