Socioeconomic Impacts of Unmet Water Needs in the Rio Grande Water Planning Area

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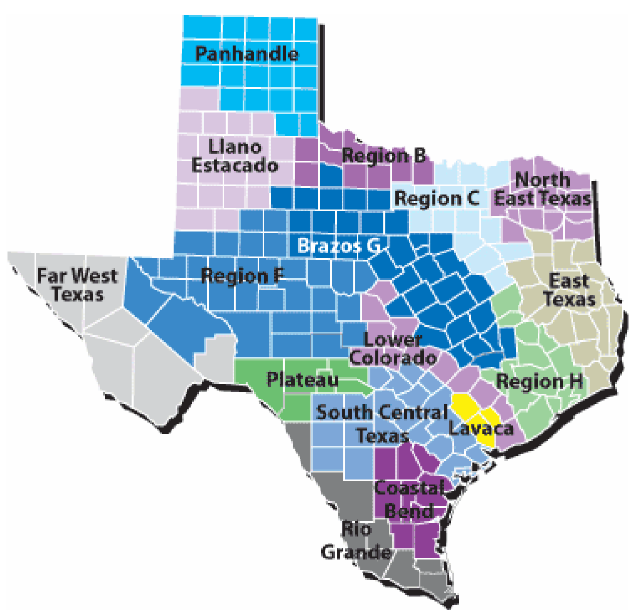

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Background

Water shortages due to severe drought combined with infrastructure limitations would likely curtail or eliminate economic activity in business and industries heavily reliant on water. For example, without water farmers cannot irrigate; refineries cannot produce gasoline and paper mills cannot make paper. Unreliable water supplies would not only have an immediate and real impact on business and industry, but they might also bias corporate decision makers against plant expansion or plant location in Texas. From a societal perspective, water supply reliability is critical as well. Shortages would disrupt activity in homes, schools and government and could adversely affect public health and safety. For all of the above reasons, it is important to analyze and understand how restricted water supplies during drought could affect communities throughout the state.

Section 357.7(4) of the rules for implementing Texas Senate Bill 1 requires regional water planning groups to evaluate the social and economic impacts of projected water shortages (i.e., "unmet water needs") as part of the planning process. The rules contain provisions that direct the Texas Water Development Board (TWDB) to provide technical assistance to complete socioeconomic impact assessments. In response to requests from regional planning groups, staff of the TWDB's Office of Water Resources Planning designed and conducted analyses to evaluate socioeconomic impacts of unmet water needs.

Overview of Methodology

Two components make up the overall approach to this study: 1) an economic impact module and 2) a social impact module. Economic analysis addresses potential impacts of unmet water needs including effects on residential water consumers and losses to regional economies stemming from reductions in economic output for agricultural, industrial and commercial water uses. Impacts to agriculture, industry and commercial enterprises were estimated using regional "input-output" models commonly used by researchers to estimate how reductions in business activity might affect a given economy. Estimated impacts are *independent* and distinct "what if" scenarios for a given point in time (i.e., 2010, 2020, 2030, 2040, 2050 and 2060). Reported figures are scenarios that illustrate what could happen in a given year if: 1) water supply infrastructure and/or water management strategies do not change through time, 2) the drought of record recurs. Details regarding the methodology and assumptions for individual water use categories (i.e., municipal consumers including residential and commercial water users, manufacturing, steam-electric, mining, and agriculture) are in the main body of the report.

The social component focuses on demographic effects including changes in population and school enrollment. Methods are based on population projection models developed by the TWDB for regional and state water planning. With the assistance of the Texas State Data Center, TWDB staff modified these models and applied them for use here. Basically, the social impact module incorporates results from the economic impact module and assesses how changes in a region's economy due to water shortages could affect patterns of migration in a region.

Summary of Results

Table E-1 and Figure E-1 summarize estimated economic impacts. Variables shown include:[1]

- **sales** - economic output measured by sales revenue;
- **jobs -** number of full and part-time jobs required by a given industry including self-employment;
- **regional income -** total payroll costs (wages and salaries plus benefits) paid by industries, corporate income, rental income and interest payments for the region; and
- **business taxes -** sales, excise, fees, licenses and other taxes paid during normal operation of an industry (does not include any type of income tax).

If drought of record conditions return and water supplies are not developed, study results indicate that the Region M Water Planning Area would suffer significant losses. If such conditions occurred 2010 lost income to residents in the region could total $186 million with associated job losses as high 4,625. State and local governments could lose nearly $6 million in tax receipts. If such conditions occurred in 2060, income losses could run $2,044 million, and job losses could be as high as 27,760. Nearly $77 million worth of state and local taxes would be lost. Reported figures are probably conservative because they are based on estimated costs for a single year; but in much of Texas, the drought of record lasted several years. For example, in 2030 models indicate that shortages would cost residents and businesses in the region $893 million in lost income. Thus, if shortages lasted for three years total losses related to unmet needs could easily approach $2,680 million.

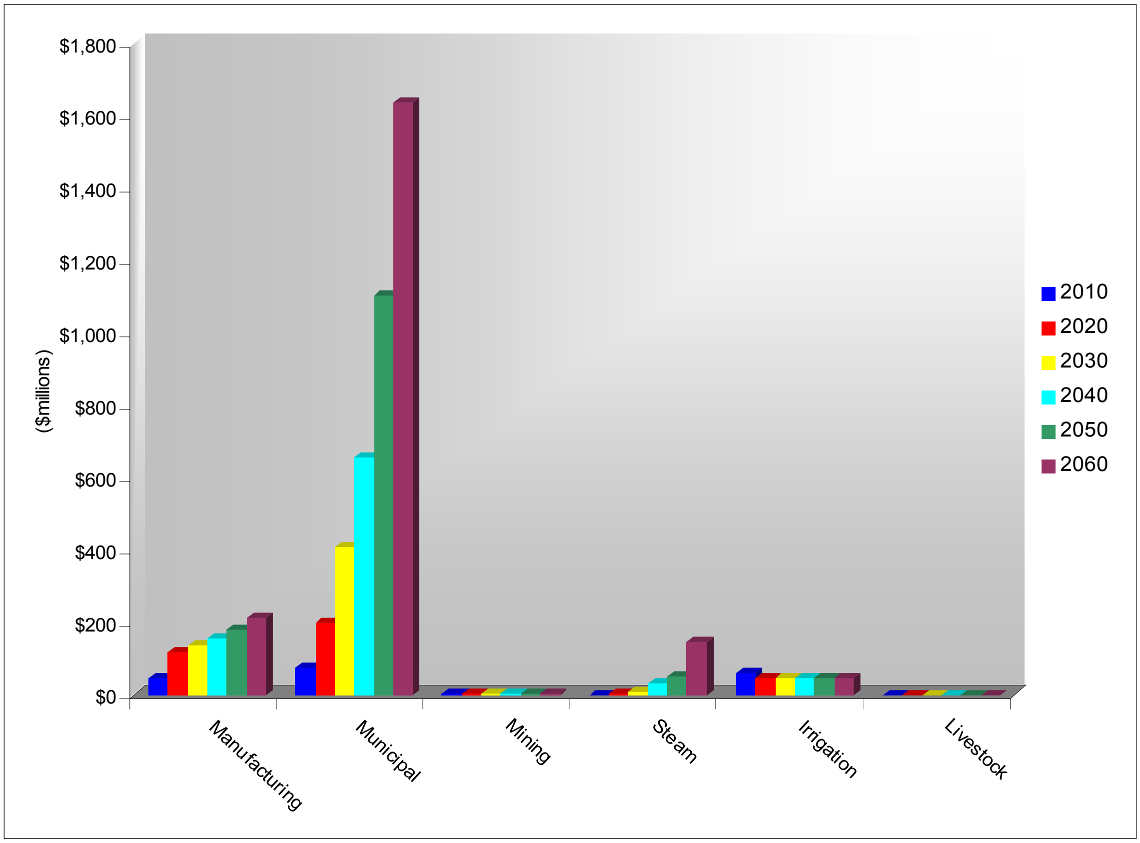
Table E-1: Annual Economic Impacts of Unmet Water Needs
(years, 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)

Year	Sales ($millions)	Income ($millions)	Jobs	State and Local Taxes ($millions)
2010	$367.98	$186.14	4,625	$6.20
2020	$621.86	$366.28	6,205	$10.09
2030	$1,105.68	$602.26	9,475	$18.60
2040	$1,136.76	$893.15	12,380	$28.24
2050	$1,598.58	$1,383.05	18,990	$44.98
2060	$2,257.03	$2,044.10	27,760	$76.96

Source: Texas Water Development Board, Office of Water Resources Planning

[1] When summed to a regional level, total sales across all sectors are not a good measure of economic prosperity because they include sales to other industries for further processing. For example, a farmer sells rice to a rice mill, which the rice mill processes and sells it to another consumer. Both transactions are counted in an input-output model. Thus, total sales “double count.” Regional income plus business taxes are more suitable because they are a better measure of net economic returns.

Figure E-1: Distribution of Lost Income by Water Use Category
(years: 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)



Source: Texas Water Development Board Office of Water Resources Planning

Table E-2 shows potential losses in population and school enrollment. Changes in population stem directly from the number of lost jobs estimated as part of the economic impact module. In other words, many – but not all - people would likely relocate due to a job loss and some have families with school age children. Section 1.3 in the main body of the report discusses methodology in detail.

Table E-2: Estimated Regional Social Impacts of Unmet Water Needs
(years, 2010, 2020, 2030, 2040, 2050 and 2060)

Year	Population Losses	Declines in School Enrollment
2010	12,150	3,160
2020	16,500	4,280
2030	19,070	4,950
2040	24,770	6,420
2050	34,650	8,980
2060	53,160	13,790

Source: Based on models developed by the Texas Water Development Board, Office of Water Resources Planning and the Texas State Data Center.

Introduction

Texas is one the nation's fastest growing states. From 1950 to 2000, population in the state grew from about 8 million to nearly 21 million. By the year 2050, the total number of people living in Texas is expected to reach 40 million. Rapid growth combined with Texas' susceptibility to severe drought makes water supply a crucial issue. If water infrastructure and water management strategies are not improved, Texas could face serious social, economic and environmental consequences - not only in our large metropolitan cities, but also on our farms and rural areas.

Water shortages due to severe drought combined with infrastructure limitations would likely curtail or eliminate economic activity in business and industries heavily reliant on water. For example, without water farmers cannot irrigate; refineries cannot produce gasoline and paper mills cannot make paper. Unreliable water supplies would not only have an immediate and real impact on business and industry, but they might also bias corporate decision makers against plant expansion or plant location in Texas. From a societal perspective, water supply reliability is critical as well. Shortages would disrupt activity in homes, schools and government and could adversely affect public health and safety. For all of the above reasons, it is important to analyze and understand how restricted water supplies during drought could affect communities throughout the state.

Section 357.7(4) of the rules for implementing Texas Senate Bill 1 requires regional water planning groups to evaluate the social and economic impacts of unmet water needs as part of the planning process. The rules contain provisions that direct the Texas Water Development Board (TWDB) to provide technical assistance to complete socioeconomic impact analyses. In response to requests from regional planning groups, TWDB staff designed and conducted required studies. The following document prepared by the TWDB's Office of Water Resources Planning summarizes analysis and results for the Region H Water Planning Area. Section 1 provides an overview of concepts and methodologies used in the study. Sections 2 and 3 provide detailed information and analyses for each water use category employed in the planning process (i.e., irrigation, livestock, municipal, manufacturing, mining and steam-electric).

1. Overview of Terms and Methodology

Section 1 provides a general overview of how economic and social impacts were measured. In addition, it summarizes important clarifications, assumptions and limitations of the study.

1.1 Measuring Economic Impacts

Economic analysis as it relates to water resources planning generally falls into two broad areas. Supply side analysis focuses on costs and alternatives of developing new water supplies or implementing programs that provide additional water from current supplies. Demand side analysis concentrates on impacts and benefits of providing water to people, businesses and the environment. Analysis in this report focuses strictly on demand side impacts. Specifically, it addresses the potential economic impacts of unmet water needs including: 1) losses to regional economies stemming from reductions in economic output, and 2) costs to residential water consumers associated with implementing emergency water procurement and conservation programs.

1.1.1 Impacts to Agriculture, Business and Industry

As mentioned earlier, severe water shortages would likely affect the ability of business and industry to operate resulting in lost output, which would adversely affect the regional economy. A variety tools are available to estimate such impacts, but by far, the most widely used today are input-output models (IO models) combined with social accounting matrices (SAMs). Referred to as IO/SAM models, these tools formed the basis for estimating economic impacts for agriculture (irrigation and livestock water uses) and industry (manufacturing, mining, steam-electric and commercial business activity for municipal water uses).

Basically, an IO/SAM model is an accounting framework that traces spending and consumption between different economic sectors including businesses, households, government and "foreign" economies in the form of exports and imports. As an example, Table 1 shows a highly aggregated segment of an IO/SAM model that focuses on key agricultural sectors in a local economy. The table contains transactions data for three agricultural sectors (cattle ranchers, dairies and alfalfa farms). Rows in Table 1 reflect sales from each sector to other local industries and institutions including households, government and consumers outside of the region in the form of exports. Columns in the table show purchases by each sector in the same fashion. For instance, the dairy industry buys $11.62 million worth of goods and services needed to produce milk. Local alfalfa farmers provide $2.11 million worth of hay and local households provide about $1.03 million worth of labor. Dairies import $4.17 million worth of inputs and pay $2.61 million in taxes and profits. Total economic activity in the region amounts to about $807.45 million. The entire table is like an accounting balance sheet where total sales equal total purchases.

Table 1: Example of a County-level Transaction and Social Accounting Matrix for Agricultural Sectors ($millions)

Sectors	Cattle	Dairy	Alfalfa	All other Industries	Taxes, govt. & profits	Households	Exports	Total
Cattle	$3.10	$0.01	$0.00	$0.03	$0.02	$0.06	$10.76	$13.98
Dairy	$0.07	$0.13	$0.00	$0.25	$0.01	$0.00	$11.14	$11.60
Alfalfa	$0.00	$2.11	$0.00	$0.01	$0.02	$0.01	$10.38	$12.53
Other industries	$2.20	$1.56	$2.90	$50.02	$70.64	$66.03	$48.48	$241.83
Taxes, govt. & profits	$2.37	$2.61	$5.10	$77.42	$0.23	$49.43	$83.29	$220.45
Households	$0.82	$1.03	$1.38	$50.94	$45.36	$7.13	$14.64	$121.30
Imports	$5.41	$4.17	$3.16	$63.32	$104.17	$5.53	$0.00	$185.76
Total	$13.97	$11.62	$12.54	$241.99	$220.45	$128.19	$178.69	$807.45

* Columns contain purchases and rows represent sales. Source: Adapted from Harris, T.R., Narayanan, R., Englin, J.E., MacDiarmid, T.R., Stoddard, S.W. and Reid, M.E. "*Economic Linkages of Churchill County*." University of Nevada Reno. May 1993.

To understand how an IO/SAM model works, first visualize that $1 of additional sales of milk is injected into the dairy industry in Table 1. For every $1 the dairies receive in revenue, they spend 18 cents on alfalfa to feed their cows; nine cents is paid to households who provide farm labor, and another 13 cents goes to the category "other industries" to buy items such as machinery, fuel, transportation, accounting services etc. Nearly 22 cents is paid out in the form of profits (i.e., returns to dairy owners) and taxes/fees to local, state and federal government. The value of the initial $1 of revenue in the dairy sector is referred to as a first-round or **direct effect.**

As the name implies, first-round or direct effects are only part of the story. In the example above, alfalfa farmers must make 18 cents worth of hay to supply the increased demand for their product. To do so, they purchase their own inputs, and thus, they spend part of the original 18 cents that they received from the dairies on firms that support their own operations. For example, 12 cents is spent on fertilizers and other chemicals needed to grow alfalfa. The fertilizer industry in turn would take these 12 cents and spend them on inputs in its production process and so on. The sum of all re-spending is referred to as the **indirect effect** of an initial increase in output in the dairy sector.

While direct and indirect impacts capture how industries respond to a change, **induced impacts** measure the behavior of the labor force. As demand for production increases, employees in base industries and supporting industries will have to work more; or alternatively, businesses will have to hire more people. As employment increases, household spending rises. Thus, seemingly unrelated businesses such as video stores, supermarkets and car dealers also feel the effects of an initial change.

Collectively, indirect and induced effects are referred to as **secondary impacts**. In their entirety, all of the above changes (direct and secondary) are referred to as **total economic impacts**. By nature, total impacts are greater than initial changes because of secondary effects. The magnitude of the increase is what is popularly termed a multiplier effect. Input-output models generate numerical multipliers that estimate indirect and induced effects.

In an IO/SAM model impacts stem from changes in output measured by sales revenue that in turn come from changes in consumer demand. In the case of water shortages, one is not assuming a change in demand, but rather a supply shock – in this case severe drought. Demand for a product such as corn has not necessarily changed during a drought. However, farmers in question lack a crucial input (i.e., irrigation water) for which there is no *short-term* substitute. Without irrigation, she cannot grow irrigated crops. As a result, her cash flows decline or cease all together depending upon the severity of the situation. As cash flows dwindle, the farmer's income falls, and she has to reduce expenditures on farm inputs such as labor. Lower revenues not only affect her operation and her employees directly, but they also indirectly affect businesses who sell her inputs such as fuel, chemicals, seeds, consultant services, fertilizer etc.

