

**An Economic Impact Analysis of a Proposed
Local Enhanced Management Area for
Groundwater Management District #4**

by

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ABSTRACT

While Kansas, and specifically western Kansas, are known by many to be the backbone of agriculture in our nation, much of that productivity has been built on the heels of the invention and efficiency of irrigation technology. Unfortunately, recharge and replenishment of the High Plains - Ogallala Aquifer has not kept pace with the demands of agricultural production, and current indications state that without the implementation of conservation or management practices that the aquifer in Kansas could be depleted by 2060 (Steward, et al. 2013). The producers of Kansas are committed to long-term solutions to preserve their way of life, espouse their commitment to natural resources and the environment, and ensure the viability of their operations for years to come.

This study analyzed the economic impact of a proposed Local Enhanced Management Area (LEMA) for Groundwater Management District (GMD) #4. While there currently is a LEMA in a portion of GMD #4 known as the Sheridan 6 LEMA, the board of GMD #4 has initiated the process to institute a district-wide LEMA that would affect a large portion of the 10-county area of the groundwater management district (Cheyenne, Rawlins, Decatur, Sherman, Thomas, Sheridan, Graham, Wallace, Logan, and Gove Counties).

To complete the analysis for the proposed policy change, multiple scenarios were derived using the IMPLAN software. The first model serves as the baseline scenario and provides status quo information on the current irrigated cropping economics of GMD #4. The second scenario assumes that a district-wide LEMA would require a 25% reduction in groundwater use, compared to current irrigation practices. To achieve this reduction in

groundwater use, irrigated acreage was reduced by 25% and transitioned to dryland production. For the third and final scenario, an optimal irrigated crop-mix ratio is determined based on the current shift in production as reported by the producers in the Sheridan 6 LEMA. While this scenario does not reduce irrigated acres, it shows the economic gains that can be captured by using less water-intensive crops as part of the crop-mix ratio. The reduction in irrigation is also imbedded in that the acreage in which production is shifted away from is more water intensive towards acreage that is less water-intensive.

Due to a reduction in groundwater use for irrigation, the study determined that there is a negative economic impact in relation to employment and total output in the GMD #4 area. There are 173 less individuals employed from the 25% reduction in groundwater use. Additionally, direct output is reduced by \$44.6 million and total output is reduced by \$60.0 million. This equates to a \$194.49 reduction per acre on a per-acre basis. The study further showed that the economic impact could be lessened by the use of a crop-mix shift as evidenced in the current Sheridan 6 LEMA. The assessment of a crop-mix shift decreased the loss of direct output by \$12.0 million to \$265.0 million and total output by \$16.5 million to \$357.1 million. On a per-acre basis, this is a reduction of \$140.97, or mitigation of \$53.52 in loss per acre due to the use of an optimal crop-mix shift.

While agricultural production is highly dependent on many factors, it can be universally agreed that the landscape of agriculture would be different if water was not an available resource. It is the hope that this research will provide a starting point for the

producers of GMD #4 to have a conversation about the economic costs associated with the implementation of a LEMA, as well as discuss other options and opportunities to make educated, well-informed decisions that are impactful both now and for generations to come.

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CHAPTER I: INTRODUCTION

1.1 Introduction

There are few resources in the world as precious as water. The great philosopher and artist Leonardo da Vinci even said, “Water is the Driving Force of all Nature” (Climate Disclosure Standards Board 2016). To the casual observer, it might seem that water is found in never-ending, abundant supply – in the form of streams, lakes, ponds, aquifers, and wells. On a daily basis, water is often overlooked as a finite resource, and that it cannot fully regenerate in some instances. In numerous locations, including Kansas, action must be taken to protect this commodity, as well as the communities that depend on it. Water is not simply a natural resource, but it provides the backbone of social, financial, and economic markets and interactions in parts of Kansas - past, present, and future.

In no area of Kansas are these issues more apparent than in the western third of the state, an area known for cattle production, irrigation, and value-added agriculture enterprises. In 2016, Kansas ranked third in the nation for commercial red meat production and cattle on feed inventory, most of which occurred in the western portion of the state. Furthermore, Kansas was second in the nation for total cropland acres at over 28.5 million, many of which were irrigated for agricultural production (United States Department of Agriculture - National Agricultural Statistics Service 2016). This area of agricultural production uses 30% of groundwater for irrigation in the nation from the Ogallala Aquifer, a large expansive body of water that underlies a 174,000-square mile region stretching from Texas to South Dakota (United States Department of Agriculture -

Natural Resources Conservation Service 2012). While regulation is frequently viewed as a top-down approach, water rights are personal property matters. The Ogallala Aquifer has provided recreation, commerce, and sustenance since the time of the Miocene, but it is sometimes hard to evaluate or conserve something that is a part of everyday life that you take for granted (Ludvigson, et al. 2009). To ensure the continued viability and vitality of the aquifer for future generations, it is important to consider possible strategies for mitigation and advancement.

1.2 Research Question and Objective

Without water conservation initiatives or policies, the Ogallala Aquifer could be depleted by 2060 (Steward, et al. 2013). Previous research has addressed the estimated economic impact of various policies in a diverse set of geographic locales, including northwest Kansas, the Rattlesnake Creek sub-basin, and others. In two counties in northwest Kansas, Sheridan and Thomas, producers formed a Local Enhanced Management Area (LEMA) in 2012 entitled the Sheridan 6 that was approved by the Kansas Department of Agriculture Division of Water Resources on 12/31/2012 (Kansas Department of Agriculture 2017c).

Extensive monitoring of agronomic and hydrologic data and conditions have occurred during the tenure of the LEMA, allowing a baseline of data from both inside the subarea and outside. LEMA's are approved by the Chief Engineer of Kansas for a period of five years, and the Sheridan 6 LEMA was approved for another 5-year period from 2018-2023. While only three years of real-time data are available, preliminary evidence indicates that there are small long-run economic effects from participation in the Sheridan 6 LEMA. Interest in a district-wide (Groundwater Management District #4) LEMA has

piqued, necessitating the need for review of the Groundwater Management District as a whole. The objective of this thesis is to complete an economic impact study of a proposed Local Enhanced Management Area (LEMA) in Groundwater Management District (GMD) #4. More specifically, this research:

- 1) Completes an economic impact analysis of GMD #4 using input-output (I-O) modeling under status quo conditions (ex-ante analysis)
- 2) Completes an economic impact analysis of GMD #4 using input-output (I-O) modeling under the groundwater management reduction conditions currently stated on the LEMA request, as submitted to the Chief Engineer of the Kansas Department of Agriculture, Division of Water Resources
- 3) Completes an economic impact analysis of GMD #4 using input-output (I-O) modeling under the reduction conditions as stated above, modeled after the hydrological and crop-mix conversion data obtained in a 2016 study completed by Golden of the Sheridan 6 LEMA

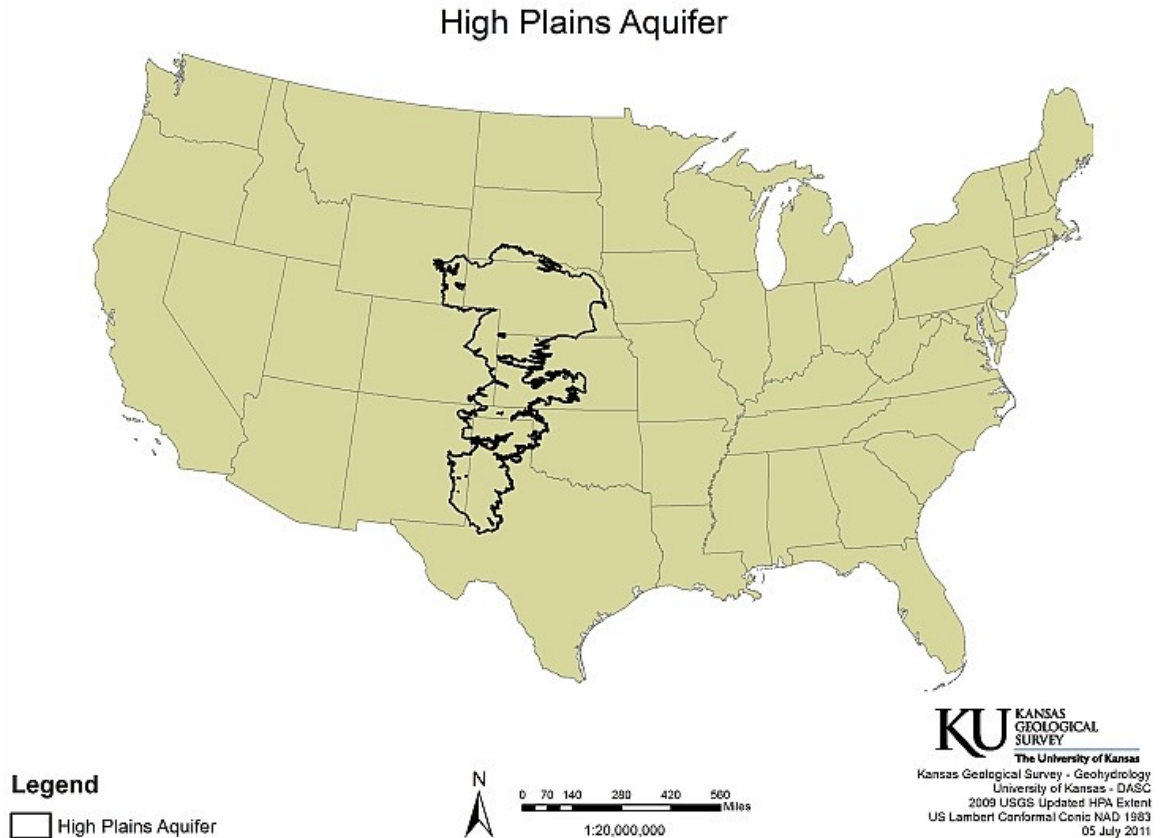
This study will assist farmers, ranchers, agribusiness owners, interested stakeholders, and the general public in estimating the economic impact from the implementation of a LEMA.

1.3 History and Overview

The High Plains Aquifer is an expansive underground geological formation that stores and transfers groundwater over an eight-state region of the central United States, from South Dakota in the north to Texas in the south, covering approximately 174,000 square miles (Figure 1.1). The High Plains - Ogallala is the largest freshwater aquifer in the world by volume, lending 81% of the water in the High Plains region (Stewarding our Aquifer 2017). Within Kansas, roughly 30,500 square miles overlay the High Plains

Aquifer, with the largest subdivision being that of the Ogallala Aquifer (Kansas Geological Survey 2017).