The methodology used to estimate regional economic impacts consists of three steps: 1) develop IO/SAM models for each county in the region and for the region as whole, 2) estimate direct impacts to economic sectors resulting from water shortages, and 3) calculate total economic impacts (i.e., direct plus secondary effects).

Step 1*: Generate IO/SAM Models and Develop Economic Baseline*

IO/SAM models were estimated using propriety software known as IMPLAN PRO™ (Impact for Planning Analysis). IMPLAN is a modeling system originally developed by the U.S. Forestry Service in the late 1970s. Today, the Minnesota IMPLAN Group (MIG Inc.) owns the copyright and distributes data and software. It is probably the most widely used economic impact model in existence. IMPLAN comes with databases containing the most recently available economic data from a variety of sources.[2] Using IMPLAN software and data, transaction tables conceptually similar to the one discussed previously (see Table 1 on page 7) were estimated for

[2] The basic IMPLAN database consists of national level technology matrices based on the Benchmark Input-Output Accounts generated the U.S. Bureau of Economic Analysis and estimates of final demand, final payments, industry output and employment for various economic sectors. IMPLAN's regional data (i.e. states, a counties or groups of counties within a state) are divided into two basic categories: 1) data on an industry basis including value-added, output and employment and 2) data on a commodity basis including final demands and institutional sales. State-level data are balanced to the national totals using a matrix ratio allocation system and county data are balanced to state totals. In other words, much of the data in IMPLAN is based on a national average for all industries.

each county in the region and for the region as a whole. Each transaction table contains 528 economic sectors and allows one to estimate a variety of economic statistics including:

- **total sales -** total production measured by sales revenues;
- **intermediate sales -** sales to other businesses and industry within a given region;
- **final sales** – sales to end users in a region and exports out of a region;
- **employment -** number of full and part-time jobs (annual average) required by a given industry including self-employment;
- **regional income -** total payroll costs (wages and salaries plus benefits) paid by industries, corporate income, rental income and interest payments; and
- **business taxes -** sales, excise, fees, licenses and other taxes paid during normal operation of an industry (does not include income taxes).

TWDB analysts developed an economic baseline containing each of the above variables using year 2000 data. Since the planning horizon extends through 2060, economic variables in the baseline were allowed to change in accordance with projected changes in demographic and economic activity. Growth rates for municipal water use sectors (i.e., commercial, residential and institutional) are based on TWDB population forecasts. Projections for manufacturing, agriculture, and mining and steam-electric activity are based on the same underlying economic forecasts used to estimate future water use for each category. Monetary impacts in future years are reported in year 2000 dollars.

It is important to stress that employment, income and business taxes are the most useful variables when comparing the relative contribution of an economic sector to a regional economy. Total sales as reported in IO/SAM models are less desirable and can be misleading because they include sales to other industries in the region for use in the production of other goods. For example, if a mill buys grain from local farmers and uses it to produce feed, sales of both the processed feed and raw corn are counted as "output" in an IO model. Thus, total sales double-count or overstate the true economic value of goods and services produced in an economy. They are not consistent with commonly used measures of output such as Gross National Product (GNP), which counts only final sales.

Another important distinction relates to terminology. Throughout this report, the term *sector* refers to economic subdivisions used in the IMPLAN database and resultant input-output models (528 individual sectors based on Standard Industrial Classification Codes). In contrast, the phrase *water use category* refers to water user groups employed in state and regional water planning including irrigation, livestock, mining, municipal, manufacturing and steam electric. All sectors in the IMPLAN database were assigned to a specific water use category (see Attachment A of this report).

Step 2: *Estimate Direct Economic Impacts of Water Shortages*

As mentioned above, direct impacts accrue to immediate businesses and industries that rely on water. Without water industrial processes could suffer. However, output responses would likely vary depending upon the severity of a shortage. A small shortage relative to total water use may have a nominal effect, but as shortages became more critical, effects on productive capacity would increase.

For example, farmers facing small shortages might fallow marginally productive acreage to save water for more valuable crops. Livestock producers might employ emergency culling strategies, or they may consider hauling water by truck to fill stock tanks. In the case of manufacturing, a good example occurred in the summer of 1999 when Toyota Motor Manufacturing experienced water shortages at a facility near Georgetown, Kentucky. As water levels in the Kentucky River fell to historic lows due to drought, plant managers sought ways to curtail water use such as reducing rinse operations to a bare minimum and recycling water by funneling it from paint shops to boilers. They even considered trucking in water at a cost of 10 times what they were paying. Fortunately, rains at the end of the summer restored river levels, and Toyota managed to implement cutbacks without affecting production. But it was a close call. If rains had not replenished the river, shortages could have severely reduced output.[3]

Note that the efforts described above are not planned programmatic or long-term operational changes. They are emergency measures that individuals might pursue to alleviate what they consider a temporary condition. Thus, they are not characteristic of long-term management strategies designed to ensure more dependable water supplies such as capital investments in conservation technology or development of new water supplies.

To account for uncertainty regarding the relative magnitude of impacts to farm and business operations, the following analysis employs the concept of elasticity. Elasticity is a number that shows how a change in one variable will affect another. In this case, it measures the relationship between a percentage reduction in water availability and a percentage reduction in output. For example, an elasticity of 1.0 indicates that a 1.0 percent reduction in water availability would result in a 1.0 percent reduction in economic output. An elasticity of 0.50 would indicate that for every 1.0 percent of unavailable water, output is reduced by 0.50 percent and so on. Output elasticities used in this study are:[4]

- if unmet water needs are 0 to 5 percent of total water demand, no corresponding reduction in output is assumed;

- if water shortages are 5 to 30 percent of total water demand, for every 1.0 one percent of unmet need, there is a corresponding 0.25 percent reduction in output;

- if water shortages are 30 to 50 percent of total water demand, for every 1.0 one percent of unmet need, there is a corresponding 0.50 percent reduction in output; and

- if water shortages are greater than 50 percent of total water demand, for every 1.0 one percent of unmet need, there is a corresponding 1.0 percent (i.e., a proportional reduction).

Once output responses to water shortages were estimated, direct impacts to total sales, employment, regional income and business taxes were derived using regional level economic multipliers estimating using IO/SAM models. When calculating direct effects for the municipal, steam electric, manufacturing and livestock water use categories, sales to final demand were applied to avoid double counting impacts. The formula for a given IMPLAN sector is:

$$D_{i,t} = Q_{i,t} *_{,} S_{i,t} * E_Q * RFD_i * DM_{i(Q, L, I, T)}$$

where:

[3] See, Royal, W. "*High And Dry - Industrial Centers Face Water Shortages*." in Industry Week, Sept, 2000.

[4] Elasticities are based on one of the few empirical studies that analyze potential relationships between economic output and water shortages in the United States. The study, conducted in California, showed that a significant number of industries would suffer reduced output during water shortages. Using a survey based approach researchers posed two scenarios to different industries. In the first scenario, they asked how a 15 percent cutback in water supply lasting one year would affect operations. In the second scenario, they asked how a 30 percent reduction lasting one year would affect plant operations. In the case of a 15 percent shortage, reported output elasticities ranged from 0.00 to 0.76 with an average value of 0.25. For a 30 percent shortage, elasticities ranged from 0.00 to 1.39 with average of 0.47. For further information, see, California Urban Water Agencies, "*Cost of Industrial Water Shortages*." Prepared by Spectrum Economics, Inc. November, 1991.

$D_{i,t}$ = direct economic impact to sector *i* in period *t*

$Q_{i,t}$ = total sales for sector *i* in period *t* in an affected county

$RFD_{i,}$ = ratio of final demand to total sales for sector *i* for a given region

$S_{i,t}$ = water shortage as percentage of total water use in period *t*

E_Q = elasticity of output and water use

$DM_{i(L, I, T)}$ = direct output multiplier coefficients for labor (L), income (I) and taxes (T) for sector *i*.

Direct impacts to irrigation and mining are based upon the same formula; however, total sales as opposed to final sales were used. To avoid double counting, secondary impacts in sectors other than irrigation and mining (e.g., manufacturing) were reduced by an amount equal to or less than direct losses to irrigation and mining. In addition, in some instances closely linked sectors were moved from one water use category to another. For example, although meat packers and rice mills are technically manufacturers, in some regions they were reclassified as either livestock or irrigation. All direct effects were estimated at the county level and then summed to arrive at a regional figure. See Section 2 of this report for additional discussion regarding methodology and caveats used when estimating direct impacts for each water use category.

Step 3: *Estimate Secondary and Total Economic Impacts of Water Shortages*

As noted earlier, the effects of reduced output would extend well beyond sectors directly affected. Secondary impacts were derived using the same formula used to estimate direct impacts; however, regional level *indirect* and *induced* multiplier coefficients were applied and only final sales were multiplied.

1.1.2 Impacts Associated with Domestic Water Uses

IO/SAM models are not well suited for measuring impacts of shortages for domestic uses, which make up the majority of the municipal category.[5] To estimate impacts associated with domestic uses, municipal water demand and thus needs were subdivided into two categories – residential and commercial. Residential water is considered “domestic” and includes water that people use in their homes for things such as cooking, bathing, drinking and removing household waste and for outdoor purposes including lawn watering, car-washing and swimming pools. Shortages to residential uses were valued using a tiered approach. In other words, the more severe the shortage, the more costly it becomes. For instance, a 2 acre-foot shortage for a group of households that use 10 acre-feet per year would not be as severe as a shortage that amounted to 8 acre-feet. In the case of a 2 acre-foot shortage, households would probably have to eliminate some or all outdoor water use, which could have implicit and explicit economic costs including losses to the horticultural and landscaping industry. In the case of an 8 acre-foot shortage, people would have to forgo all outdoor water use and most indoor water consumption. Economic costs would be much higher in this case because people could probably not live with such a reduction, and would be forced to find emergency alternatives. The alternative assumed in this study is a very uneconomical and worst-case scenario (i.e., hauling water in from other communities by truck or rail). Section 2.3.3 of this report discusses methodology for municipal uses in greater detail.

[5] A notable exception is the potential impacts to the nursery and landscaping industry that could arise due to reductions in outdoor residential uses and impacts to “water intensive” commercial businesses (see Section 2.3.3).

1.2 Measuring Social Impacts

As the name implies, the effects of water shortages can be social or economic. Distinctions between the two are both semantic and analytical in nature – more so analytic in the sense that social impacts are much harder to measure in quantitative terms. Nevertheless, social effects associated with drought and water shortages usually have close ties to economic impacts. For example, they might include:

- demographic effects such as changes in population,
- disruptions in institutional settings including activity in schools and government,
- conflicts between water users such as farmers and urban consumers,
- health-related low-flow problems (e.g., cross-connection contamination, diminished sewage flows, increased pollutant concentrations),
- mental and physical stress (e.g., anxiety, depression, domestic violence),
- public safety issues from forest and range fires and reduced fire fighting capability,
- increased disease caused by wildlife concentrations,
- loss of aesthetic and property values, and
- reduced recreational opportunities.[6]

Social impacts measured in this study focus strictly on demographic effects including changes in population and school enrollment. Methods are based on models used by the TWDB for state water planning and by the U.S. Census Bureau for national level population projections. With the assistance of the Texas State Data Center (TSDC), TWDB staff modified population projection models used for state water planning and applied them here. Basically, the social impact model incorporates results from the economic component of the study and assesses how changes in labor demand due to unmet water needs could affect migration patterns in a region. Before discussing particulars of the approach model, some background information regarding population projection models is useful in understanding the overall approach.

1.2.1 Overview of Demographic Projection Models

More often than not, population projections are reported as a single number that represents the size of an overall population. While useful in many cases, a single number says nothing about the composition of projected populations, which is critical to public officials who must make decisions regarding future spending on public services. For example, will a population in the future have more elderly people relative to today, or will it have more children? More children might mean that more schools are needed. Conversely, a population with a greater percentage of elderly people may need additional healthcare facilities. When projecting future populations, cohort-survival models break down a population into groups (i.e., cohorts) based on factors such as age, sex and race. Once a population is separated into cohorts, one can estimate the magnitude and composition of future population changes.

Changes in a population's size and makeup in survival cohort models are driven by three factors:

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[6] Based on information from the website of the National Drought Mitigation Center at the University of Nebraska Lincoln. Available online at: http://www.drought.unl.edu/risk/impacts.htm. See also, Vanclay, F. "*Social Impact Assessment*." in Petts, J. (ed) International Handbook of Environmental Impact Assessment. 1999.

1. *Births:* Obviously, more babies mean more people. However, only certain groups in a population are physically capable of bearing children– typically women between the ages of 13 and 49. The U.S. Census Bureau and the TSDC continually updates fertility rates for different cohorts. For each race/ethnicity category, birth rates decline and then stabilize in the future.

2. *Deaths:* When people die, populations shrink. Unlike giving birth, however, everyone is capable of dying and mortality rates are applied to all cohorts in a given population. Hence their name, cohort-survival models use survival rates as opposed to mortality rates. A survival rate is simply the probability that a given person with certain attributes (i.e., race, age and sex) will survive over a given period of time.

3. *Migration*: Migration is the movement of people in or out of a region. Migration rates used to project future changes in a region are usually based on historic population data. When analyzing historic data, losses or increases that are not attributed to births or deaths are assumed to be the result of migration. Migration can be further broken down into changes resulting from economic and non-economic factors. Economic migrants include workers and their families that relocate because of job losses (or gains), while non-economic migrants move due to lifestyles choices (e.g., retirees fleeing winter cold in the nation's heartland and moving to Texas).

In summary, knowledge of a population's composition in terms of age, sex and race combined with information regarding birth and survival rates, and migratory patterns, allows a great deal of flexibility and realism when estimating future populations. For example, an analyst can isolate population changes due to deaths and births from changes due to people moving in and out of a region. Or perhaps, one could analyze how potential changes in medical technology would affect population by reducing death rates among certain cohorts. Lastly, one could assess how changes in *economic conditions* might affect a regional population

1.2.2 Methodology for Social Impacts

Two components make up the model. The first component projects populations for a given year based on the following six steps:

1) *Separate "special" populations from the "general" population of a region:* The general population of a region includes the portion subject to rates of survival, fertility, economic migration and non-economic migration. In other words, they live, die, have children and can move in and out of a region freely. "Special populations," on the other hand, include college students, prisoners and military personnel. Special populations are treated differently than the general population. For example, fertility rates are not applied to prisoners because in general inmates at correctional facilities do not have children, and they are incapable of freely migrating or out of a region. Projections for special populations were compiled by the TSDC using data from the Higher Education Coordinating Board, the Texas Department of Criminal Justice and the U.S. Department of Defense. Starting from the 2000 Census, general and special populations were broken down into the following cohorts:

• age cohorts ranging from age zero to 75 and older,
• race/ethnicity cohorts, including Anglo, Black, Hispanic and "other," and
• gender cohorts (male and female).

2) *Apply survival and fertility rates to the general population* : Survival and fertility rates were compiled by the TSDC with data from the Texas Department of Health (TDH). Natural decreases (i.e., deaths) are estimated by applying survival rates to each cohort and then subtracting estimated deaths from the total population. Birth rates were then applied to females in each age

and race cohort in general and special populations (college and military only) to arrive at a total figure for new births.

3) *Estimate economic migration based on labor supply and demand*: TSDC year 2000 labor supply estimates include all non-disabled and non-incarcerated civilians between the ages of 16 and 65. Thus, prisoners are not included. Labor supply for years beyond 2001 was calculated by converting year 2000 data to rates according to cohort and applying these rates to future years. Projected labor demand was estimated based on historical employment rates. Differences between total labor supply and labor demand determines the amount of in or out migration in a region. If supply is greater than demand, there is an out-migration of labor. Conversely, if demand is greater than supply, there is an in-migration of labor. The number of migrants does not necessarily reflect total population changes because some migrants have families. To estimate how many people might accompany workers, a migrant worker profile was developed based on the U.S. Census Bureau's Public Use Microdata Samples (PUMs) data. Migrant profiles estimate the number of additional family members, by age and gender that accompany migrating workers. Together, workers and their families constitute economic migration for a given year.

4) *Estimate non-economic migration*: As noted previously, migration patterns of individuals age 65 and older are generally independent of economic conditions. Retirees usually do not work, and when they relocate, it is primarily because of lifestyle preferences. Migratory patterns for people age 65 or older are based on historical PUMs data from the U.S. Census.

5) *Calculate ending population for a given year*: The total year-ending population is estimated by adding together: 1) surviving population from the previous year, 2) new births, 3) net economic migration, 4) net non-economic migration and 5) special populations. This figure serves as the baseline population for the next year and the process repeats itself.

The second component of the social impact model is identical to the first and includes the five steps listed above for each year where water shortages are reported (i.e., 2010, 2020, 2030, 2040, 2050 and 2060). The only difference is that labor demand changes in years with shortages. Shifts in labor demand stem from employment impacts estimated as part of the economic analysis component of this study with some slight modifications. IMPLAN employment data is based on the number of full and part-time jobs as opposed to the number of people working. To remedy discrepancies, employment impacts from IMPLAN were adjusted to reflect the number of people employed by using simple ratios (i.e., labor supply divided by number of jobs) at the county level. Declines in labor demand as measured using adjusted IMPLAN data are assumed to affect net economic migration in a given regional water planning area. Employment losses are adjusted to reflect the notion that some people would not relocate but would seek employment in the region and/or public assistance and wait for conditions to improve. Changes in school enrollment are simply the proportion of lost population between the ages of 5 and 17.