Figure 1.1: Map of High Plains Aquifer



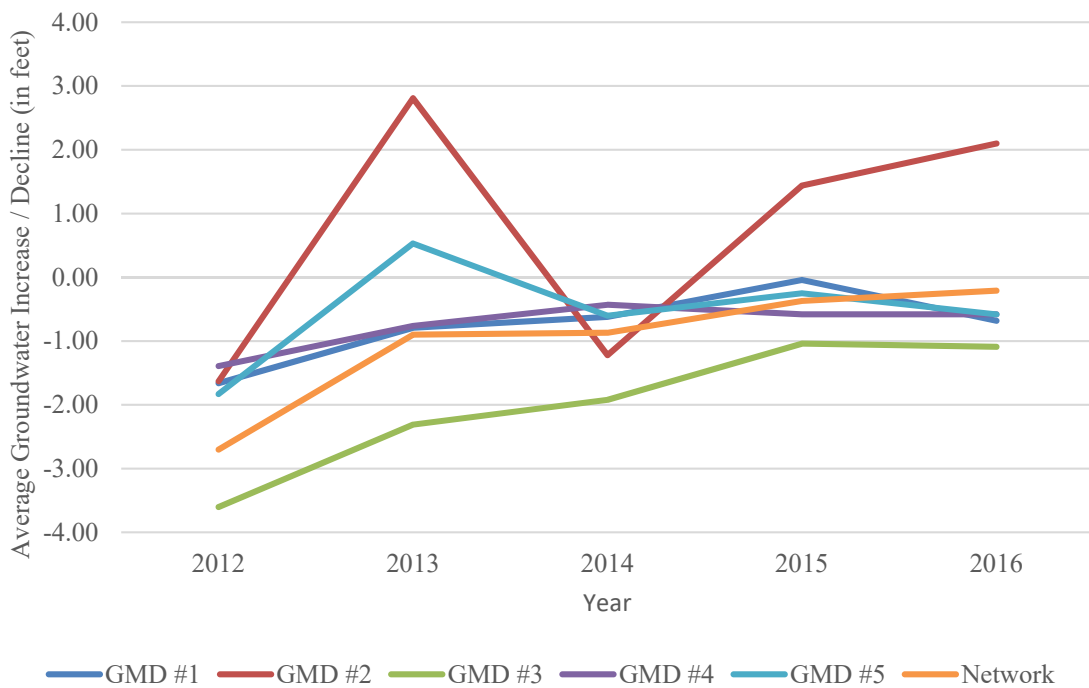
Source: Kansas Geological Survey, University of Kansas

Since the advent of irrigation technology, the Ogallala has been a primary source of water for irrigation in western Kansas. Additionally, the aquifer provides one-fourth of the water supply for agricultural production in the entire United States (Taghvaeian, et al. 2017). The demand for irrigation has caused a significant reduction in the saturated thickness for the High Plains Aquifer in Kansas.

By legislative declaration, the Groundwater Management District Act was established in 1972 (and enacted in 1978) for “the proper management of the groundwater

resources of the state, for the conservation of groundwater resources, and for the prevention of economic deterioration” (Kansas Statute 1972). Based upon the doctrine of local control and action of water right holders, the creation of Groundwater Management Districts provided a framework for a democratic, local approach towards water conservation and regulation. There are currently five (5) Groundwater Management Districts in operation within Kansas, the largest two being Groundwater Management District #3 (GMD #3) in southwest Kansas and Groundwater Management District #4 (GMD #4) in northwest Kansas (Kansas Department of Agriculture 2017b).

Figure 1.2: Average Annual Groundwater Change in Kansas, 2012-2016



Source: Kansas Geological Survey, WIZARD Database

From the middle of the twentieth century and well into the next, the level of the aquifer continued to decline. From 1950 to 2011, the High-Plains - Ogallala Aquifer saw a reduction of 267 million acre-feet of water or 8% of the capacity of the entire system

(U.S. Geological Survey 2014). The average annual groundwater change in Kansas from 2012 to 2016 (Figure 1.2) showed declines ranging from approximately 2.7 feet in 2012 to roughly -0.25 feet in 2016. While some areas improved, such as Groundwater Management District #2, the system as a whole still show declines.

Multiple methods, both at the state and local levels, have been instituted to address the situation. One of the first options, instituted in 1978, were intensive groundwater use control areas, or IGUCA's. Nine IGUCA's exist in Kansas, but producers felt that these remedies were top-down approaches from the state. In response to the declining state of the water table, individual agricultural producers, along with the Groundwater Management Districts, took a proactive approach to extend the useful life of the Ogallala Aquifer. In 2012, the Groundwater Management Districts Act was updated to allow GMD's the authority to initiate the process for local conservation planning efforts to establish a Local Enhanced Management Area (LEMA) (Kansas Statute 2012). There is currently only one active LEMA in Kansas, located in Sheridan and Thomas Counties, but the expansion of the LEMA to include all counties located in Northwest Kansas has begun. The official proposal for a district-wide LEMA for GMD #4 was filed with the Kansas Department of Agriculture Division of Water Resources on June 8, 2017, and was found acceptable for possible approval. As of the date of this thesis, the public hearing process for the formation of the district-wide LEMA has begun, but has not been completed (Kansas Department of Agriculture 2017a).

It is important to note that extensive research has been conducted on the High Plains - Ogallala Aquifer system from multiple hydrologic, sociologic, and economic perspectives. Many choices are not discrete variables with the ability to be examined in a

closed-model setting. The Ogallala Aquifer is one of those issues in which simple, definitive solutions might not be easily determined.

1.4 Challenges

While economic impact modeling is important, the practice itself is not without flaw. Economic impact modeling, or I-O (input-output) modeling in this situation, is fairly easy to use and the results can be clearly explained and shared. However, assumptions are required in the modeling process and must be explicitly notated. Developed by Wassily Leontief, the input-output model determines the interdependence of sectors in a national or regional economy (Leontief 1985). All inputs are rarely obtained within a given regional economy (imports are required); thus, it is important to select an appropriate regional economy for the sectors in the model. Additionally, it is important to note that Economic Impact Analysis (EIA) is not the same as Cost-Benefit Analysis (CBA). Furthermore, it has been found that economic impact modeling often overstates employment changes. The challenges of I-O modeling can often be overcome by application of sound economic principle to modeling methods and the method is especially useful for comparison. Economic impact modeling provides a “point-in-time” snapshot; however, this function also leads to the fact that the underlying data matrices change from year to year. According to Leontief himself, “none of the figures entered in the present input-output tables were obtained through immediate observation. Most have been arrived at through application of the usual indirect estimating procedures to various well-known sets of primary data” (Leontief, Some Basic Problems of Empirical Input-Output Analysis 1955).

CHAPTER II: LITERATURE REVIEW

2.1 Introduction

The literature review is broken down into two distinct categories; first, a review of input-output analysis, followed by a review of applicable water and conservation economic policy analysis.

2.2 Regional Economic Impact Modeling

Economic Impact Analysis or Input-Output modeling has been used extensively in government, academia, and policy application since Leontief created the first industry account tables in the 1930s. As stated by Leones et al. (1994), “one of its most common uses is in determining the size or importance of an industry or set of industries” (p. 1123). This multi-industry analysis underscores the requirements in not only selecting the correct industries to include in the analysis, but also in communicating this inclusion to those who are beneficiaries of the data. Leones et al. states, “agricultural economists have a responsibility to make sure that such studies follow acceptable procedures in economic accounting” (p. 1123).

At one time, agriculture was more defined from farm to fork. Now, agricultural manufacturing, value-added processing, and related industries have made it much more difficult to discern which industries to include in a multi-industry analysis. Input-Output analysis provides vital tools for economic modeling, especially when comparing multiple states or regions and in terms of the economic impact that agricultural sectors have on the overall economy. Input-Output analysis determines differing levels of inter-industry linkage, that can be determined by looking at type I, type II, and type SAM output multipliers. Type I multipliers capture indirect effects in the economy, whereas type II multipliers estimate the effect on both indirect and induced sectors in the region. The type

SAM multiplier is very similar to the type II multiplier, but includes industrial, household and institutional responding that are included in the predictive model (Bess and Ambargis 2011). Throughout the entire process sectors are identified by SIC (Standard Industrial Classification) or NAICS (North American Industry Classification System), and the inclusion of specific industries might overstate the final economic impact (Leones, Schlutter and Goldman 1994).

Once the sectors or industries for a multi-sector analysis have been determined, the application of the I-O model can be determined. The model must be built following a prescriptive process of determining the inter-relationships between each of the sectors (Heady and Schnittker 1957). For example, in production agriculture, a single sector uses and procures inputs from a variety of other sectors. A commodity farmer who plants corn purchases inputs from a seed dealer, who in turn purchases inputs from a wholesaler. The model divides each sector into the summation of the output that is provided to these additional sectors, becoming input for the other sectors. This method of dividing and calculating the intermediate output of the sectors that is transferred to other sectors in the analysis ensures that double counting does not occur. If double counting occurred, the output and economic contribution would be greatly overstated. At each step, the amount of product destined for final consumption is determined, as this is the final output of each sector that reaches the market as finished product (Heady and Schnittker 1957). Heady and Schnittker (1957) suggest that interdependence coefficients can be illustrative in notating these inter-industry relationships, as they exhibit the average change of a good or service (sector) from a one-dollar change in direct consumption or final demand of another sector. As displayed in Table 2.1, a one-dollar change in the oilseed industry in Kansas in 2015

leads to a \$0.06 increase in the sector of wholesale trade, when incorporating both indirect and induced effects.

Table 2.1: Top 10 Inter-Industry Economic Multipliers for Oilseed Farming Sector in Kansas, 2015

Sector	Description	Type I Multiplier	Type SAM Multiplier
395	Wholesale trade	0.05	0.06
19	Support activities for agriculture and forestry	0.04	0.04
440	Real estate	0.04	0.06
156	Petroleum refineries	0.02	0.03
62	Maintenance and repair construction of nonresidential structures	0.02	0.03
262	Farm machinery and equipment manufacturing	0.02	0.02
437	Insurance carriers	0.01	0.02
411	Truck transportation	0.01	0.02
172	Pesticide and other agricultural chemical manufacturing	0.01	0.01
10	All other crop farming	0.01	0.01

Source: IMPLAN

Heady and Schnittker (1957) focus on the fact that input-output models are completed at a single point in time and are appropriate for description and comparison in determining relationships. They hold that the long-term projective value is less appropriate, except in the case of minor adjustments expected in the near to immediate future.

Hamilton, Whittlesey, Robison, and Ellis (1991) show the advantages of using I-O modeling for assessing the impact, both positive and negative, from specific events. In their work, they not only address the fact that regional analysis is beneficial for estimating both direct and secondary (indirect and induced) impacts, but also some of the issues that can come from the use of the method. It is important to have an understanding of these issues and limitations of I-O modeling. One such limit of input-output modeling is that the technique only estimates and captures backward linkages between related industries and applies this as secondary impacts. In certain situations, forward linkages are also important, but also difficult to capture and measure. Another issue that can have wide-ranging

implications in an I-O model is the geographical or political boundary determined in the area of study. Selection of a particular boundary can have vast consequences. Furthermore, in the Hamilton et al. article, “it is usually a methodological error to use project impact on value added as the measure of project regional benefits or costs” (Hamilton, et al. 1991, 335). Heady and Schnittker (1957) discussed the interdependence of coefficients in input-output modeling, while Hamilton et al. highlight the usage of interregional spillover coefficients to show the impact of proper selection of a “region” in a model and the connectivity of certain areas, regardless of political boundary.

The use of input-output analysis for regional water management was studied by Hartman (1965). He contends that water use and allocation models are unique because the outside factor change relates to an input of a sector, rather than the final demand (Hartman 1965). Hartman points out the interdependence of sectors and notes that they vary significantly, based on the analysis or industry change. He hypothesizes the ability to follow a one-way estimation model for agricultural sectors, due to the fact that producers and manufacturers seldom rely on down-stream organizations in their input scenarios. Hartman warns against spurious linkages resulting from combining non-similar sectors in an agricultural analysis and cautions against utilizing complex methods when more simple approaches might be appropriate (Hartman 1965).