1.3 Clarifications, Assumptions and Limitations of Analysis

As with any attempt to measure and quantify human activities at a societal level, assumptions are necessary and every model has limitations. Assumptions are needed to maintain a level of generality and simplicity such that models can be applied on several geographic levels and across different economic sectors. In terms of the general approach used here several clarifications and cautions are warranted:

1) While useful for planning purposes, this study is not a benefit-cost analysis (BCA). BCA is a tool widely used to evaluate the economic feasibility of specific policies or projects as opposed to estimating economic impacts of unmet water needs. Nevertheless, one could include some impacts measured in this study as part of a BCA if done so properly.

2) Since this is not a BCA, future impacts are not weighted differently. In other words, estimates are not "discounted." If used as a measure of benefits in a BCA, one must consider the uncertainty of estimated monetary impacts.

3) All monetary figures are reported in constant year 2000 dollars.

4) Shortages reported by regional planning groups are the starting point for socioeconomic analyses. No adjustments or assumptions regarding the magnitude or distributions of unmet needs among different water use categories are incorporated in the analysis.

5) Estimated impacts are point estimates for years in which needs are reported (i.e., 2010, 2020, 2030, 2040, 2050 and 2060).They are independent and distinct "what if" scenarios for each particular year and water shortages are assumed to be temporary events resulting from severe drought conditions combined with infrastructure limitations. In other words, growth occurs and future shocks are imposed on an economy at 10-year intervals and resultant impacts are measured. Given, that reported figures are not cumulative in nature, it is inappropriate to sum impacts over the entire planning horizon. Doing so, would imply that the analysis predicts that drought of record conditions will occur every ten years in the future, which is not the case. Similarly, authors of this report recognize that in many communities needs are driven by population growth, and in the future total population will exceed the amount of water available due to infrastructure limitations, *regardless of whether or not there is a drought*. This implies that infrastructure limitations would constrain economic growth. However, since needs as defined by planning rules are based upon water supply and demand under the assumption of drought of record conditions, it improper to conduct economic analysis that focuses on growth related impacts over the planning horizon. Figures generated from such an analysis would presume a 50-year drought of record, which is unrealistic. Estimating lost economic activity related to constraints on population and commercial growth due to lack of water would require developing water supply and demand forecasts under "normal" or "most likely" future climatic conditions. *It is critical to stress that this is a modeling assumption necessary to maintain consistency with planning criteria, which states that water availability be evaluated assuming drought of record conditions. Analysis in this report does not predict that the drought of record will recur, nor does it predict or imply that growth will or should occur as projected.*

6) IO multipliers measure the strength of backward linkages to supporting industries (i.e., those who sell inputs to an affected sector). However, multipliers say nothing about forward linkages consisting of businesses that purchase goods from an affected sector for further processing. For example, ranchers in many areas sell most of their animals to local meat packers who process animals into a form that consumers ultimately see in grocery stores and restaurants. Multipliers do not capture forward linkages to meat packers, and since meat packers sell livestock purchased from ranchers as "final sales," multipliers for the ranching sector do fully account for all losses to a region's economy. Thus, as mentioned previously, in some cases closely linked sectors were moved from one water use category to another.

7) Cautions regarding interpretations of direct and secondary impacts are warranted. IO/SAM multipliers are based on "fixed-proportion production functions," which basically means that input use - including labor - moves in lockstep fashion with changes in levels of output. In a scenario where output (i.e., sales) declines, losses in the immediate sector or supporting sectors could be much less than predicted by an IO/SAM model for several reasons. For one, businesses will likely expect to continue operating so they might maintain spending on inputs for future use; or they may be under contractual obligations to purchase inputs for an extended period regardless of external conditions. Also, employers may not lay-off workers given that experienced labor is sometimes scarce and skilled personnel may not be readily available when water shortages subside. Lastly people who lose jobs might find other employment in the region. As a result, direct losses

for employment and secondary losses in sales and employment should be considered an *upper bound*. Similarly, since population projections are based on reduced employment in the region, they should be considered an upper bound as well.

8) IO models are static in nature. Models and resultant multipliers are based upon the structure of the U.S. and regional economies in the year 2000. In contrast, unmet water needs are projected to occur well into the future (i.e., 2010 through 2060). Thus, the analysis assumes that the general structure of the economy remains the same over the planning horizon.

9) With respect to municipal needs, an important assumption is that people would eliminate all outdoor water use before indoor water uses were affected, and people would implement emergency indoor water conservation measures before commercial businesses had to curtail operations, and households had to seek alternative sources of water. Section 2.3.3 discusses this in greater detail.

10) Impacts are annual estimates. If one were to assume that conditions persisted for more than one year, figures should be adjusted to reflect the extended duration. The drought of record in Texas for many communities lasted several years.

2. Economic Impacts

Part 2 of this report summarizes economic analysis for each water use category. Section 2.1 presents the year 2000 economic baseline for Region M. Section 2.2 presents results for agricultural water uses including livestock and irrigated crop production, while Section 2.3 reviews impacts to municipal and industrial water uses including manufacturing, mining, steam-electric and municipal demands.

2.1 Economic Baseline

Table 2 summarizes baseline economic variables.[7] In year 2000, Region M produced $32,549 million in output that generated $17,412 million in income for residents in the region. Economic activity supported an estimated 481,449 full and part-time jobs. Business and industry also generated $1,343 million in state and local taxes. Sections 2.2.and 2.3 discuss contributions of individual water use categories in greater detail.

Table 2: Year 2000 Economic Baseline for Region M (monetary figures reported in $millions)

	Sales Activity			Jobs	Regional Income	Business Taxes
	Total	Intermediate	Final			
Irrigation	$393.24	$32.47	$360.77	5,973	$114.17	$7.05
% of Total	1%	<1%	1%	1%	1%	1%
Livestock	$127.31	$82.37	$44.94	2,918	$63.24	$4.45
% of Total	<1%	1%	<1%	1%	<1%	<1%
Manufacturing	$4,376.79	$647.42	$3,729.36	37,781	$1,210.74	$32.99
% of Total	13%	7%	16%	8%	7%	2%
Mining	$573.25	$150.26	$422.99	1,158	$218.51	$27.32
% of Total	2%	2%	2%	0%	1%	2%
Steam Electric	$354.12	$63.15	$290.97	661	$242.15	$41.22
% of Total	1%	1%	1%	<1%	1%	3%
Municipal*	$26,837.45	$6,187.05	$20,650.41	434,714	$15,595.83	$1,232.20
% of Total	82%	89%	80%	90%	89%	92%
Total	$32,662.15	$7,162.72	$25,499.43	483,205	$17,444.65	$1,345.24
% of Total	100%	100%	100%	100%	100%	100%

* Municipal includes all non-industrial commercial enterprises and institutional water uses such as the military, schools and other government organizations. Source: Generated using IMPLAN models and data from MIG, Inc.

[7] Baseline figures for income and employment may differ than those presented in year 2002 regional water plans for several reasons. For one, estimates shown in 2002 stem from 1995 economic data. In contrast, current figures are based upon year 2000 data. In addition, previous estimates included annual payroll costs only. Income as defined in Table 2 includes additional measures of wealth such as corporate income, payroll benefits, rental income, proprietor income and interest payments. Figures for jobs in Table 2 are higher because they include full *and* part-time positions. Baseline employment data in 2002 plans reported full-time jobs only.

2.2 Agriculture

Agriculture is a small but important component of the region's economy. In 2000, farmers using irrigation produced $281 million dollars worth of crops that generated a total of $82 million in income. With $127 million in sales, the region's livestock industry is somewhat smaller. Collectively, irrigated farming and the livestock industry accounted for around two percent of regional income and jobs.

2.2.1 Irrigation

The first step in estimating impacts to irrigation required calculating gross sales for IMPLAN crop sectors. Default IMPLAN data do not distinguish irrigated production from dry-land production. Once gross sales were known other statistics such as employment and income were derived using IMPLAN direct multiplier coefficients. Gross sales for a given crop are based on two data sources:

1) county-level statistics collected and maintained by the TWDB and the USDA Natural Resources Conservation Service (NRCS) including the number of irrigated acres by crop type and water application per acre, and

2) regional-level data published by the Texas Agricultural Statistics Service (TASS) including prices received for crops (marketing year averages), crop yields and crop acreages.

Crop categories used by the TWDB differ from those used in IMPLAN datasets. To maintain consistency, sales and other statistics are reported using IMPLAN crop classifications. Table 3 shows the TWDB crops included in corresponding IMPLAN sectors. Table 4 summarizes acreage and estimated annual water use for each crop classification. Table 5 shows baseline economic data for irrigated crop production in the region.[8] When measured in dollars, vegetables, fruits (primarily citrus), cotton and sugar crops (sugar cane) are the largest sectors. With $185 million in sales, vegetables alone account for slightly more than one-half or all irrigated crop production in the region.

Table 3: Crop Classifications Used in TWDB Water Use Survey and Corresponding IMPLAN Crop Sectors Applied in Socioeconomic Impact Analysis

IMPLAN Sector	TWDB Sector
Cotton	Cotton
Feed Grains	Corn, sorghum and “forage crops”
Food Grains	Rice, wheat and "other grains"
Fruits	Citrus
Hay and Pasture	Alfalfa and “other hay and pasture”
Oil Crops	Peanuts, soybeans and “other oil crops”
Sugar Crops	Sugarbeets and sugarcane
Tree Nuts	Pecans
Vegetables *	Deep-rooted vegetables, shallow-rooted vegetables and potatoes
Other Crops	"All other crops" "other orchards" and vineyards

* includes melons.

[8] Economic figures for irrigation are based on estimated production in 1994 rather than 2000. Regional Planning Group M opted to use 1994 as the baseline year for irrigation given than water availability and hence agricultural production in 2000 was abnormal due to a variety of climatological and political factors.

Table 4. Summary of Irrigated Crop Acreage and Water Demand for Region M (1994)				
Sector	Acres (1000s)	Distribution of Acres	Water Use (1000s of AF)	Distribution of Water Use
Cotton	116.77	25%	169	16%
Feed Grains	110.81	24%	189	17%
Sugar Crops	59.57	13%	235	22%
Vegetables	58.38	12%	187	17%
Hay and Pasture	47.66	10%	91	8%
Fruits	38.13	8%	122	11%
Tree Nuts	15.49	3%	48	4%
Other Crops	21.45	5%	43	4%
Total	468.25	100%	1,084	100%

Source: Statistics for irrigated crop acreage are based upon annual survey data collected by the TWDB and the National Resources Conservation Service (USDA).

Table 5: Baseline for Irrigation in Region M (monetary figures reported in $millions)

	Sales Activity			Jobs	Regional Income	Business Taxes
	Total	Intermediate	Final			
Vegetables	$184.93	$20.06	$164.86	2,109	$55.22	$2.07
Fruits	$66.93	$1.38	$65.55	1,164	$9.40	$0.56
Sugar Crops	$53.84	$2.05	$51.79	933	$24.50	$2.11
Cotton	$43.13	$3.11	$40.03	342	$11.18	$0.97
Feed Grains	$24.08	$0.99	$23.09	440	$7.92	$0.89
Hay and Pasture	$9.50	$0.39	$9.11	650	$2.50	$0.25
Miscellaneous Crops	$9.02	$4.33	$4.69	295	$2.89	$0.19
Tree Nuts	$1.41	$0.02	$1.39	29	$0.45	$0.01
Food Grains	$0.40	$0.13	$0.26	11	$0.10	$0.01
Total	$393.24	$32.47	$360.77	5,973	$114.17	$7.05

Source: Generated using IMPLAN models and data from MIG, Inc, and the Texas Agricultural Statistics Service.

An important consideration when estimating impacts to irrigation was determining which crops are affected by water shortages. One approach is the so-called rationing model, which assumes that farmers respond to water supply cutbacks by fallowing the lowest value crops in the region first and the highest valued crops last until the amount of water saved equals the shortage.[9] For example, if farmer A grows vegetables (higher value) and farmer B grows wheat (lower value) and they both face a proportionate cutback in irrigation water, then farmer B will sell water to farmer A. Farmer B will fallow her irrigated acreage before farmer A fallows anything. Of course, this assumes that farmers can and do transfer enough water to allow this to happen. A different approach involves constructing farm-level profit maximization models that conform to widely-accepted economic theory that farmers make decisions based on marginal net returns. Such models have good predictive capability, but data requirements and complexity are high. Given that a detailed analysis for each region would require a *substantial* amount of farm-level data and analysis, the following investigation assumes that projected shortages are distributed equally across predominant crops in the region. “Predominant” in this case are crops that comprise at least one percent of total acreage in the region (see Table 4).

The following steps outline the overall method used to estimate direct impacts to irrigated agriculture:

1. *Distribute shortages across predominant crop types in the region*. Again, unmet water needs were distributed equally across crop sectors that constitute one percent or more of irrigated acreage in 2000.

2. *Estimate associated reductions in output for affected crop sectors*. Output reductions are based on elasticities discussed in Section 1.2.1 and on estimated values per acre for different crops. Values per acre stem from the same data used to estimate output for the year 2000 baseline. Given that 2000 may have been an unusually poor or productive year for some crops and not necessarily representative of normal conditions, statistics regarding yield, price and acreage for crop sectors were averaged over a five-year period (1995-2000) if sufficient data were available.

3. *Offset reductions in output by revenues from dry-land production.* If TASS acreage data indicate that farmers grow a dry-land version of a given crop in the region (e.g., cotton or corn), estimated losses from irrigated acreage are offset by assumed revenues from dry-land harvests. Basically, the analysis assumes that farmers who use irrigation would try and grow something even if irrigation water were not available. Given that water shortages are expected to occur under drought conditions, values per acre for dry-land crops are based on 1998 and/or 1996 yields and prices. Both 1996 and 1998 were particularly bad drought years for most of West Texas. Table 6 summarizes data used to estimate the value of lost output.

[9] The rationing model was initially proposed by researchers at the University of California at Berkeley, and was then modified for use in a study conducted by the U.S. Environmental Protection Agency that evaluated how proposed water supply cutbacks recommended to protect water quality in the Bay/Delta complex in California would affect farmers in the Central Valley. See, Zilberman, D., Howitt, R. and Sunding, D. “*Economic Impacts of Water Quality Regulations in the San Francisco Bay and Delt*a.” Western Consortium for Public Health. May 1993.

Table 6: Data Used to Estimate Impacts to Irrigated Crop Production in Region M			
Crop sector	Gross sales revenue per irrigated acre	Gross sales revenue per dry-land acre (drought conditions)	Data Sources for yield, prices and planted acreage used to estimate gross sales per acre
Cotton	$340	$105	Based on five-year (1995-2000) price, yield and acreage data from TASS for Lower Valley Region. Dry-land Value based on 1996 data for Edwards Plateau Region.
Feed Grains	$170	$75	Based on five-year (1995-2000) price, yield and acreage data from TASS for corn and grain sorghum in Lower Valley Region. Dry-land Value based on same data using 1998 figures only.
Fruit	$1500	$0	Based on TAMU crop budget enterprise data for grapefruit orchards. Average value for year 2000 for 3-year, 4-year, 5-year, 6-year and 7-year old orchards in South Texas Region.
Hay Pasture	$220	$110	Based on TAMU data for South Texas Region for coastal Bermuda hay (average of 3, 4 and 5 cuttings). Dry-land value assumes a 50 percent reduction in yield.
Sugar Crops	$765	$0	Based on TAMU Crop Enterprise Budget data for sugar cane (planted and ratoon crop) for year 2000 for South Central District.
Tree Nuts	$515	$0	Five year (1995-2000) statewide average for pecans. Based on TASS data.
Vegetables	$1870	$0	Based on TASS statewide five-year (1995-2000) data for deep-rooted vegetables and melons.
All values are rounded. TASS = Texas Agricultural Statistics Service. TAMU = Texas A&M University.			

The Region M 2006 Water Plan indicates that under drought of record conditions, shortages to irrigation would occur in Cameron, Hidalgo, Maverick, Starr, Webb, Willacy and Zapata counties. Table 7 summarizes estimated impacts. Attachment B of this report shows impacts by county, and Attachment C shows impacts by major river basin.

Table 7: Annual Economic Impacts Associated with Unmet Irrigation Water Needs (years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)				
Year	Sales ($millions)	Regional Income ($millions)	Jobs	Business Taxes ($millions)
2010	$155.27	$60.51	2,885	$3.03
2020	$120.26	$46.90	2,235	$2.37
2030	$116.59	$45.45	2,165	$2.27
2040	$122.64	$47.83	2,270	$2.41
2050	$122.64	$47.83	2,270	$2.41
2060	$122.64	$47.83	2,270	$2.41

* Estimates are based on projected economic activity in the region. Source: Based on economic impact models developed by the Texas Water Development Board, Office of Water Planning.

2.2.2 Livestock

Table 8 summarizes economic indicators for livestock in Region M. Cattle ranching and feedlot operations are key livestock sectors. In 2000, cattle production produced about $114 million in output and $63 million worth of income. Livestock water shortages are projected to occur in Maverick County in the Nueces-Rio Grande River Basin. Compared to other water use categories needs for livestock are relatively small, and the analysis assumes that ranchers would haul water by truck to fill stock tanks. Table 9 shows estimated annual costs.