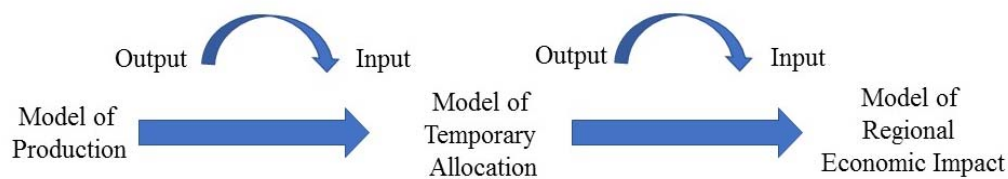
2.3 Water and Conservation Economics

The regional economic impact of a proposed local enhanced management area (LEMA) is grounded in the study of water economics. Studies have been performed in differing time periods and geographic regions to determine the implication of policy implementation, changing model assumptions, and differing management practices. Amosson et al. studied the economic impact of five different water conservation policies in

the Southern Ogallala Aquifer region. The five water conservation policies included the implementation of biotechnology, adoption of irrigation technology, a restriction of water use, voluntary temporary conversion to dryland agricultural production, and a voluntary permanent conversion to dryland agricultural production (Amosson, et al. 2009). These policies were compared against a baseline scenario of no water conservation policy, or a status quo scenario. Over a 60-year planning horizon, the study determined that the implementation of biotechnology and water use restriction policies resulted in an increase in saturated thickness of water. It is also notated that irrigation policies are not impactful alone, but coupled with water use restrictions can result in water conservation. Additionally, “any water conservation policy that is implemented will make the regional economy worse off with the exception of biotechnology and irrigation technology” (in certain regions) (Amosson, et al. 2009, 47).

Golden, Peterson, and O’Brien (2012) examined the potential economic impact of water use change and/or restrictions. Models of production, temporal allocation, and regional economic impact are used.

Figure 2.1: Flow Chart of Economic Impact Modeling



As part of the study, the overall economic impact of three alternative policy options were evaluated: the continuation of agricultural operation at the status-quo with current water use, immediate conversion of all irrigated acreage to non-irrigated acreage, and a 30% reduction in current water use. The 30% reduction in current water use was modeled

under three separate water management techniques: the institution of a Conservation Reserve Enhancement Program (CREP), a water rights buy-out program, and an immediate shift from irrigated cropping practices to a limited irrigation option. Both short-run and long-run economic impacts were viewed and compared to the status quo scenario and value added was looked at as a means of determining the local economic impact and as a metric for comparison of the policies (Golden, Peterson and O'Brien 2012).

The study found that a conversion of all irrigated acreage to dryland acreage in the study area would result in lost value added of \$172,381,183 over the 60-year planning horizon. In contrast, a 30% reduction in current water use created total lost value added of \$28,214,016, \$24,208,710, and \$66,132,000 for the three policy options - limited irrigation, water rights buy-out, and CREP, respectively. The CREP option was the most expensive of the three water-usage reduction options, followed by limited irrigation and water rights buy-out. A successful policy for the Ogallala Aquifer might necessitate the combination of two or more of these policy options. Furthermore, the authors of the study note, "since this research does not attempt to place a value on the conserved water, it is not appropriate to use this net present value analysis to make the decision on whether or not water-use restrictions should be implemented" (Golden, Peterson and O'Brien 2012).

The only active local enhanced management district (LEMA) in Kansas is located in Groundwater Management District #4. A study by Golden provides information that might be transferrable to a district-wide LEMA. Golden notes that the LEMA has caused statistically significant changes in total groundwater use, as well as the total crop acreage of multiple crops, affecting the crop-mix ratio (Golden 2016). For example, from 2013-2016, total groundwater use in the Sheridan 6 LEMA compared to the control area showed a

25.3% reduction. Additionally, as shown in Table 2.2, individual crop acreage allocations have been affected by the implementation of the LEMA, with irrigated grain sorghum acreage increasing 406.2% and irrigated corn acreage decreasing by 22.8%.

Table 2.2: Impact of Local Enhanced Management Area (LEMA) on Sheridan 6 Crop Acreage, 2013-2016

Crop	Impact
Irrigated Corn	-22.8%
Irrigated Alfalfa	-4.9%
Irrigated Grain Sorghum	406.2%
Irrigated Soybean	-13.5%
Irrigated Wheat	95.0%
Irrigated Mixed Crop	-18.3%

This information shows that producers within the Sheridan 6 LEMA have modified their crop-mix ratios to comply with the reduced groundwater restrictions.

CHAPTER III: THEORY, MODEL, AND METHODS

3.1 Profit Maximization Theory

Within economics, it is well accepted that firms and organizations maximize profit. To obtain profit from the sale of goods or services, a firm will seek to maximize their total revenue, while at the same time minimizing cost to produce that output. Agricultural producers grow and market a crop up to the point that the marginal revenue received from producing another unit of a grain or forage equals the marginal cost of producing another unit of the grain or forage. With this theory, producers seek to maximize their total overall profit and adjust their crop if the return from the production of another crop is greater than the current crop produced. This thesis assumes that producers within Groundwater Management District #4 and the proposed Local Enhanced Management Area (LEMA) maximize profit for their individual operations. This theory does not account for externalities of natural resources. It can be argued that producers will select water conservation and management policies that allow them to maximize profit over the long-run time horizon using net present value.

3.2 Model of Regional Economic Impact

As previously discussed, an economic impact analysis can be useful for policy at the local, state, and federal level. One of the most widely used forms of regional economic impact analysis is the Input-Output (I-O) model, or a technique that uses I-O accounts and tables, along with economic multipliers, to determine the total economic impact of an industry change. In addition to determining the economic activity of the change, I-O

modeling can provide a snapshot of the change in employment, value added, and tax ramifications of the project or industry.

3.2.1 Regional Economic Impact Analysis Overview

With a regional economic impact analysis, the selected economy can be described as a “closed” economy where outputs from one sector become inputs for another sector. This circular flow of goods and services continues through the economy until they are finally exported from the study region. One of the main goals of an economic impact model is to determine the inter-relationships or backward linkages between goods and services in an economy and determine the strength of the relationship. Additionally, the composition of a robust regional economic impact analysis ensures that output or industries are not double-counted and that the economic impact is only calculated at the point that a good or service becomes available for consumption or final end use.

3.2.2 Implan Explanation

One of the most widely used software packages for I-O modeling is IMPLAN, or Impact Analysis for PLANning. Originally started in the late 1970s due to the need for management plans for the U.S. Forest Service, the data collected and compiled became available for public use. In 1993, the Minnesota IMPLAN Group (MIG, Inc.) was formed to focus on data for public sale. IMPLAN is used for economic modeling, policy analysis, and planning purposes by academia, government, and private organizations. IMPLAN data is compiled from the Bureau of Labor Statistics, Bureau of Economic Analysis, and Ag Census Data allowing for multiple software options at the federal, state, county, and Zip code level. Data are compiled every year; however, due to the timing of reporting and review procedures, updated information for a specific year is not available for approximately 12-18 months.

IMPLAN uses a framework of Input-Output accounts to determine the flow of goods and services within a given economy, while also employing Social Accounting Matrices (SAM) and accepted multipliers. An input-output matrix is established, where the rows indicate how the output of each sector is connected to other sectors in the economy. The columns indicate how each sector obtains inputs from the other sectors in the modeled economy. The Social Accounting Matrix (SAM) is an extension of the I-O matrix in that the rows and columns do not exhibit sectors in the economy, but rather buyers and sellers in the economy. The Social Accounting Matrix contains the structure and composition of the economy for a given year and is instrumental in understanding transactions and relationships.

Currently, there are 536 distinct sectors available in IMPLAN. Each sector contains an aggregation of multiple NAICS (North American Industrial Classification System) codes, allowing for analysis at the NAICS+4 or NAICS+6 level.

3.2.3 Direct, Indirect & Induced Effects

It is important to have an understanding of regional economic impact analysis and I-O modeling to fully grasp the process and results produced. Results of Input-Output models estimate a direct effect, indirect effect, and induced effect. These three values sum to equal the total effect. The direct effect in an agricultural-related model captures the value of the goods or services produced by the industries modeled, or the value of the goods at the “farm gate.” Agricultural producers and businesses purchase inputs necessary to make or process goods or services, and a change in the industry or sector creates a change in the supporting or ancillary industries in which they obtain services and supplies. This is called the indirect effect. Finally, growth or expansion of an industry stimulates employment (wages) in the sector, allowing employees additional disposable income to spend in the

local economy – the induced effect. The sum of the direct, indirect, and induced effect equal the total effect, or the total output, employment, labor income and value added from a specific industry change (Table 3.1).

Table 3.1: Economic Impact Summary of Agriculture, Food, and Food Processing in Kansas, 2015 Data in 2017 Nominal Dollars

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	125,715	\$6,158,610,103	\$9,805,298,245	\$47,940,354,172
Indirect Effect	64,207	\$3,985,956,872	\$6,419,450,787	\$11,957,098,963
Induced Effect	56,956	\$2,305,448,158	\$4,213,001,039	\$7,563,649,223
Total Effect	246,877	\$12,450,015,134	\$20,437,750,071	\$67,461,102,358

Source: Kansas Department of Agriculture

More specifically, the employment impact contribution includes all workers, both hourly wage earners and salaried individuals, as well as those who are self-employed. Labor income collects payments earned in the form of salaries and wages, including proprietor income earned by those who are self-employed or unincorporated business entrepreneurs. Value Added is the difference in value of an industry’s final output and the cost of intermediate inputs. Value added includes compensation of employees, taxes on production and imports, and gross operation surplus. Gross value added “is a measure of the contribution to GDP made by an individual producer, industry or sector” (International Monetary Fund 2004).

3.2.4 Multipliers

One way in which the regional economic impact is determined is through the use of economic multipliers. Within IMPLAN, as well as other I-O modeling software packages, multipliers are the means by which direct, indirect, and induced effects are determined. Multipliers capture the change in marginal activity within an industry or sector as economic activity changes within the modeled economy. To understand how a change in one industry

affects other industries within the economy, it is important to understand how economic multipliers are calculated. An explanation of the multipliers and their given effects are:

1. Direct Effect – The Direct Effect captures the contribution of the modeled sector or sectors to the end-use consumer. As these contributions do not “ripple” through the economy, the direct effect multiplier is a value of 1.0.
2. Indirect Effect – The Indirect Effect captures the contribution of the modeled industry on the sectors that provide input supplies for it. For example, an indirect multiplier of 0.33 for the oilseed farming industry illustrates that for every dollar increase in output for the oilseed industry there is a \$0.33 increase in the economy for input suppliers. In IMPLAN, the indirect effect is captured by the Type I Multiplier, or the sum of the direct effect plus the indirect effect divided by the direct effect.
3. Induced Effect –The Induced Effect captures marginal change in spending as a result from a change in the Direct Effect. An increase in the Direct Effect will supply more wages and spending for both the industry of study and indirectly affected industries. As with the Indirect Effect, a one-dollar change in the industry(s) of study will cause a specific increase in tertiary industries as these wages move through the economy in industries not directly linked to inputs (Day n.d.).

In IMPLAN, the Total Effect is determined by the SAM Multiplier, or the sum of the Direct, Indirect, and Induced Effect divided by the Direct Effect (1.0). If a single sector has a SAM Multiplier of 1.5, it can be determined that a \$1.00 increase in output from the sector creates \$0.50 of additional output or effect in the region of study. Multipliers can be

used to study the impact of employment, labor income, and value added as a result of the proposed change.