Table 8: Year 2000 Baseline for Livestock in Region M (monetary figures are reported in $millions)						
	Sales Activity			Jobs	Regional Income	Business Taxes
Sector	Total	Intermediate	Final			
Range Fed Cattle	$53.54	$23.16	$30.38	1,829	$21.67	$1.39
Cattle Feedlots	$48.18	$41.50	$6.68	359	$35.85	$2.76
Ranch Fed Cattle	$12.17	$11.90	$0.27	354	$3.39	$0.24
Miscellaneous Livestock	$8.13	$4.19	$3.94	304	$0.94	$0.03
Dairy Farm Products	$2.56	$0.09	$2.47	22	$0.76	$0.01
Poultry and Eggs	$1.76	$0.59	$1.18	15	$0.44	$0.01
Hogs, Pigs and Swine	$0.84	$0.82	$0.01	16	$0.15	$0.02
Sheep, Lambs and Goats	$0.13	$0.12	$0.01	19	$0.04	$0.00
Other Livestock	$0.01	$0.01	$0.00	1	$0.00	$0.00
Total	$127.31	$82.37	$44.94	2,918	$63.24	$4.45

Source: Based input-output models generated using IMPLAN Pro software from MIG Inc, and data from the Texas Agricultural Statistics Service. Figures are rounded.

Table 9: Annual Costs to Livestock Producers (years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)	
Year	$millions
2010	$0.67
2020	$0.67
2030	$0.67
2040	$0.67
2050	$0.67
2060	$0.67
Source: Texas Water Development Board, Office of Water Planning.	

2.3 Municipal and Industrial

2.3.1 Manufacturing

Table 10 summarizes baseline economic data for manufacturing sectors in the region. Apparel, motor vehicle parts, plastic products, meat-packing plants, prepared seafood and paperboard containers are the leader sectors with total sales of $1,930 million. In 2000, these sectors supported an estimated 13,382 jobs that provided regional residents incomes worth slightly less than $429 million.

Table 10: Year 2000 Baseline Economic Activity for Manufacturing in Region M
(monetary figures are reported in $millions)

Sector	Sales Activity			Jobs	Regional Income	Business Taxes
	Total	Intermediate	Final			
Apparel	$919.98	$21.20	$898.78	8,766	$216.66	$3.56
Motor Vehicle Parts	$258.50	$39.49	$219.01	1,083	$74.67	$1.02
Electronic Components	$234.97	$70.74	$164.23	933	$47.00	$1.66
Plastics Products	$142.61	$2.25	$140.36	890	$33.01	$0.77
Meat Packing Plants	$131.59	$14.89	$116.70	357	$8.12	$0.58
Prepared Fish and Seafood	$121.88	$0.79	$121.09	807	$17.09	$0.62
Paperboard Containers	$120.72	$71.48	$49.24	546	$33.18	$1.25
All other manufacturing sectors	$2,446.53	$426.58	$2,019.95	24,399	$781.01	$23.52
Total	$4,376.79	$647.42	$3,729.36	37,781	$1,210.74	$32.99

Source: Generated by the Texas Water Development Board, Office of Water Planning using IMPLAN Pro™ software and data.

Direct impacts to manufacturing were estimated by distributing water shortages among industrial sectors at the county level. Care was taken to include only sectors recorded in the TWDB Water Uses database. Some sectors in IMPLAN databases are not part of the TWDB database given that they use relatively small amounts of water - primarily for on-site sanitation and potable uses. To maintain consistency between IMPLAN and TWDB databases, Standard Industrial Classification (SIC) codes in TWDB databases were matched to IMPLAN sector codes for each affected county. Non-matches were excluded when calculating direct impacts.

The distribution of water shortages among TWDB manufacturing sectors is weighted according to year 2000 water use. Accordingly, industries with the greatest use are affected the most. As a general observation, these sectors include petroleum and chemical refineries, plastic producers, paper mills, food processors and cement manufacturers. Other manufacturing sectors use considerably less water for productive processes and are less likely to suffer substantial negative effects due to water shortages. In other words, they would likely be able to haul in enough water by truck to keep their operations running.

The Region M 2006 Water Plan indicates that under drought of record conditions, shortages to manufacturing water uses would occur in Cameron, Hidalgo and Willacy counties and could affect several types of industries including food and drink processors, yarn and fabric mills and cement manufacturers. Table 11 summarizes estimated impacts. Attachment B of this report shows impacts by county, while Attachment C shows impacts by major river basin.

Table 11: Annual Economic Impacts Associated with Unmet Manufacturing Water Needs
(years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)

Year	Sales ($millions)	Regional Income ($millions)	Jobs	Business Taxes ($millions)
2010	$161.65	$47.61	1,255	$1.83
2020	$377.71	$117.01	3,085	$4.49
2030	$677.63	$136.74	3,610	$5.25
2040	$499.97	$156.28	4,120	$6.00
2050	$575.70	$180.62	4,765	$6.94
2060	$677.63	$213.37	5,630	$8.20

* Estimates are based on projected economic activity in the region. Source: Based on economic impact models developed by the Texas Water Development Board, Office of Water Planning.

2.3.2 Mining

Table 12 summarizes sales, employment and regional income for the mining industry in Region M. In 2000, mining sectors generated $573 million worth of income and provided jobs for 1,158 workers. Natural gas and petroleum extraction accounts for over 95 percent of mining activity.

Table 12: Year 2000 Baseline for Mining in Region M (monetary figures are in $millions)						
Sector	Sales Activity			Jobs	Regional Income	Business Taxes
	Total	Intermediate	Final			
Natural Gas & Crude Petroleum	$560.29	$148.90	$411.39	1,011	$211.20	$26.84
All other mining sectors	$12.96	$1.36	$11.60	147	$7.31	$0.48
Total	$573.25	$150.26	$422.99	1,158	$218.51	$27.32
Source: Generated using data from MIG, Inc., and models developed by the TWDB using IMPLAN software.						

When estimating impacts to natural gas and oil extraction a major consideration is that the petroleum and gas extraction industry only uses water in significant amounts for secondary recovery. Known in the industry as "enhanced" or "water flood" extraction, secondary recovery involves pumping water down injection wells to increase underground pressure thereby pushing oil or gas into other wells. IMPLAN output numbers do not distinguish between secondary and non-secondary recovery. To account for the discrepancy, county-level data from the Texas Railroad Commission (TRC) showing the proportion of barrels produced using secondary methods were used to adjust IMPLAN data to reflect only the portion of sales attributed to secondary recovery.

An additional problem with standard IMPLAN data matter relates to estimates of output at the county level. In general, IMPLAN data for mining at the county level reflect sales and employment, but not necessarily physical output. For instance, a mining company and its employees may be based in Dallas County Texas, but most of its product comes from oil well leases in West Texas. However, company sales and employment figures are reported for Dallas County. To account for potential discrepancies, analysts relied on data from the TRC to check the accuracy of output in affected counties by comparing average well-head market prices for crude and gas to TRC production statistics in each county. If there were large discrepancies, estimates that reflect physical output based on TRC data were used instead of IMPLAN data.

The 2006 Region M Water Plan indicates that under drought of record conditions, shortages to mining could occur in Willacy County in the Nueces-Rio Grande River Basin. Table 13 shows estimated impacts.

Table 13: Annual Economic Impacts Associated with Unmet Water Needs for Mining Water Uses (years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)				
Year	Sales ($millions)	Regional Income ($millions)	Jobs	Business Taxes ($millions)
2010	$2.07	$1.08	10	$0.02
2020	$2.07	$1.08	10	$0.02
2030	$2.07	$1.08	10	$0.02
2040	$2.07	$1.08	10	$0.02
2050	$2.07	$1.08	10	$0.02
2060	$2.07	$1.08	10	$0.00

* Estimates are based on *projected* economic activity in the region. Source: Based on economic impact models developed by the Texas Water Development Board, Office of Water Resources Planning.

2.3.3 Municipal

Table 14 summarizes economic activity for municipal uses. In 2000, businesses and institutions that make up the municipal category produced $26,837 million worth of goods and services. In return, they received $15,595 million in wages, salaries and profits. Municipal uses generate the bulk of business taxes in the region – nearly $1,232 million (92 percent of all business taxes generated in the region). Top sectors include state and local government, banking, transportation and warehousing, real estate and eating and drinking establishments.

Table 14: Year 2000 Baseline Data for Municipal Water Uses in Region M (monetary figures reported in $millions)

Sector	Sales Activity			Jobs	Regional Income	Business Taxes
	Total	Intermediate	Final			
State and Local Govt. (Education)	$1,846.08	$0.00	$1,846.08	57,306	$1,846.08	$0.00
Banking	$1,459.40	$313.80	$1,145.60	7,971	$942.85	$23.59
Transport and Warehousing	$1,427.64	$505.78	$921.85	14,544	$537.42	$16.89
Wholesale Trade	$1,346.56	$628.46	$718.10	17,419	$735.25	$191.27
Real Estate	$1,042.74	$413.03	$629.71	5,907	$618.36	$123.37
Eating & Drinking	$947.28	$39.95	$907.34	27,675	$426.48	$59.51
All Other Municipal Sectors	$17,916.52	$4,261.77	$13,654.74	278,671	$10,139.34	$806.65
Total	$26,837.45	$6,187.05	$20,650.41	434,714	$15,595.83	$1,232.20

Source: Generated using data from MIG, Inc., and models developed by the TWDB using IMPLAN software.

Estimating direct economics impacts for the municipal category is complicated for several reasons. For one, municipal uses comprise a range of different consumers including commercial businesses, institutions (e.g., schools and government) and households. However, reported shortages do not specify how needs are distributed among different consumers. In other words, how much of a municipal need is commercial and how much is residential? The amount of commercial water use as a percentage of total municipal demand was estimated based on "GED" coefficients (gallons per employee per day) published in secondary sources (see Attachment A). For example, if year 2000 baseline data for a given economic sector (e.g., amusement and recreation services) shows employment at 30 jobs and the GED coefficient is 200, then average daily water use by that sector is (30 x 200 = 6,000 gallons) and thus annual use is 6.7 acre-feet. Water not attributed to commercial use is considered domestic, which includes single and multi-family residential consumption, institutional uses and all use designated as "county-other." The estimated proportion of water used for commercial purposes ranges from about 5 to 35 percent of total municipal demand at the county level. Less populated rural counties occupy the lower end of the spectrum, while larger metropolitan counties are at the higher end.

As mentioned earlier, a key study assumption is that people would eliminate outdoor water use before indoor water consumption was affected; and they would implement *voluntary* emergency indoor water conservation measures before people had to curtail business operations or seek emergency sources of water. This is logical because most water utilities have drought contingency plans. Plans usually specify curtailment or elimination of outdoor water use during periods of drought. In Texas, state law requires retail and wholesale water providers to prepare and submit plans to the Texas Commission on Environmental Quality (TCEQ). Plans must specify demand management measures for use during drought including curtailment of "non-essential water uses."[10] Thus, when assessing municipal needs there are several important considerations: 1) how much of a need would people reduce via eliminating outdoor uses and implementing emergency indoor conservation measures; and 2) what are the economic implications of such measures?

Determining how much water is used for outdoor purposes is key to answering these questions. The proportion used here is based on several secondary sources. The first is a major study sponsored by the American Water Works Association, which surveyed cities in states including Colorado, Oregon, Washington, California, Florida and Arizona. On average across all cities surveyed 58 percent of residential water use was for outdoor activities. In cities with climates comparable to large metropolitan areas of Texas, the average was 40 percent.[11]Earlier findings of the U.S. Water Resources Council showed a national average of 33 percent. Similarly, the United States Environmental Protection Agency (USEPA) estimated that landscape watering accounts for 32 percent of total residential and commercial water use on annual basis.[12] A study conducted for the California Urban Water Agencies (CUWA) calculated values ranging from 25 to 35 percent.[13] Unfortunately, there does not appear to be any comprehensive research that has estimated non-agricultural outdoor water use in Texas. As an approximation, an average annual value of 30 percent based on the above references was selected to serve as a rough estimate in this study. With respect to emergency indoor conservation measures, this analysis assumes that citizens in affected communities would reduce needs by an additional 20 percent. Thus, 50

[10] Non-essential uses include, but are not limited to, landscape irrigation and water for swimming pools or fountains. For further information see the Texas Environmental Quality Code §288.20.

[11] See, Mayer, P.W., DeOreo, W.B., Opitz, E.M., Kiefer, J.C., Davis, W., Dziegielewski, D., Nelson, J.O. "*Residential End Uses of Water*." Research sponsored by the American Water Works Association and completed by Aquacraft, Inc. and Planning and Management Consultants, Ltd. (PMCL@CDM).

[12] U.S. Environmental Protection Agency. *"Cleaner Water through Conservation*." USEPA Report no. 841-B-95-002. April, 1995.

[13] Planning and Management Consultants, Ltd. "*Evaluating Urban Water Conservation Programs: A Procedures Manual*." Prepared for the California Urban Water Agencies. February 1992.

percent of total needs could be eliminated before households and businesses had to implement emergency water procurement activities.

Eliminating outdoor watering would have a range of economic implications. For one, such a restriction would likely have adverse impacts on the landscaping and horticultural industry. If people are unable to water their lawns, they will likely purchase less lawn and garden materials such as plants and fertilizers. On the other hand, during a bad drought people may decide to invest in drought tolerant landscaping, or they might install more efficient landscape plumbing and other water saving devices. But in general, the horticultural industry would probably suffer considerable losses if outdoor water uses were restricted or eliminated. For example, many communities in Colorado, which are in the midst of a prolonged drought, have severely restricted lawn irrigation. In response, the turf industry in Colorado has laid off at least 50 percent of its 2,000 employees.[14] To capture impacts to the horticultural industry, regional sales net of exports for the greenhouse and nursery sectors and the landscaping services sector were reduced in proportion to reductions in outdoor water use. Note that these losses would not necessarily appear as losses to the regional or state economies because people would likely spend the money that they would have spent on landscaping on other goods in the economy. Thus, the net effect on state or regional accounts could be neutral.

Other considerations include the "welfare" losses to consumers who had to forgo outdoor and indoor water uses to reduce needs. In other words, the water that people would have to give up has an economic value. Estimating the economic value of this forgone water for each planning area would be a very time consuming and costly task, and thus secondary sources served as a proxy. Previous research funded by the TWDB, explored consumer "willingness to pay" for avoiding restrictions on water use.[15] Surveys revealed that residential water consumers in Texas would be willing to pay – on average across all income levels - $36 to avoid a 30 percent reduction in water availability lasting for at least 28 days. Assuming the average person in Texas uses 140 gallons per day and the typical household in the state has 2.7 persons (based on U.S. Census data), total monthly water use is 13,205 gallons per household. Therefore, the value of restoring 30 percent of average monthly water use during shortages to residential consumers is roughly one cent per gallon or $2,930 per acre-foot. This figure serves as a proxy to measure consumer welfare losses that would result from restricted outdoor uses and emergency indoor restrictions.

The above data help address the impacts of incurring water needs that are 50 percent or less of projected use. Any amount greater than 50 percent would result in municipal water consumers having to seek alternative sources. Costs to residential and non-water intensive commercial operations (i.e., those that use water only for sanitary purposes) are based on the most likely alternative source of water in the absence of water management strategies. In this case, the most likely alternative is assumed to be "hauled-in" water from other communities at annual cost of $6,530 per acre-foot for small rural communities and approximately and $10,995 per acre-foot for metropolitan areas.[16]

This is not an unreasonable assumption. It happened during the 1950s drought and more recently in Texas and elsewhere. For example, in 2000 at the heels of three consecutive drought years Electra - a small town in North Texas - was down to its last 45 days worth of reservoir water

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[14] Based on assessments of the Rocky Mountain Sod Growers. See, "*Drought Drying Up Business for Landscapers*." Associated Press. September, 17 2002.

[15] See, Griffin, R.C., and Mjelde, W.M. "*Valuing and Managing Water Supply Reliability*. Final Research Report for the Texas Water Development Board: Contract no. 95-483-140." December 1997.

[16] For rural communities, figure assumes an average truck hauling distance of 50 miles at a cost of 8.4 cents per ton-mile (an acre foot of water weighs about 1,350 tons) with no rail shipment. For communities in metropolitan areas, figure assumes a 50 mile truck haul, and a rail haul of 300 miles at a cost of 1.2 cents per ton-mile. Cents per ton-mile are based on figures in: Forkenbrock, D.J., "*Comparison of External Costs of Rail and Truck Freight Transportation*." Transportation Research. Vol. 35 (2001).

when rain replenished the lake, and the city was able to refurbish old wells to provide supplemental groundwater. At the time, residents were forced to limit water use to 1,000 gallons per person per month - less than half of what most people use - and many were having water hauled delivered to their homes by private contractors.[17] In 2003 citizens of Ballinger, Texas, were also faced with a dwindling water supply due to prolonged drought. After three years of drought, Lake Ballinger, which supplies water to more than 4,300 residents in Ballinger and to 600 residents in nearby Rowena, was almost dry. Each day, people lined up to get water from a well in nearby City Park. Trucks hauling trailers outfitted with large plastic and metal tanks hauled water to and from City Park to Ballinger.[18] In Australia, four cities have run out of water as a result of drought, and residents have been trucking in water since November 2002. One town has five trucks carting about one acre-foot eight times daily from a source 20 miles away. They had to build new roads and infrastructure to accommodate the trucks. Residents are currently restricted to indoor water use only.[19]

Direct impacts to commercial sectors were estimated in a fashion similar to other business sectors. Output was reduced among "water intensive" commercial sectors according to the severity of projected shortages. Water intensive is defined as non-medical related sectors that are heavily dependent upon water to provide their services. These include:

- car-washes,
- laundry and cleaning facilities,
- sports and recreation clubs and facilities including race tracks,
- amusement and recreation services,
- hotels and lodging places, and
- eating and drinking establishments.