3.2.5 Selecting a Region

As part of a regional economic impact analysis, the selection and definition of the region is of vital importance. Not only are the basic assumptions of the model determined, but the selection of an incorrect region can lead to skewed results. Therefore, when completing a regional economic impact analysis, it is important to evaluate the location of suppliers, the location of the labor supply, and additional factors that will modify the gross regional product, base employment, or import requirements of the region. For example, in an analysis of a single agricultural business that is located in County A, it is common that they obtain labor supply from neighboring County B and inputs are supplied from a primary input supplier in County C. In this scenario, a more robust analysis is provided if all three counties (County A, B, and C) are included in the model. While it is best in this situation to include all three counties, it is often functionally important to select the most inclusive area, while maintaining the smallest area possible for study purposes (Watson, et al. 2007). From the selection of a particular region, aggregate data of the entire region, such as Gross Regional Product (GRP), total employment, and additional demographic information can be determined. After an analysis has been completed for a specific industry or sector, the percentage or proportion of the entire regional economy can be determined for comparison.

3.2.6 Assumptions

It is important to note that while the economic and statistical data used in an I-O model can be replicated, multiple assumptions are often required for the analysis to be completed. It is imperative that all assumptions made in the process of the model are explained and

sources of all data cited. All assumptions made within the context of this project, as well as calculations when appropriate, provide for a basic understanding of the process and methods employed. Additionally, due to the fact that I-O modeling provides room for flexibility and interpretation by the practitioner, it is important to note that economic impact models prepared by differing modelers should be compared against their own results and trends.

3.3 Methods

The objective of this thesis is to complete an agricultural economic impact study of a proposed Local Enhanced Management Area (LEMA) in Groundwater Management District (GMD) #4. The first task of an economic impact study is to determine the “region” for the study. In this instance, GMD #4 comprises all or a portion of ten counties in northwest Kansas including Cheyenne, Rawlins, Decatur, Sherman, Thomas, Sheridan, Graham, Wallace, Logan, and Gove Counties. According to the Kansas Department of Agriculture, there are currently 65 agriculture, food, and food processing sectors in Kansas, of which 14 constitute production agriculture. The sectors present in Kansas related to production agriculture are in Table 3.2. A selection of the industries present are beef cattle ranching and farming, grain farming, oilseed farming, and vegetable and melon farming. These 14 sectors are directly involved in food and agriculture production at the farm and ranch level; thus, they are classified as “production” agriculture.

Table 3.2: Production Agriculture Sectors present in Kansas, 2017

Sector	Sector Description
1	Oilseed farming
2	Grain farming
3	Vegetable and melon farming
4	Fruit farming
5	Tree nut farming
6	Greenhouse, nursery, and floriculture production
8	Cotton farming
10	All other crop farming
11	Beef cattle ranching and farming
12	Dairy cattle and milk production
13	Poultry and egg production
14	Animal production, except cattle and poultry and eggs
16	Commercial logging
18	Commercial hunting and trapping

Source: IMPLAN

To complete the task of this objective, the following method is used to determine the economic viability of the proposed policy option (LEMA) in GMD #4.

For sub-objective 1, the baseline scenario (status quo scenario) is used as a benchmark based upon current irrigated cropping acreage in the GMD #4 study area. Only economically significant commodities are included in the model – corn, grain sorghum, soybeans, and wheat. Budgets from the Kansas State University (KSU) Agricultural Economics Farm Management Guides are used to determine the gross income per bushel/acre, and a five-year average is determined to smooth price fluctuations. Output or total direct impact is determined for each crop based on current acreage times the five-year average gross income per acre obtained from KSU Ag Econ Farm Management Guide data (KSU Agricultural Economics 2017). Direct impact of each crop is modeled based on the corresponding IMPLAN code, either for oilseed farming (soybeans) or for corn, grain sorghum, and wheat. To ensure an accurate analysis of the trade flows, the Local Use

Ratio, or Regional Sales Coefficient (RSC) within IMPLAN is updated to 0 so that purchases will not be made from local industry in excess of that specified in the initial scenario. In addition, the commodity production amount for each modeled industry is modified to the sectors being analyzed. Trade flows apply to specific commodities, and not entire industries. Thus, the commodity production amount must be updated to the primary commodity to ensure that the trade flows are applied in the appropriate manner

For sub-objective 2, an economic impact analysis is modeled with a groundwater reduction applied as projected based on the current district-wide LEMA request. The sectors modeled in the scenario for sub-objective 1 are modeled for sub-objective 2. However, the production function is modified by the appropriate reduction in groundwater. Currently, GMD #4 has allocated water rights of 848,500 AF (acre-feet) per year. The current district-wide LEMA request, GMD #4 intends to limit their total water usage to 1.7 million acre-feet of irrigation usage, applicable to all townships that show a 0.5% or greater annual water decline over an 11-year period of 2004-2015. According to the LEMA request, no individual water right shall be reduced by more than 25%, and was arrived at by calculating “five (5) times the sum of designated legally eligible acres times the amount designated for irrigation water rights” as specified in the LEMA request (Northwest Kansas Groundwater Management District No. 4 2017). Based on the assumption that 25% of the crop would face limited-irrigated practices, total output is adjusted and cost information is obtained from KSU agricultural economic data provided on Agmanager.info (KSU Agricultural Economics 2017).

For sub-objective 3, modifications are made to the scenario allowing for changes in the long-run crop-mix to determine the economic impact for the entire district if crop

production shifted similar to the shift in the current Sheridan 6 LEMA. A recent study of the Sheridan 6 LEMA by Golden found that total irrigated corn, alfalfa, grain sorghum, soybean, and wheat acres have shifted, in accordance with the availability of limited irrigation resources. Buller (1988) and Wu, Bernardo, and Mapp (1996) found that agricultural producers modify their current crop mix to less water-consumptive crops to lessen potential revenue loss. The first three years of data from the Sheridan 6 LEMA indicate a change in the crop-mix ratio. For the purpose of this thesis, an assumption is that irrigated corn acreage will decrease by approximately 20%, grain sorghum acreage will increase by 400%, and irrigated wheat acres will increase by 95%. The change in irrigated alfalfa and irrigated soybean acreage was not large over the first three years of the Sheridan 6 LEMA, therefore an assumption will be made for no observable change in either of these crops.