For non-water intensive sectors, it is assumed that businesses would haul water by truck and/or rail.

An example will illustrate the breakdown of municipal water needs and the overall approach to estimating impacts of municipal needs. Assume City B has an unmet need of 50 acre feet in 2020 and projected demands of 200 acre-feet. In this case, residents of City B could eliminate needs via restricting all outdoor water use. City A, on the other hand, has an unmet need of 150 acre-feet in 2020 with a projected demand of 200 acre-feet. Thus, total shortages are 75 percent of total demand. Emergency outdoor and indoor conservation measures would eliminate 50 percent of projected needs; however, 50 acre-feet would still remain. This remaining portion would result in costs to residential and commercial water users. Water intensive businesses such as car washes, restaurants, motels, race tracks would have to curtail operations (i.e., output would decline), and residents and non-water intensive businesses would have to have water hauled-in assuming it was available.

The last element of municipal water shortages considered focused on lost water utility revenues. Estimating these was straightforward. Analyst used annual data from the "*Water and Wastewater Rate Survey*" published annually by the Texas Municipal League to calculate an average value per acre-foot for water and sewer. For water revenues, averages rates multiplied by total water needs served as a proxy. For lost wastewater, total unmet needs were adjusted for return flow factor of 0.60 and multiplied by average sewer rates for the region. Needs reported as "county-other" were excluded under the presumption that these consist primarily of self-supplied water uses. In addition, 15 percent of water demand and needs are considered non-billed or "unaccountable" water that comprises things such leakages and water for municipal government functions (e.g., fire departments). Lost tax receipts are based on current rates for the

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[17] Zewe, C. "*Tap Threatens to Run Dry in Texas Town*." July 11, 2000. CNN Cable News Network.

[18] Associated Press, "*Ballinger Scrambles to Finish Pipeline before Lake Dries Up*." May 19, 2003.

[19] Healey, N. (2003) *Water on Wheels*, Water: Journal of the Australian Water Association, June 2003.

“miscellaneous gross receipts tax, “which the state collects from utilities located in most incorporated cities or towns in Texas.

The Region M 2006 Water Plan indicates that under drought of record conditions, municipal water shortages would occur in all counties in the region. Tables 15 through 18 summarize estimated impacts to domestic uses, commercial businesses, water utilities and the horticultural industry. Attachment B of this report shows impacts by county, and Attachment C shows impacts by major river basin.

Table 15: Annual Economic Impacts of Unmet Water Needs for Water Intensive Commercial Businesses
(years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)

Year	Sales ($millions)	Regional Income ($millions)	Jobs	Business Taxes ($millions)
2010	$13.36	$7.03	330	$0.82
2020	$16.08	$8.46	395	$0.98
2030	$107.19	$56.06	2,630	$6.60
2040	$174.41	$93.67	4,015	$9.74
2050	$416.78	$230.37	8,865	$20.61
2060	$691.18	$386.59	14,210	$32.35

* Estimates are based on *projected* economic activity in the region. Source: Source: Texas Water Development Board, Office of Water Resources Planning.

Table 16: Annual Economic Impacts of Unmet Water Needs for the Horticultural Industry
(years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)

Year	Sales ($millions)	Regional Income ($millions)	Jobs	Business Taxes ($millions)
2010	$11.50	$4.78	145	$0.09
2020	$31.12	$12.95	440	$0.23
2030	$59.68	$24.83	980	$0.45
2040	$89.86	$37.39	1,685	$0.67
2050	$123.91	$51.55	2,650	$0.92
2060	$174.32	$72.53	4,410	$1.30

Source: Generated by the Texas Water Development Board, Office of Water Resources Planning.

Table 17: Annual Impacts Associated with Unmet Domestic Water Needs (years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)	
Year	$millions
2010	$64.47
2020	$174.74
2030	$327.52
2040	$523.23
2050	$820.03
2060	$1,175.05

Source: Generated by Texas Water Development Board, Office of Water Resources Planning.

Table 18: Impacts to Water Utilities (years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)		
Year	Revenues ($millions)	Utility Taxes ($millions)
2010	$24.13	$0.42
2020	$67.96	$1.20
2030	$127.79	$2.25
2040	$198.72	$3.50
2050	$281.78	$4.97
2060	$369.96	$6.52

Source: Texas Water Development Board, Office of Water Resources Planning.

2.3.4 Steam Electric

The steam electric sector represents economy activity associated with retail and wholesale transactions of electricity. As shown in Table 19, in 2000 the electric services sector generated annual sales of approximately $354 million that resulted in nearly $242 million in income for Region M residents. Electric utilities support 660 full and part-time jobs.

Table 19:Year 2000 Direct Economic Activity Associated with Steam Electric Production in Region M ((monetary figures are in $millions)

Sector	Sales Activity			No. of Jobs	Regional Income	Business Taxes
	Total	Intermediate	Final			
Electric Services	$321.78	$57.42	$264.36	590	$230.12	$41.22
State and Local Electric Utilities	$32.33	$5.73	$26.60	70	$12.03	$0.00
Total	$354.12	$63.15	$290.97	660	$242.15	$41.22

Source: Generated using data from MIG, Inc., and models developed by the TWDB using IMPLAN software.

Without adequate cooling water, power plants cannot safely operate. As water availability falls below projected demands, water levels in lakes and rivers that provide cooling water would also decline, particularly during drought when surface flows are reduced. Low water levels could affect raw water intakes and water discharge outlets (i.e., outfalls) at power facilities in several ways. For one, power plants are regulated by thermal emission guidelines that specify the maximum amount of heat that can go back into a river or lake via discharged cooling water. Low lake or river levels could result in permit compliance issues due to reduced dilution and dispersion of heat and subsequent impacts on aquatic biota near outfalls.[20] But the primary concern would be a loss of head (i.e., pressure) over intake structures that would decrease flows through intake tunnels. This could affect safety related pumps, increase operating costs and/or result in sustained shut-downs. Assuming plants did shutdown, they would not be able to generate electricity, which implies that output (i.e., sales of electricity) would decline.

Among all water use categories, steam-electric is unique and cautions are necessary when applying methods used in this study. Measured changes to an economy using input-output models stem directly from changes in sales revenue. In the case of water shortages, one assumes that businesses will suffer lost output if process water is in short supply. For power generation facilities this is true as well. However, the electric services sector in IMPLAN represents a corporate entity that may own and operate several power plants in a given region. If one plant became inoperable due to water shortages, plants in other areas or generation facilities that do not rely heavily water (e.g., gas powered turbines or "peaking plants") might be able to compensate for lost generating capacity. Utilities could also offset lost production via purchases on the spot market.[21] Thus, to presume that electricity would stop flowing may be unrealistic, but

[20] Section 316 (b) of the Clean Water Act requires that thermal wastewater discharges do not harm fish and other wildlife.

[21] Today, most utilities participate in large interstate "power pools" and can buy or sell electricity "on the grid" from other utilities or power marketers. Thus, assuming power was available to buy, and assuming that no contractual or physical limitations were in place (e.g., transmission constraints); utilities could offset lost power that resulted from waters shortages with purchases via the power grid.

to maintain consistency, the model assumes that water shortages would result in lost sales of electricity.[22] Another related consideration is that IMPLAN output data report all sales transactions for particular utility in a given county - including sales generated from stations outside a county. As a countermeasure, analysts estimated sales for affected counties using production and price data from the U.S. Energy Information Administration.

The Region M 2006 Water Plan indicates that under drought of record conditions, steam-electric water shortages would occur in Cameron, Hidalgo and Webb counties. Table 20 summarizes estimated impacts. Attachment B of this report shows impacts by county, and Attachment C shows impacts by major river basin.

Table 20: Annual Economic Impacts of Unmet Water Needs for Steam-electric Water Uses
(years 2010, 2020, 2030, 2040, 2050 and 2060, constant year 2000 dollars)

Year	Total Sales	Regional Income ($millions)	Jobs	Business Taxes
2010	$0.00	$0.00	0	$0.00
2020	$6.67	$4.48	35	$0.80
2030	$14.73	$9.90	85	$1.77
2040	$49.09	$33.01	275	$5.91
2050	$75.70	$50.91	425	$9.12
2060	$219.23	$146.98	1,230	$26.18

Source: Texas Water Development Board Office of Water Resources Planning.

3. Regional Social Impacts

As discussed previously in Section 1.2, estimated social impacts focus changes including population loss and subsequent related in school enrollment. As shown in Table 19, water shortages in 2010 could result in a population loss of 12,150 people with a corresponding reduction in school enrollment of 3,160. Models indicate that shortages in 2060 could cause population in the region to fall by 53,160 people and school enrollment by 13,790 students.

[22] Losses offset through grid purchases or from peaking plants would likely result in higher production costs, which utilities would ultimately pass on to consumers in the form of higher utility bills. Determining the impacts of higher costs is not considered in this study.

Table 19: Estimated Regional Social Impacts of Unmet Water Needs (years, 2010, 2020, 2030, 2040, 2050 and 2060)		
Year	Population Losses	Declines in School Enrollment
2010	12,150	3,160
2020	16,500	4,280
2030	19,070	4,950
2040	24,770	6,420
2050	34,650	8,980
2060	53,160	13,790
Source: Generated by the Texas Water Development Board, Office of Water Planning.		

Attachment A: Baseline Regional Economic Data

Tables A-1 through A-6 contain data from several sources that form a basis of analyses in this report. Economic statistics were extracted and processed via databases purchased from MIG, Inc. using IMPLAN Pro™ software. Values for gallons per employee (i.e. GED coefficients) for the municipal water use category are based on several secondary sources.[23] County-level data sets along with multipliers are not included given their large sizes (i.e., 528 sectors per county each with 12 different multiplier coefficients). Fields in Tables A-1 through A-6 contain the following variables:

- *GED -* average gallons of water use per employee per day (municipal use only);
- *total sales -* total industry production measured in millions of dollars (equal to shipments plus net additions to inventories);
- *intermediate sales -* sales to other industries in the region measured in millions of dollars;
- *final sales -* all sales to end-users including sales to households in the region and exports out of the region;
- *jobs -* number of full and part-time jobs (annual average) required by a given industry;
- *regional income* - total payroll costs (wages and salaries plus benefits), proprietor income, corporate income, rental income and interest payments;
- *business taxes –* sales taxes, excise taxes, fees, licenses and other taxes paid during normal business operations (includes all payments to federal, state and local government except income taxes).

[23] Sources for GED coefficients include: Gleick, P.H., Haasz, D., Henges-Jeck, C., Srinivasan, V., Wolff, G. Cushing, K.K., and Mann, A. "*Waste Not, Want Not*: *The Potential for Urban Water Conservation in California*." Pacific Institute. November 2003. U.S. Bureau of the Census. 1982 Census of Manufacturers: Water Use in Manufacturing. USGPO, Washington D.C. See also: "*U.S. Army Engineer Institute for Water Resources, IWR Report 88-R-6.*," Fort Belvoir, VA. See also, Joseph, E. S., 1982, "*Municipal and Industrial Water Demands of the Western United States*." Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, v. 108, no. WR2, p. 204-216. See also, Baumann, D. D., Boland, J. J., and Sims, J. H., 1981, "*Evaluation of Water Conservation for Municipal and Industrial Water Supply*." U.S. Army Corps of Engineers, Institute for Water Resources, Contract no. 82-C1.

Table A-1: Economic Data for Predominant Irrigated Crops in Region M (Year 2000)

Sector	Total Sales	Intermediate Sales	Final Sales	Labor Force	Regional Income	Business Taxes
Cotton	$43.13	$3.11	$40.03	342	$11.18	$0.97
Feed Grains	$24.08	$0.99	$23.09	440	$7.92	$0.89
Food Grains	$0.40	$0.13	$0.26	11	$0.10	$0.01
Fruits	$66.93	$1.38	$65.55	1,164	$9.40	$0.56
Hay and Pasture	$9.50	$0.39	$9.11	650	$2.50	$0.25
Miscellaneous Crops	$9.02	$4.33	$4.69	295	$2.89	$0.19
Oil Bearing Crops	$0.00	$0.00	$0.00	0	$0.00	$0.00
Sugar Crops	$53.84	$2.05	$51.79	933	$24.50	$2.11
Tree Nuts	$1.41	$0.02	$1.39	29	$0.45	$0.01
Vegetables	$184.93	$20.06	$164.86	2,109	$55.22	$2.07
Total	$393.24	$32.47	$360.77	5,973	$114.17	$7.05

Table A-2: Economic Data for Livestock Sectors, Region M (Year 2000)

Sector	Total Sales	Intermediate Sales	Final Sales	Labor Force	Regional Income	Business Taxes
Cattle Feedlots	$48.18	$41.50	$6.68	359	$35.85	$2.76
Dairy Farm Products	$2.56	$0.09	$2.47	22	$0.76	$0.01
Hogs, Pigs and Swine	$0.84	$0.82	$0.01	16	$0.15	$0.02
Miscellaneous Livestock	$8.13	$4.19	$3.94	304	$0.94	$0.03
Other Meat Animal Products	$0.01	$0.01	$0.00	1	$0.00	$0.00
Poultry and Eggs	$1.76	$0.59	$1.18	15	$0.44	$0.01
Ranch Fed Cattle	$12.17	$11.90	$0.27	354	$3.39	$0.24
Range Fed Cattle	$53.54	$23.16	$30.38	1829	$21.67	$1.39
Sheep, Lambs and Goats	$0.13	$0.12	$0.01	19	$0.04	$0.00
Total	$127.31	$82.37	$44.94	2,918	$63.24	$4.45

Table A-3: Economic Data for Municipal Sectors, Region M (Year 2000)

Sector	GED	Total Sales	Intermediate Sales	Final Sales	Labor Force	Regional Income	Business Taxes
Accounting, Auditing and Bookkeeping	120	$112.66	$96.41	$16.25	2,365	$88.78	$1.01
Advertising	117	$30.79	$29.15	$1.64	325	$14.56	$0.26
Air Transportation	171	$108.61	$17.31	$91.30	1,245	$52.46	$7.50
Amusement and Recreation Services,	427	$70.00	$1.54	$68.46	2,726	$39.62	$3.84
Apparel & Accessory Stores	68	$201.31	$9.10	$192.21	5,520	$111.27	$32.12
Arrangement Of Passenger	130	$39.67	$12.93	$26.74	299	$27.39	$1.19
Automobile Parking and Car Wash	681	$30.52	$2.84	$27.68	975	$20.61	$1.41
Automobile Rental and Leasing	147	$50.25	$36.37	$13.87	525	$29.33	$3.97
Automobile Repair and Services	55	$193.48	$59.98	$133.50	2,725	$94.61	$8.57
Automotive Dealers & Service Stations	49	$542.80	$98.47	$444.34	8,077	$323.70	$83.96
Banking	59	$1,459.40	$313.80	$1,145.60	7,971	$942.85	$23.59
Beauty and Barber Shops	216	$43.90	$3.59	$40.31	1,758	$26.47	$0.52
Bowling Alleys and Pool Halls	86	$2.25	$0.01	$2.24	101	$1.22	$0.20
Building Materials & Gardening	35	$156.80	$17.29	$139.50	3,544	$111.87	$25.79
Business Associations	160	$121.01	$18.09	$102.91	3,187	$81.53	$0.07
Child Day Care Services	120	$127.48	$0.00	$127.48	3,128	$42.97	$1.24
Colleges, Universities, Schools	75	$0.95	$0.01	$0.94	37	$0.60	$0.00
Commercial Sports Except Racing	391	$0.47	$0.26	$0.21	12	$0.31	$0.03
Commodity Credit Corporation	-	$0.00	$0.00	$0.00	0	$0.00	$0.00
Communications, Except Radio and TV	47	$478.42	$211.27	$267.15	1,921	$239.82	$25.53
Computer and Data Processing Services	40	$19.74	$11.89	$7.85	379	$15.97	$0.30
Credit Agencies	156	$242.17	$161.65	$80.52	6,288	$130.99	$8.46
Detective and Protective Services	84	$46.32	$26.08	$20.24	2,181	$34.32	$0.63
Doctors and Dentists	203	$1,136.52	$0.00	$1,136.52	11,597	$758.77	$14.57
Domestic Services	-	$59.65	$59.65	$0.00	7,463	$59.13	$0.00
Dummy	-	$0.00	$0.00	$0.00	0	$0.00	$0.00
Dummy	-	$0.00	$0.00	$0.00	0	$0.00	$0.00

Table A-3: Economic Data for Municipal Sectors, Region M (Year 2000)

Eating & Drinking	157	$947.28	$39.95	$907.34	27,675	$426.48	$59.51
Electrical Repair Service	37	$44.78	$12.47	$32.31	707	$14.74	$1.27
Elementary and Secondary Schools	169	$50.89	$0.00	$50.89	1,979	$32.40	$0.00
Engineering, Architectural Services	87	$122.62	$106.68	$15.94	1,556	$44.57	$0.66
Equipment Rental and Leasing	29	$109.84	$63.47	$46.38	911	$48.18	$3.35
Federal Government - Military	-	$102.68	$102.68	$0.00	3,316	$102.68	$0.00
Federal Government - Non-Military	-	$524.09	$524.09	$0.00	9,027	$524.09	$0.00
Food Stores	98	$508.02	$11.96	$496.06	14,860	$380.86	$81.18
Funeral Service and Crematories	111	$32.00	$0.00	$32.00	1,030	$21.20	$0.91
Furniture & Home Furnishings Stores	42	$126.88	$12.83	$114.04	3,601	$82.33	$19.90
Gas Production and Distribution	51	$172.08	$63.21	$108.87	173	$41.66	$11.53
General Merchandise Stores	47	$418.42	$10.86	$407.56	12,926	$263.12	$66.77
Greenhouse and Nursery Products	-	$79.22	$16.03	$63.19	1,070	$20.94	$0.29
Hospitals	76	$1,002.04	$0.66	$1,001.38	14,103	$639.92	$3.59
Hotels and Lodging Places	230	$239.10	$75.62	$163.48	5,405	$124.39	$16.01
Insurance Agents and Brokers	89	$103.73	$25.62	$78.11	2,509	$80.50	$1.11
Insurance Carriers	136	$100.26	$9.49	$90.77	1,063	$48.43	$4.96
Inventory Valuation Adjustment	-	-$13.13	-$13.13	$0.00	0	-$12.54	$0.00
Job Trainings & Related Services	141	$23.76	$4.25	$19.51	670	$11.37	$0.05
Labor and Civic Organizations	122	$84.85	$0.47	$84.38	6,583	$60.16	$0.01
Landscape and Horticultural Services	-	$26.06	$19.02	$7.04	1,084	$15.18	$0.65
Laundry, Cleaning and Shoe Repair	517	$44.34	$9.85	$34.48	2,057	$32.63	$1.13
Legal Services	76	$256.68	$91.65	$165.03	3,345	$197.58	$2.30
Local Government Passenger Transit	-	$2.22	$0.19	$2.03	39	-$3.30	$0.00
Local, Interurban Passenger Transit	68	$107.60	$9.63	$97.97	2,295	$65.83	$2.36
Maintenance and Repair Oil and Gas	25	$155.03	$35.69	$119.33	1,261	$89.46	$6.10
Maintenance and Repair Other Facilities	25	$404.71	$153.88	$250.83	8,713	$264.95	$1.77
Maintenance and Repair, Residential	25	$338.83	$89.04	$249.79	2,761	$77.84	$1.06
Management and Consulting Services	87	$104.01	$73.29	$30.72	1,189	$54.30	$0.72
Membership Sports and Recreation	427	$40.60	$1.03	$39.56	1,411	$21.03	$1.49
Miscellaneous Personal Services	129	$44.12	$3.09	$41.03	611	$13.35	$1.01
Miscellaneous Repair Shops	124	$32.71	$19.81	$12.90	600	$13.08	$0.82
Miscellaneous Retail	132	$481.41	$35.90	$445.52	12,798	$301.95	$73.55
Motion Pictures	113	$98.40	$58.38	$40.02	1,338	$29.06	$1.02
Motor Freight Transport and	85	$1,427.64	$505.78	$921.85	14,544	$537.42	$16.89
New Government Facilities	63	$560.27	$0.00	$560.27	4,155	$179.74	$2.83
New Highways and Streets	45	$137.08	$0.00	$137.08	1,416	$44.03	$0.72
New Industrial and Commercial	63	$546.41	$0.00	$546.41	5,212	$159.43	$3.30
New Mineral Extraction Facilities	63	$309.26	$3.91	$305.36	6,154	$173.63	$14.01
New Residential Structures	35	$1,092.73	$0.00	$1,092.73	7,439	$161.67	$5.50
New Utility Structures	63	$232.55	$0.00	$232.55	2,548	$80.74	$1.05
Noncomparable Imports	-	$0.00	$0.00	$0.00	0	$0.00	$0.00
Nursing and Protective Care	197	$116.27	$0.00	$116.27	3,800	$83.98	$2.85
Other Business Services	84	$133.07	$126.09	$6.98	1,450	$50.46	$1.83
Other Educational Services	116	$78.57	$7.25	$71.32	1,753	$26.72	$2.00
Other Medical and Health Services	168	$851.23	$24.24	$826.99	25,220	$350.05	$10.93
Other Nonprofit Organizations	122	$41.46	$2.10	$39.36	1,838	$20.10	$0.25
Other State and Local Govt Enterprises	-	$307.13	$75.71	$231.41	1,749	$91.99	$0.00
Owner-occupied Dwellings	89	$1,662.65	$0.00	$1,662.65	0	$1,043.83	$215.59
Personnel Supply Services	484	$186.19	$156.20	$29.99	9,803	$179.30	$3.54
Photofinishing, Commercial	112	$20.19	$13.27	$6.92	221	$6.51	$0.40
Portrait and Photographic Studios	184	$11.46	$0.80	$10.66	301	$5.31	$0.27
Racing and Track Operation	391	$4.88	$0.57	$4.32	89	$1.95	$0.91
Radio and TV Broadcasting	64	$162.58	$142.39	$20.19	1,047	$58.17	$2.14
Railroads and Related Services	68	$69.55	$21.10	$48.46	617	$18.88	$1.00
Real Estate	89	$1,042.74	$413.03	$629.71	5,907	$618.36	$123.37
Religious Organizations	328	$61.24	$0.00	$61.24	471	$9.63	$0.00
Research, Development & Testing	123	$33.30	$12.62	$20.68	667	$15.81	$0.29
Residential Care	111	$33.99	$0.00	$33.99	1,240	$21.10	$0.30
Rest Of The World Industry	-	$0.00	$0.00	$0.00	0	$0.00	$0.00
Sanitary Services and Steam Supply	51	$24.26	$15.63	$8.63	110	$10.14	$4.44
Scrap	-	$0.00	$0.00	$0.00	0	$0.00	$0.00
Security and Commodity Brokers	59	$132.00	$86.03	$45.97	727	$48.65	$4.29
Services To Buildings	67	$57.06	$39.96	$17.10	1,489	$25.70	$1.02
Social Services, N.E.C.	42	$238.64	$20.53	$218.11	5,119	$74.13	$0.22
State & Local Government - Education	-	$1,846.08	$1,846.08	$0.00	57,306	$1,846.08	$0.00
State & Local Government - Non-	-	$800.33	$800.33	$0.00	20,078	$800.33	$0.00
Theatrical Producers, Bands Etc.	36	$5.23	$3.14	$2.08	87	$1.38	$0.12
Transportation Services	40	$825.89	$114.79	$711.10	9,049	$616.79	$7.15
U.S. Postal Service	-	$125.53	$80.59	$44.95	1,958	$86.86	$0.00
Used and Secondhand Goods	-	$0.00	$0.00	$0.00	0	$0.00	$0.00
Watch, Clock, Jewelry and Furniture	50	$4.48	$0.04	$4.45	76	$1.67	$0.23
Water Supply and Sewerage Systems	51	$38.64	$7.04	$31.60	221	$21.05	$2.62
Water Transportation	353	$78.98	$30.09	$48.90	412	$11.39	$1.01
Wholesale Trade	43	$1,346.56	$628.46	$718.10	17,419	$735.25	$191.27
Total	na	$26,837.45	$6,187.05	$20,650.41	434,714	$15,595.83	$1,232.20

NEC = not elsewhere classified. “na” = not available.

Table A-4: Economic Data for Manufacturing Sectors, Region M (Year 2000)

Sector	Total Sales	Intermediate Sales	Final Sales	Labor Force	Regional Income	Business Taxes
Abrasive Products	$48.35	$1.77	$46.59	237	$16.49	$0.62
Agricultural Chemicals, N.E.C	$1.38	$0.58	$0.80	5	$0.81	$0.02
Agricultural, Forestry, Fishery Services	$118.45	$62.89	$55.55	7791	$61.27	$2.70
Aircraft	$31.84	$0.95	$30.89	109	$9.98	$0.40
Aircraft and Missile Engines and Parts	$51.98	$9.71	$42.27	258	$14.92	$0.38
Aircraft and Missile Equipment,	$0.31	$0.00	$0.30	3	$0.09	$0.00
Alkalies & Chlorine	$1.87	$1.05	$0.82	11	$0.72	$0.03
Aluminum Foundries	$2.80	$0.14	$2.66	22	$1.23	$0.03
Animal and Marine Fats and Oils	$2.76	$0.34	$2.42	11	$0.72	$0.02
Apparel Made From Purchased Materials	$919.98	$21.20	$898.78	8766	$216.66	$3.56
Architectural Metal Work	$8.86	$0.29	$8.58	105	$4.62	$0.08
Asphalt Felts and Coatings	$21.63	$13.89	$7.75	75	$14.52	$0.20
Automatic Temperature Controls	$0.30	$0.26	$0.04	5	$0.15	$0.00
Automotive and Apparel Trimmings	$11.27	$8.60	$2.66	86	$1.50	$0.04
Automotive Stampings	$1.65	$0.30	$1.36	10	$0.37	$0.01
Bags, Paper	$28.14	$0.26	$27.88	166	$8.49	$0.27
Bags, Plastic	$41.97	$0.39	$41.58	226	$11.22	$0.37
Blast Furnaces and Steel Mills	$1.46	$0.45	$1.01	5	$0.15	$0.01
Blended and Prepared Flour	$0.37	$0.00	$0.37	1	$0.04	$0.00
Blinds, Shades, and Drapery Hardware	$1.68	$0.00	$1.68	23	$0.64	$0.01
Blowers and Fans	$0.87	$0.01	$0.86	10	$0.29	$0.01
Boat Building and Repairing	$3.26	$0.02	$3.24	34	$0.81	$0.02
Book Publishing	$6.86	$0.58	$6.28	22	$3.05	$0.11
Bottled and Canned Soft Drinks & Water	$103.96	$0.42	$103.53	318	$19.27	$0.70
Brass, Bronze, and Copper Foundries	$2.91	$0.14	$2.78	76	$1.73	$0.03
Bread, Cake, and Related Products	$34.02	$9.86	$24.16	182	$13.46	$0.23
Broadwoven Fabric Mills and Finishing	$0.26	$0.22	$0.04	2	$0.08	$0.00
Brooms and Brushes	$2.90	$0.16	$2.75	32	$1.30	$0.04
Canned Fruits and Vegetables	$54.39	$0.25	$54.14	292	$11.96	$0.27
Canned Specialties	$3.37	$0.02	$3.35	9	$0.74	$0.02
Canvas Products	$9.21	$3.74	$5.47	150	$3.66	$0.05
Carbon and Graphite Products	$0.52	$0.10	$0.42	4	$0.14	$0.00
Chemical Preparations, N.E.C	$1.79	$1.20	$0.59	5	$0.55	$0.02
Clay Refractories	$0.33	$0.00	$0.33	3	$0.12	$0.00
Cold Finishing Of Steel Shapes	$2.41	$0.74	$1.66	12	$0.57	$0.02
Commercial Fishing	$32.56	$4.52	$28.04	1131	$29.54	$1.02
Commercial Printing	$30.77	$20.14	$10.63	315	$7.71	$0.23
Communications Equipment N.E.C.	$0.39	$0.24	$0.15	5	$0.22	$0.00
Concrete Block and Brick	$8.61	$0.06	$8.55	51	$3.09	$0.14
Concrete Products, N.E.C	$15.76	$0.08	$15.69	145	$4.74	$0.18
Construction Machinery and Equipment	$0.49	$0.02	$0.46	2	$0.08	$0.00
Converted Paper Products, N.E.C	$0.70	$0.01	$0.69	4	$0.16	$0.01
Conveyors and Conveying Equipment	$11.67	$2.02	$9.66	75	$3.83	$0.09
Cordage and Twine	$3.24	$0.05	$3.19	36	$0.62	$0.02
Costume Jewelery	$2.69	$0.02	$2.66	15	$1.76	$0.03
Cottonseed Oil Mills	$44.44	$4.49	$39.96	117	$5.03	$0.29
Curtains and Draperies	$10.89	$1.41	$9.48	123	$2.72	$0.06
Cut Stone and Stone Products	$0.13	$0.00	$0.13	2	$0.05	$0.00
Dental Equipment and Supplies	$5.38	$2.89	$2.49	30	$0.98	$0.04
Drugs	$5.40	$1.66	$3.73	35	$2.65	$0.06
Electric Lamps	$0.16	$0.00	$0.16	2	$0.09	$0.00
Electrical Equipment, N.E.C.	$15.90	$1.51	$14.39	84	$1.90	$0.05
Electron Tubes	$0.16	$0.11	$0.05	1	$0.04	$0.00
Electronic Components, N.E.C.	$234.97	$70.74	$164.23	933	$47.00	$1.66
Engine Electrical Equipment	$43.99	$16.11	$27.88	297	$13.67	$0.34
Fabricated Metal Products, N.E.C.	$0.64	$0.18	$0.45	5	$0.19	$0.00
Fabricated Plate Work (Boiler Shops)	$2.87	$0.04	$2.83	36	$1.46	$0.03
Fabricated Rubber Products, N.E.C.	$16.37	$0.18	$16.19	108	$5.16	$0.12
Fabricated Structural Metal	$47.57	$1.18	$46.39	335	$14.80	$0.38
Fabricated Textile Products, N.E.C.	$8.50	$2.23	$6.28	42	$3.83	$0.09
Farm Machinery and Equipment	$16.77	$5.61	$11.16	116	$2.38	$0.06
Fertilizers, Mixing Only	$2.45	$0.49	$1.96	6	$0.67	$0.04
Flavoring Extracts and Syrups, N.E.C.	$0.55	$0.06	$0.49	7	$0.37	$0.00
Flour and Other Grain Mill Products	$95.83	$0.50	$95.34	312	$12.51	$0.42
Fluid Milk	$24.46	$1.17	$23.29	63	$4.99	$0.22
Fluid Power Cylinders & Actuators	$2.06	$0.03	$2.03	11	$0.46	$0.01
Food Preparations, N.E.C	$115.51	$0.45	$115.07	729	$24.17	$0.52
Food Products Machinery	$1.34	$0.52	$0.81	15	$0.56	$0.01
Footwear Cut Stock	$1.53	$0.01	$1.52	7	$0.78	$0.02
Forest Products	$0.08	$0.00	$0.08	2	$0.02	$0.00
Forestry Products	$1.05	$0.00	$1.05	14	$0.80	$0.16
Frozen Fruits, Juices and Vegetables	$80.02	$0.83	$79.19	421	$12.52	$0.41
Frozen Specialties	$1.93	$0.02	$1.91	13	$0.41	$0.01

Table A-4: Economic Data for Manufacturing Sectors, Region M (Year 2000)

Furniture and Fixtures, N.E.C	$0.49	$0.25	$0.24	2	$0.12	$0.00
General Industrial Machinery, N.E.C	$0.51	$0.01	$0.50	3	$0.10	$0.00
House Slippers	$33.82	$0.01	$33.81	340	$20.54	$0.30
Housefurnishings, N.E.C	$38.75	$4.41	$34.34	221	$16.74	$0.40
Household Cooking Equipment	$1.34	$0.01	$1.33	8	$0.28	$0.01
Household Furniture, N.E.C	$3.67	$0.35	$3.32	55	$1.02	$0.01
Industrial and Fluid Valves	$63.77	$7.14	$56.63	270	$16.95	$0.50
Industrial Gases	$1.05	$0.59	$0.46	21	$0.81	$0.02
Industrial Machines N.E.C.	$27.76	$0.22	$27.54	314	$9.50	$0.19
Industrial Patterns	$0.10	$0.00	$0.10	2	$0.05	$0.00
Inorganic Chemicals Nec.	$36.35	$20.45	$15.90	137	$16.09	$1.06
Instruments To Measure Electricity	$0.57	$0.03	$0.54	4	$0.10	$0.00
Iron and Steel Forgings	$0.69	$0.12	$0.57	6	$0.28	$0.01
Iron and Steel Foundries	$0.37	$0.01	$0.36	3	$0.09	$0.00
Jewelry, Precious Metal	$9.62	$0.03	$9.59	36	$5.36	$0.13
Leather Goods, N.E.C	$1.32	$0.19	$1.13	34	$1.00	$0.01
Machine Tools, Metal Cutting Types	$0.66	$0.20	$0.45	10	$0.23	$0.00
Malt Beverages	$0.50	$0.05	$0.45	3	$0.15	$0.08
Manufactured Ice	$2.36	$0.13	$2.23	68	$1.26	$0.01
Manufacturing Industries, N.E.C.	$41.19	$1.47	$39.72	444	$16.04	$0.40
Meat Packing Plants	$131.59	$14.89	$116.70	357	$8.12	$0.58
Metal Coating and Allied Services	$0.35	$0.10	$0.25	2	$0.14	$0.00
Metal Doors, Sash, and Trim	$3.43	$0.18	$3.25	40	$1.11	$0.02
Metal Household Furniture	$2.50	$0.33	$2.17	23	$0.45	$0.01
Metal Stampings, N.E.C.	$20.60	$2.50	$18.10	115	$8.44	$0.20
Millwork	$34.44	$27.82	$6.61	359	$11.75	$0.29
Minerals, Ground Or Treated	$2.50	$0.01	$2.49	14	$1.18	$0.03
Miscellaneous Fabricated Wire Products	$3.82	$1.26	$2.55	35	$1.74	$0.03
Miscellaneous Plastics Products	$142.61	$2.25	$140.36	890	$33.01	$0.77
Miscellaneous Publishing	$7.20	$4.85	$2.34	61	$3.43	$0.08
Mobile Homes	$0.14	$0.00	$0.14	1	$0.05	$0.00
Motor Vehicle Parts and Accessories	$258.50	$39.49	$219.01	1083	$74.67	$1.02
Motor Vehicles	$3.50	$0.01	$3.49	6	$0.58	$0.01
Motors and Generators	$45.64	$3.63	$42.00	362	$18.32	$0.52
Narrow Fabric Mills	$4.92	$2.10	$2.82	88	$1.96	$0.04
Newspapers	$68.74	$47.79	$20.95	1011	$27.02	$0.62
Nonferrous Wire Drawing and Insulating	$2.30	$0.31	$1.98	9	$0.38	$0.01
Nonmetallic Mineral Products, N.E.C.	$2.76	$0.06	$2.70	32	$1.10	$0.03
Oil Field Machinery	$1.15	$0.20	$0.96	13	$0.31	$0.01
Packaging Machinery	$13.76	$2.51	$11.25	84	$4.03	$0.11
Paints and Allied Products	$4.13	$0.08	$4.04	12	$1.44	$0.04
Paper Coated & Laminated N.E.C.	$7.56	$0.43	$7.14	35	$3.10	$0.07
Paper Mills, Except Building Paper	$1.37	$0.01	$1.36	6	$0.25	$0.01
Paperboard Containers and Boxes	$120.72	$71.48	$49.24	546	$33.18	$1.25
Paving Mixtures and Blocks	$24.42	$18.36	$6.06	81	$9.46	$0.18
Periodicals	$1.33	$0.76	$0.57	7	$0.59	$0.01
Personal Leather Goods	$0.19	$0.01	$0.18	2	$0.12	$0.00
Petroleum Refining	$19.95	$8.84	$11.10	8	$1.60	$0.11
Photographic Equipment and Supplies	$2.11	$0.26	$1.85	8	$0.28	$0.01
Pickles, Sauces, and Salad Dressings	$2.22	$0.05	$2.17	7	$0.76	$0.01
Pipe, Valves, and Pipe Fittings	$0.79	$0.09	$0.70	7	$0.30	$0.01
Plating and Polishing	$0.33	$0.09	$0.24	4	$0.26	$0.00
Pleating and Stitching	$0.12	$0.10	$0.03	2	$0.08	$0.00
Potato Chips & Similar Snacks	$17.20	$0.49	$16.71	66	$4.28	$0.10
Poultry Processing	$0.42	$0.05	$0.38	3	$0.09	$0.00
Power Transmission Equipment	$0.89	$0.01	$0.88	6	$0.26	$0.01
Prefabricated Metal Buildings	$0.84	$0.02	$0.81	7	$0.34	$0.01
Prepared Fresh Or Frozen Fish Or Seafood	$121.88	$0.79	$121.09	807	$17.09	$0.62
Printed Circuit Boards	$5.36	$1.61	$3.74	97	$2.50	$0.03
Printing Trades Machinery	$0.43	$0.13	$0.30	3	$0.09	$0.00
Public Building Furniture	$0.62	$0.41	$0.21	4	$0.13	$0.00
Radio and Tv Communication Equipment	$0.33	$0.21	$0.13	1	$0.10	$0.00
Radio and TV Receiving Sets	$14.16	$1.11	$13.06	69	$6.25	$0.18
Ready-mixed Concrete	$95.26	$0.78	$94.47	688	$27.72	$1.12
Refrigeration and Heating Equipment	$3.17	$2.14	$1.03	17	$0.61	$0.02
Relays & Industrial Controls	$31.28	$4.67	$26.60	185	$10.47	$0.25
Sausages and Other Prepared Meats	$47.03	$6.04	$41.00	215	$8.33	$0.32
Sawmills and Planing Mills, General	$0.68	$0.64	$0.03	4	$0.18	$0.01
Screw Machine Products and Bolts, Etc.	$0.29	$0.14	$0.15	2	$0.12	$0.00
Secondary Nonferrous Metals	$11.95	$0.13	$11.82	32	$1.87	$0.13
Semiconductors and Related Devices	$0.64	$0.55	$0.09	4	$0.22	$0.00
Service Industry Machines, N.E.C.	$0.44	$0.18	$0.26	3	$0.10	$0.00
Sheet Metal Work	$14.57	$0.37	$14.20	122	$5.22	$0.11
Ship Building and Repairing	$116.86	$0.09	$116.78	1180	$45.22	$0.86
Shoes, Except Rubber	$5.45	$0.03	$5.42	81	$2.18	$0.04
Shortening and Cooking Oils	$1.46	$0.37	$1.09	2	$0.26	$0.01
Signs and Advertising Displays	$14.48	$5.77	$8.71	170	$6.22	$0.14

Table A-4: Economic Data for Manufacturing Sectors, Region M (Year 2000)

Small Arms	$9.16	$0.02	$9.13	147	$6.62	$0.87
Soap and Other Detergents	$1.67	$0.23	$1.44	12	$0.88	$0.02
Special Dies and Tools and Accessories	$28.90	$7.51	$21.39	384	$13.48	$0.22
Special Industry Machinery N.E.C.	$72.56	$4.69	$67.87	202	$8.51	$0.25
Sporting and Athletic Goods, N.E.C.	$10.35	$0.05	$10.29	84	$4.15	$0.35
Steam Engines and Turbines	$0.48	$0.18	$0.29	2	$0.08	$0.00
Storage Batteries	$0.51	$0.16	$0.35	3	$0.11	$0.00
Sugar	$2.74	$0.02	$2.71	7	$0.22	$0.01
Surgical and Medical Instrument	$26.44	$10.34	$16.10	162	$6.08	$0.21
Synthetic Rubber	$0.79	$0.55	$0.24	3	$0.23	$0.01
Telephone and Telegraph Apparatus	$0.80	$0.55	$0.25	2	$0.12	$0.00
Thread Mills	$0.23	$0.11	$0.13	5	$0.04	$0.00
Toilet Preparations	$35.60	$1.01	$34.59	106	$15.35	$0.32
Transformers	$0.40	$0.05	$0.35	4	$0.12	$0.00
Transportation Equipment, N.E.C	$1.64	$0.03	$1.62	7	$0.27	$0.01
Typesetting	$0.65	$0.14	$0.50	7	$0.26	$0.01
Upholstered Household Furniture	$2.86	$0.02	$2.84	38	$0.75	$0.01
Wood Household Furniture	$13.31	$0.32	$12.99	166	$4.20	$0.08
Wood Kitchen Cabinets	$19.02	$16.14	$2.88	288	$7.16	$0.14
Wood Pallets and Skids	$24.03	$9.02	$15.01	314	$10.22	$0.22
Wood Preserving	$0.67	$0.65	$0.02	2	$0.10	$0.00
Wood Products, N.E.C	$5.67	$2.12	$3.55	62	$1.72	$0.05
Yarn Mills and Finishing Of Textiles, N.E.C.	$0.18	$0.17	$0.01	1	$0.04	$0.00
Total	$4,376.79	$647.42	$3,729.36	37781	$1,210.74	$32.99

NEC = not elsewhere classified. "na" = not available.

Table A-5: Economic Data for Mining Sectors, Region M (Year 2000)

Sector	Total Sales	Intermediate Sales	Final Sales	Labor Force	Regional Income	Business Taxes
Chemical, Fertilizer Mineral Mining	$0.81	$0.22	$0.60	8	$0.53	$0.04
Clay, Ceramic, Refractory Minerals	$0.44	$0.00	$0.44	2	$0.26	$0.01
Coal Mining	$0.66	$0.15	$0.52	2	$0.20	$0.08
Dimension Stone	$1.76	$0.03	$1.73	14	$1.07	$0.05
Natural Gas & Crude Petroleum	$357.87	$95.11	$262.77	841	$159.59	$18.73
Natural Gas Liquids	$202.42	$53.79	$148.62	170	$51.62	$8.12
Sand and Gravel	$8.22	$0.20	$8.02	79	$5.12	$0.26
Uranium-radium-vanadium Ores	$1.06	$0.76	$0.29	42	$0.12	$0.04
Total	$573.25	$150.26	$422.99	1,158	$218.51	$27.32

Table A-6: Economic Data for the Steam Electric Sector, Region M (Year 2000)

Sector	Total Sales	Intermediate Sales	Final Sales	Labor Force	Regional Income	Business Taxes
Electric Services	$321.78	$57.42	$264.36	591	$230.12	$41.22
State and Local Electric Utilities	$32.33	$5.73	$26.60	70	$12.03	$0.00
Total	$354.12	$63.15	$290.97	661	$242.15	$41.22

na = "not available"

Attachment B: Distribution of Economic Impacts by County and Water User Group

Tables B-1 through B-9 show economic impacts by county and water user group; however, caution is warranted. Figures shown for specific counties are *direct* impacts only. For the most part, figures reported in the main text for all water use categories uses include *direct and secondary* impacts. Secondary effects were estimated using regional level multipliers that treat each regional water planning area as an aggregate and autonomous economy. Multipliers do not specify where secondary impacts will occur at a sub-regional level (i.e., in which counties or cities). All economic impacts that would accrue to a region as a whole due to secondary economic effects are reported in Tables B-1 through B-9 as “secondary regional level impacts.”

For example, assume that in a given county (or city) water shortages caused significant reductions in output for a manufacturing plant. Reduced output resulted in lay-offs and lost income for workers and owners of the plant. This is a *direct* impact. Direct impacts were estimated at a county level; and thus one can say with certainty that direct impacts occurred in that county. However, secondary impacts accrue to businesses and households throughout the region where the business operates, and it is impossible using input-output models to determine where these businesses are located spatially.

The same logic applies to changes in population and school enrollment. Since employment losses and subsequent out-migration from a region were estimated using *direct* and *secondary* multipliers, it is impossible to say with any degree of certainty how many people a given county would lose regardless of whether the economic impact was direct or secondary. For example, assume the manufacturing plant referred to above is in County A. If the firm eliminated 50 jobs, one could state with certainty that water shortages in County A resulted in a loss of 50 jobs in that county. However, one could not unequivocally say whether 100 percent of the population loss due to lay-offs at the manufacturing would accrue to County A because many affected workers might commute from adjacent counties. This is particularly true in large metropolitan areas that overlay one or counties. Thus, population and school enrollment impacts cannot be reported at a county level.

Irrigation

Table B-1: Distribution of Economic Impacts by County and Water User Groups: (Irrigation)						
Lost Sales, $millions)						
County	2010	2020	2030	2040	2050	2060
Cameron						
Direct	$33.04	$29.80	$25.47	$29.02	$29.02	$29.02
Secondary Regional Level Impacts	$21.04	$18.97	$16.22	$18.48	$18.48	$18.48
Hidalgo						
Direct	$46.99	$30.62	$32.94	$32.94	$32.94	$32.94
Secondary Regional Level Impacts	$33.74	$21.99	$23.66	$23.66	$23.66	$23.66
Maverick						
Direct	$2.65	$1.73	$1.86	$1.86	$1.86	$1.86
Secondary Regional Level Impacts	1.9541	1.2735	1.3701	1.3701	1.3701	1.3701
Starr						
Direct	$3.40	$3.14	$2.87	$2.87	$2.87	$2.87
Secondary Regional Level Impacts	$2.50	$2.31	$2.11	$2.11	$2.11	$2.11
Webb						
Direct	$1.52	$1.41	$1.30	$1.32	$1.32	$1.32
Secondary Regional Level Impacts	$1.13	$1.04	$0.96	$0.98	$0.98	$0.98
Willacy						
Direct	$2.40	$2.20	$2.00	$2.04	$2.04	$2.04
Secondary Regional Level Impacts	$1.70	$1.56	$1.42	$1.45	$1.45	$1.45
Zapata						
Direct	$1.84	$2.41	$2.53	$2.61	$2.61	$2.61
Secondary Regional Level Impacts	$1.37	$1.79	$1.88	$1.93	$1.93	$1.93
Total	$155.27	$120.26	$116.59	$122.64	$122.64	$122.64
Lost Income ($millions)						
County	2010	2020	2030	2040	2050	2060
Cameron						
Direct	$10.08	$9.09	$7.78	$8.86	$8.86	$8.86
Secondary Regional Level Impacts	$11.20	$10.10	$8.64	$9.84	$9.84	$9.84
Hidalgo						
Direct	$13.39	$8.73	$9.39	$9.39	$9.39	$9.39
Secondary Regional Level Impacts	$17.97	$11.71	$12.60	$12.60	$12.60	$12.60
Maverick						
Direct	$0.76	$0.49	$0.53	$0.53	$0.53	$0.53
Secondary Regional Level Impacts	1.0376	0.676	0.728	0.728	0.728	0.728
Starr						
Direct	0.9903	0.915	0.836	0.836	0.836	0.836
Secondary Regional Level Impacts	1.3351	1.234	1.127	1.127	1.127	1.127
Webb						
Direct	$0.46	$0.42	$0.39	$0.40	$0.40	$0.40
Secondary Regional Level Impacts	$0.60	$0.56	$0.51	$0.52	$0.52	$0.52
Willacy						
Direct	$0.50	$0.46	$0.42	$0.42	$0.42	$0.42
Secondary Regional Level Impacts	$0.90	$0.83	$0.75	$0.77	$0.77	$0.77
Zapata						
Direct	$0.55	$0.72	$0.76	$0.78	$0.78	$0.78
Secondary Regional Level Impacts	$0.73	$0.96	$1.00	$1.03	$1.03	$1.03
Total	$60.51	$46.90	$45.45	$47.83	$47.83	$47.83
Lost Jobs						
	2010	2020	2030	2040	2050	2060
Cameron						
Direct	490	442	378	430	430	430
Secondary Regional Level Impacts	514	464	397	452	452	452
Hidalgo						
Direct	607	396	426	426	426	426

Secondary Regional Level Impacts	891	581	625	625	625	625
Maverick						
Direct	38	25	26	26	26	26
Secondary Regional Level Impacts	51	33	36	36	36	36
Starr						
Direct	42	38	35	35	35	35
Secondary Regional Level Impacts	67	62	57	57	57	57
Webb						
Direct	18	16	15	15	15	15
Secondary Regional Level Impacts	30	28	26	26	26	26
Willacy						
Direct	35	32	29	29	29	29
Secondary Regional Level Impacts	44	40	36	37	37	37
Zapata						
Direct	21	28	29	30	30	30
Secondary Regional Level Impacts	37	49	51	52	52	52
Total	2,884	2,233	2,165	2,277	2,277	2,277
Lost Business Taxes ($millions)						
County	2010	2020	2030	2040	2050	2060
Cameron						
Direct	$0.76	$0.69	$0.59	$0.67	$0.67	$0.67
Secondary Regional Level Impacts	$0.46	$0.41	$0.35	$0.40	$0.40	$0.40
Hidalgo						
Direct	$0.65	$0.42	$0.45	$0.45	$0.45	$0.45
Secondary Regional Level Impacts	$0.84	$0.55	$0.59	$0.59	$0.59	$0.59
Maverick						
Direct	$0.03	$0.02	$0.02	$0.02	$0.02	$0.02
Secondary Regional Level Impacts	0.042	0.027	0.029	0.029	0.029	0.029
Starr						
Direct	$0.04	$0.04	$0.03	$0.03	$0.03	$0.03
Secondary Regional Level Impacts	$0.05	$0.05	$0.04	$0.04	$0.04	$0.04
Webb						
Direct	$0.02	$0.02	$0.01	$0.01	$0.01	$0.01
Secondary Regional Level Impacts	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02
Willacy						
Direct	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03
Secondary Regional Level Impacts	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03
Zapata						
Direct	$0.02	$0.03	$0.03	$0.03	$0.03	$0.03
Secondary Regional Level Impacts	$0.03	$0.04	$0.04	$0.04	$0.04	$0.04
Total	$3.03	$2.37	$2.27	$2.41	$2.41	$2.41

Source: Texas Water Development Board, Office of Water Resources Planning

Livestock

Given the relatively small amount of unmet needs for livestock water uses, this study assumed that ranchers would haul water in by truck to fill stock tanks. Costs reflect water transportation costs.

Table B-2: Projected Costs to Livestock Producers						
County	2010	2020	2030	2040	2050	2060
Maverick	$0.67	$0.67	$0.67	$0.67	$0.67	$0.67
Cameron	$0.65	$0.65	$0.65	$0.65	$0.65	$0.65
Webb	$0.39	$0.39	$0.39	$0.39	$0.39	$0.39
Total	$1.71	$1.71	$1.71	$1.71	$1.71	$1.71
Source: Texas Water Development Board, Office of Water Resources Planning						

Manufacturing

Table B-3: Distribution of Economic Impacts by County and Water User Groups: (Manufacturing)						
Lost Output (Total Sales, $millions)						
County	2010	2020	2030	2040	2050	2060
Cameron						
Direct	$96.94	$238.25	$399.30	$318.21	$352.67	$399.30
Secondary Regional Level Impacts	$51.28	$126.02	$211.21	$168.32	$186.55	$211.21
Hidalgo						
Direct	$0.00	$0.00	$31.42	$0.00	$13.49	$31.42
Secondary Regional Level Impacts	$0.00	$0.00	$22.27	$0.00	$9.56	$22.27
Willacy						
Direct	$8.95	$8.95	$8.95	$8.95	$8.95	$8.95
Secondary Regional Level Impacts	$4.48	$4.48	$4.48	$4.48	$4.48	$4.48
Total	$161.65	$377.71	$677.63	$499.97	$575.70	$677.63
Lost Income ($millions)						
County	2010	2020	2030	2040	2050	2060
Cameron						
Direct	524	1,288	1,505	1,720	1,907	2,159
Secondary Regional Level Impacts	731	1,797	2,100	2,400	2,660	3,012
Hidalgo						
Direct	0	0	0	0	58	134
Secondary Regional Level Impacts	0	0	0	0	139	323
Willacy						
Direct	85	85	85	85	85	85
Secondary Regional Level Impacts	63	63	63	63	63	63
Total	1,255	3,085	3,606	4,121	4,763	5,628
Lost Jobs (numbers may not sum to figures in text due to rounding)						
County	2010	2020	2030	2040	2050	2060
Cameron						
Direct	$20.02	$49.20	$57.50	$65.72	$72.83	$82.46
Secondary Regional Level Impacts	$27.59	$67.80	$79.24	$90.56	$100.37	$113.64
Hidalgo						
Direct	$0.00	$0.00	$0.00	$0.00	$2.15	$5.01

Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$5.27	$12.27
Willacy						
Direct	$2.11	$2.11	$2.11	$2.11	$2.11	$2.11
Secondary Regional Level Impacts	$2.57	$2.57	$2.57	$2.57	$2.57	$2.57
Total	$47.61	$117.01	$136.74	$156.28	$180.62	$213.37
Lost Business Taxes ($millions)						
County	2010	2020	2030	2040	2050	2060
Cameron						
Direct	$0.72	$1.78	$2.08	$2.38	$2.64	$2.99
Secondary Regional Level Impacts	$1.10	$2.71	$3.16	$3.62	$4.01	$4.54
Hidalgo						
Direct	$0.00	$0.00	$0.00	$0.00	$0.07	$0.16
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.22	$0.51
Willacy						
Direct	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03
Secondary Regional Level Impacts	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04
Total	$1.83	$4.49	$5.25	$6.00	$6.94	$8.20
Source: Texas Water Development Board, Office of Water Resources Planning						

Mining

Table B-4: Distribution of Economic Impacts by County and Water User Groups: (Mining)						
Lost Output (Total Sales, $millions)						
County	2010	2020	2030	2040	2050	2060
Willacy						
Direct	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25
Secondary Regional Level Impacts	$0.82	$0.82	$0.82	$0.82	$0.82	$0.82
Total	$2.07	$2.07	$2.07	$2.07	$2.07	$2.07
Lost Income ($millions)						
County	2010	2020	2030	2040	2050	2060
Willacy						
Direct	$0.61	$0.61	$0.61	$0.61	$0.61	$0.61
Secondary Regional Level Impacts	$0.47	$0.47	$0.47	$0.47	$0.47	$0.47
Total	$1.08	$1.08	$1.08	$1.08	$1.08	$1.08
Lost Jobs (numbers may not sum to figures in text due to rounding)						
County	2010	2020	2030	2040	2050	2060
Willacy						
Direct	3	3	3	3	3	3
Secondary Regional Level Impacts	8	8	8	8	8	8
Total	11	11	11	11	11	11
Lost Business Taxes ($millions)						
County	2010	2020	2030	2040	2050	2060
Willacy						
Direct	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01
Secondary Regional Level Impacts	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01
Total	$0.02	$0.02	$0.02	$0.02	$0.02	$0.00
Source: Texas Water Development Board, Office of Water Resources Planning						

Municipal

Impacts to the horticultural industry were estimated at the regional level only and are not included in the tables below.

Table B-5: Lost Water Utility Revenues (Municipal)

County	2010	2020	2030	2040	2050	2060
Cameron	$12.83	$26.76	$41.49	$57.57	$74.76	$92.82
Hidalgo	$3.66	$14.18	$36.47	$65.93	$104.13	$144.42
Jim Hogg	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01
Maverick	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Starr	$0.52	$1.21	$2.14	$3.04	$4.00	$4.98
Webb	$7.12	$25.80	$47.67	$72.03	$98.49	$127.18
Willacy	$0.00	$0.00	$0.00	$0.14	$0.38	$0.56
Zapata	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	$24.13	$67.96	$127.79	$198.72	$281.78	$369.96

Source: Texas Water Development Board, Office of Water Resources Planning

Table B-6: Lost Water Utility Taxes (Municipal)

County	2010	2020	2030	2040	2050	2060
Cameron	$0.23	$0.47	$0.73	$1.01	$1.32	$1.63
Hidalgo	$0.06	$0.25	$0.64	$1.16	$1.83	$2.54
Jim Hogg	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Maverick	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Starr	$0.01	$0.02	$0.04	$0.05	$0.07	$0.09
Webb	$0.13	$0.45	$0.84	$1.27	$1.73	$2.24
Willacy	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01
Zapata	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01
Total	$0.42	$1.20	$2.25	$3.50	$4.97	$6.52

Source: Texas Water Development Board, Office of Water Resources Planning

Table B-7: Impacts Associated with Unmet Needs for Domestic Water Uses						
County	2010	2020	2030	2040	2050	2060
Cameron	$33.82	$65.67	$100.51	$140.75	$200.85	$284.81
Hidalgo	$10.65	$43.02	$106.90	$191.79	$319.11	$460.36
Jim Hogg	$0.20	$0.21	$0.23	$0.24	$0.23	$0.21
Maverick	$0.73	$2.35	$3.80	$5.09	$6.23	$7.29
Starr	$1.14	$2.68	$4.88	$7.05	$9.38	$12.71
Webb	$16.25	$57.94	$106.82	$172.15	$276.09	$398.16
Willacy	$0.00	$0.00	$0.10	$0.49	$1.09	$1.53
Zapata	$1.68	$2.86	$4.29	$5.68	$7.05	$9.97
Total	$64.47	$174.74	$327.52	$523.23	$820.03	$1,175.05
Source: Texas Water Development Board, Office of Water Resources Planning						

Table B-8: Distribution of Economic Impacts by County and Water User Groups: (Commercial Water Uses)						
Lost Output (Total Sales, $millions)						
County	2010	2020	2030	2040	2050	2060
Cameron						
Direct	$8.04	$9.68	$28.43	$32.64	$36.86	$40.87
Secondary Regional Level Impacts	$5.32	$6.40	$18.79	$21.58	$24.37	$27.02
Hidalgo						
Direct	$0.00	$0.00	$36.19	$43.28	$66.07	$76.10
Secondary Regional Level Impacts	$0.00	$0.00	$23.78	$28.45	$43.43	$50.02
Webb						
Direct	$0.00	$0.00	$0.00	$29.16	$148.05	$299.14
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$19.31	$98.01	$198.03
Total	$13.36	$16.08	$107.19	$174.41	$416.78	$691.18
Lost Income ($millions)						
County	2010	2020	2030	2040	2050	2060
Cameron						
Direct	$4.07	$4.89	$14.37	$16.50	$18.63	$20.66
Secondary Regional Level Impacts	$2.96	$3.56	$10.47	$12.02	$13.58	$15.05
Hidalgo						
Direct	$0.00	$0.00	$18.01	$21.54	$32.88	$37.87
Secondary Regional Level Impacts	$0.00	$0.00	$13.21	$15.80	$24.13	$27.79
Webb						
Direct	$0.00	$0.00	$0.00	$16.53	$83.94	$169.61
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$11.27	$57.21	$115.61
Total	$7.03	$8.46	$56.06	$93.67	$230.37	$386.59
Lost Jobs (numbers may not sum to figures in text due to rounding)						
County	2010	2020	2030	2040	2050	2060
Cameron						
Direct	247	297	874	1,003	1,133	1,256
Secondary Regional Level Impacts	81	97	286	328	371	411
Hidalgo						
Direct	0	0	1,111	1,328	2,028	2,336
Secondary Regional Level Impacts	0	0	362	433	661	762
Webb						
Direct	0	0	0	622	3,157	6,378
Secondary Regional Level Impacts	0	0	0	299	1,516	3,064
Total	328	395	2,632	4,013	8,866	14,207

Lost Business Taxes ($millions)						
County	2010	2020	2030	2040	2050	2060
Cameron						
Direct	$0.47	$0.56	$1.65	$1.89	$2.13	$2.37
Secondary Regional Level Impacts	$0.35	$0.42	$1.25	$1.43	$1.62	$1.79
Hidalgo						
Direct	$0.00	$0.00	$2.11	$2.52	$3.85	$4.43
Secondary Regional Level Impacts	$0.00	$0.00	$1.60	$1.91	$2.91	$3.35
Webb						
Direct	$0.00	$0.00	$0.00	$1.14	$5.80	$11.71
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.85	$4.30	$8.69
Total	$0.82	$0.98	$6.60	$9.74	$20.61	$32.35
Source: Texas Water Development Board, Office of Water Resources Planning						

Steam Electric

Table B-9: Distribution of Economic Impacts by County and Water User Groups: (Steam-electric)						
Lost Output (Total Sales, $millions)						
Cameron	2010	2020	2030	2040	2050	2060
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$6.27
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$2.47
Hidalgo						
Direct	$0.00	$4.92	$10.86	$36.21	$53.86	$150.79
Secondary Regional Level Impacts	$0.00	$1.75	$3.87	$12.89	$19.17	$53.68
Webb						
Direct	$0.00	$0.00	$0.00	$0.00	$1.97	$4.44
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.70	$1.58
Total	$0.00	$6.67	$14.73	$49.09	$75.70	$219.23
Lost Income ($millions)						
Cameron	2010	2020	2030	2040	2050	2060
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$4.07
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$1.36
Hidalgo						
Direct	$0.00	$3.52	$7.77	$25.89	$38.52	$107.83
Secondary Regional Level Impacts	$0.00	$0.97	$2.14	$7.12	$10.60	$29.67
Webb						
Direct	$0.00	$0.00	$0.00	$0.00	$1.41	$3.18
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.39	$0.87
Total	$0.00	$4.48	$9.90	$33.01	$50.91	$146.98
Lost Jobs (numbers may not sum to figures in text due to rounding)						
Cameron	2010	2020	2030	2040	2050	2060
Direct	0	0	0	0	0	12
Secondary Regional Level Impacts	0	0	0	0	0	37
Hidalgo						
Direct	0	9	20	67	99	277
Secondary Regional Level Impacts	0	28	63	209	310	869
Webb						
Direct	0	0	0	0	4	8
Secondary Regional Level Impacts	0	0	0	0	11	26
Total	0	37	83	275	424	1,228

Lost Business Taxes ($millions)						
Cameron	2010	2020	2030	2040	2050	2060
Direct	$0.00	$0.00	$0.00	$0.00	$0.00	$0.65
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.00	$0.18
Hidalgo						
Direct	$0.00	$0.63	$1.39	$4.64	$6.90	$19.31
Secondary Regional Level Impacts	$0.00	$0.17	$0.38	$1.28	$1.90	$5.31
Webb						
Direct	$0.00	$0.00	$0.00	$0.00	$0.25	$0.57
Secondary Regional Level Impacts	$0.00	$0.00	$0.00	$0.00	$0.07	$0.16
Total	$0.00	$0.80	$1.77	$5.91	$9.12	$26.18
Source: Texas Water Development Board, Office of Water Resources Planning						

Attachment C: Allocation of Economic Impacts by River Basin

Tables C-1 through C-4 distribute regional economic and social impacts by major river basin. Impacts were allocated based on distribution of water shortages among counties. For instance, if 50 percent of water shortages in River Basin A and 50 percent occur in River Basin then impacts were split equally among the two basins.

Irrigation

Table C-1: Distribution of Impacts among Major River Basins (Irrigation)						
Lost Sales ($millions)						
Basin	2010	2020	2030	2040	2050	2060
Nueces-Rio Grande	$112.08	$78.69	$49.47	$54.54	$56.82	$58.75
Rio Grande	$43.19	$41.57	$67.12	$68.10	$65.82	$63.89
Total	$155.27	$120.26	$116.59	$122.64	$122.64	$122.64
Lost Income ($millions)						
Basin	2010	2020	2030	2040	2050	2060
Nueces-Rio Grande	$43.68	$30.69	$19.29	$21.27	$22.16	$22.91
Rio Grande	$16.83	$16.21	$26.16	$26.56	$25.67	$24.92
Total	$60.51	$46.90	$45.45	$47.83	$47.83	$47.83
Job Losses (numbers may not sum to figures in text due to rounding)						
Basin	2010	2020	2030	2040	2050	2060
Nueces-Rio Grande	2,082	1,461	919	1,013	1,055	1,091
Rio Grande	802	772	1,246	1,264	1,222	1,186
Total	2,884	2,233	2,165	2,277	2,277	2,277
Lost Business Taxes ($millions)						
Basin	2010	2020	2030	2040	2050	2060
Nueces-Rio Grande	$2.19	$1.55	$0.96	$1.07	$1.11	$1.15
Rio Grande	$0.84	$0.82	$1.31	$1.34	$1.29	$1.25
Total	$3.03	$2.37	$2.27	$2.41	$2.41	$2.41
Source: Texas Water Development Board, Office of Water Resources Planning						

Livestock

Table C-2: Distribution of Impacts among Major River Basins (Livestock)						
($millions)						
Basin	2010	2020	2030	2040	2050	2060
Nueces	$0.67	$0.67	$0.67	$0.67	$0.67	$0.67
Nueces-Rio Grande	$1.04	$1.04	$1.04	$1.04	$1.04	$1.04
total	$1.71	$1.71	$1.71	$1.71	$1.71	$1.71
Source: Texas Water Development Board, Office of Water Resources Planning						

Manufacturing

All manufacturing impacts are in the Nueces-Rio Grande River Basin.

Mining

All mining impacts are in the Nueces-Rio Grande River Basin.

Municipal

Table C-3 Distribution of Impacts among Major River Basins (Municipal)						
Lost Sales ($millions)						
Basin	2010	2020	2030	2040	2050	2060
Nueces-Rio Grande	$13.73	$43.84	$102.77	$166.52	$273.60	$435.77
Nueces	$0.03	$0.06	$0.10	$0.15	$0.23	$0.36
Rio Grande	$16.06	$44.73	$83.05	$125.56	$195.95	$302.55
Total	$29.81	$88.63	$185.93	$292.23	$469.79	$738.68
Lost Income ($millions)						
Basin	2010	2020	2030	2040	2050	2060
Nueces-Rio Grande	$32.07	$89.34	$192.34	$307.20	$488.77	$743.72
Nueces	$0.06	$0.12	$0.19	$0.28	$0.42	$0.62
Rio Grande	$37.51	$91.15	$155.44	$231.64	$350.05	$516.35
Total	$69.64	$180.61	$347.97	$539.12	$839.23	$1,260.69
Job Losses (numbers may not sum to figures in text due to rounding)						
Basin	2010	2020	2030	2040	2050	2060
Nueces-Rio Grande	67	219	688	1,319	2,816	5,446
Nueces	0	0	1	1	2	5
Rio Grande	79	223	556	995	2,017	3,781
Total	146	442	1,245	2,315	4,836	9,232
Lost Business Taxes ($millions)						
Basin	2010	2020	2030	2040	2050	2060
Nueces-Rio Grande	$0.19	$0.62	$1.73	$3.05	$6.07	$11.29
Nueces	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01
Rio Grande	$0.22	$0.63	$1.40	$2.30	$4.35	$7.84
Total	$0.41	$1.24	$3.14	$5.36	$10.43	$19.13
Source: Texas Water Development Board, Office of Water Resources Planning						

Steam-electric

Table C-4: Distribution of Impacts among Major River Basins (Steam-electric)						
Lost Sales ($millions)						
Sales	2010	2020	2030	2040	2050	2060
Nueces-Rio Grande	$0.00	$6.67	$14.73	$49.09	$73.75	$210.46
Rio Grande	$0.00	$0.00	$0.00	$0.00	$1.96	$8.77
Total	$0.00	$6.67	$14.73	$49.09	$75.70	$219.23
Lost Income ($millions)						
Sales	2010	2020	2030	2040	2050	2060
Nueces-Rio Grande	$0.00	$4.48	$9.90	$33.01	$49.59	$141.11
Rio Grande	$0.00	$0.00	$0.00	$0.00	$1.32	$5.88
Total	$0.00	$4.48	$9.90	$33.01	$50.91	$146.98
Job Losses (numbers may not sum to figures in text due to rounding)						
Sales	2010	2020	2030	2040	2050	2060
Nueces-Rio Grande	0	37	83	275	413	1,179
Rio Grande	0	0	0	0	11	49
Total	0	37	83	275	424	1,228
Lost Business Taxes ($millions)						
Sales	2010	2020	2030	2040	2050	2060
Nueces-Rio Grande	$0.00	$0.80	$1.77	$5.91	$8.88	$25.14
Rio Grande	$0.00	$0.00	$0.00	$0.00	$0.24	$1.05
Total	$0.00	$0.80	$1.77	$5.91	$9.12	$26.18
Source: Texas Water Development Board, Office of Water Resources Planning						