Table 3.3: Proposed Crop-Mix Change from Implementation of District-Wide GMD #4 LEMA, Acres

Crop	GMD #4 LEMA Pre	GMD #4 LEMA Post	Impact
Irrigated Corn	232,897	180,000	-23%
Irrigated Grain Sorghum	6,864	30,900	350%
Irrigated Soybeans	36,459	36,459	0%
Irrigated Wheat	32,115	60,976	90%
Total	308,335	308,335	0%

Application of these assumptions for the entire GMD #4 area provides an estimate on cropping strategies that producers might implement to conserve groundwater resources and provide the greatest profit from their farming operation. Table 3.3 indicates a decrease of 23% is assumed for irrigated corn acreage, an increase of 350% is assumed for irrigated grain sorghum, and an increase of 90% is assumed for irrigated wheat acreage, and no acreage change is assumed overall. The percentage change in acreage is slightly different

from that of the Sheridan 6 LEMA due to rounding variations and total acreage available for irrigation in the GMD #4 study area.

CHAPTER IV: DATA, RESULTS & ANALYSIS

Data for the economic impact analysis is presented in four separate sections, one for the overarching study area and separately corresponding to the specific sub-objectives of the research. Assumptions are explicitly detailed for comparison to be made across the three separate scenarios.

4.1 GMD #4 Overall Regional Economic Impact

Within the 10-county region of GMD #4, information is obtained from IMPLAN, based on the sectors that are present in the overall area. The study area of the model has a total Gross Regional Product (GRP) of \$1,555,304,239 and there are 26,774 employees in the 10-county area. While there are 65 agriculture, food, and food processing sectors present in the entire state, GMD #4 contains only 22 of the sectors. The top 10 industries in the model area are listed in Table 4.1, while all 22 sectors contained in the GMD #4 study area, and their direct output contribution, are in Table 4.2.

Table 4.1: Top 10 Industries by Output in GMD #4 Region, 2015 Data in 2017
Nominal Dollars

Sector	Description	Employment	Output
11	Beef cattle ranching and farming	2,599	\$668,700,000
2	Grain farming	1,022	\$641,441,200
395	Wholesale trade	1,560	\$331,195,900
441	Owner-occupied dwellings	0	\$143,418,400
165	Other basic organic chemical manufacturing	71	\$131,379,000
20	Extraction of natural gas and crude petroleum	1,023	\$97,023,130
534	Employment and payroll of local govt-education	1,728	\$86,509,230
66	Other animal food manufacturing	66	\$85,660,980
533	Employment and payroll of local govt, non-education	1,809	\$79,970,900
61	Construction of other new residential structures	289	\$70,677,410

Source: IMPLAN

Table 4.2: Agriculture, Food, and Food Processing Sectors Present in GMD #4 Region, 2015 Data in 2017 Nominal Dollars

Industry Code	Description	Output
1	Oilseed farming	\$41,562,969
2	Grain farming	\$641,441,223
3	Vegetable and melon farming	\$145,285
6	Greenhouse, nursery, and floriculture production	\$1,185,783
10	All other crop farming	\$42,913,574
11	Beef cattle ranching and farming	\$668,699,951
12	Dairy cattle and milk production	\$25,151,720
13	Poultry and egg production	\$4,170,794
14	Animal production, except cattle and poultry and eggs	\$37,724,815
16	Commercial logging	\$34,151
18	Commercial hunting and trapping	\$2,427,891
66	Other animal food manufacturing	\$85,660,980
71	Soybean and other oilseed processing	\$39,170,715
84	Fluid milk manufacturing	\$24,782,406
89	Animal, except poultry, slaughtering	\$6,055,534
94	Bread and bakery product, except frozen, manufacturing	\$2,658,457
95	Frozen cakes and other pastries manufacturing	\$114,832
104	Spice and extract manufacturing	\$17,506,552
169	Nitrogenous fertilizer manufacturing	\$154,454
262	Farm machinery and equipment manufacturing	\$14,643,953
459	Veterinary services	\$6,887,212
469	Landscape and horticultural services	\$2,698,276

Source: IMPLAN

The beef cattle ranching and farming industry, including feedlots and dual-purpose ranching and farming is the largest industry in the GMD #4 study area (Tables 4.1 and 4.2). Grain farming is the second largest industry by output in the GMD #4 region with a direct output of over \$641.4 million. The economic impact analysis of GMD #4 using IMPLAN for all 22 agriculture, food, and food processing sectors produces the direct, indirect, and induced effects (Table 4.3).

**Table 4.3: Agriculture, Food, and Food Processing Impact in GMD #4 Region, 2015
Data in 2017 Nominal Dollars**

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	4,616	\$204,864,389	\$355,450,445	\$1,665,791,576
Indirect Effect	1,995	\$132,121,724	\$190,001,418	\$325,670,216
Induced Effect	1,310	\$34,568,590	\$74,218,683	\$143,053,922
Total Effect	7,921	\$371,554,702	\$619,670,546	\$2,134,515,714

Source: IMPLAN

Industry sales for the 22 included sectors in the 10-county GMD #4 study area were modeled to determine the impact of agriculture, food, and food processing in the study area. The model indicates that the 22 included sectors have a direct effect on the regional economy of nearly \$1.7 billion (Table 4.3). The sectors employ 4,616 individuals and contribute a value added of over \$355.4 million. Because the modeled sectors purchase inputs from other businesses in the regional area, the indirect effect is \$325.7 million. The primary sectors in the analysis stimulate the regional economy, causing a “ripple” effect when employees of direct and indirect-affected firms spend their wages at other businesses within the study area. The total economic output of the 22 sectors is over \$2.1 billion, value added is \$619.7 million, and the sectors employ 7,921 employees.

Additionally, Table 4.4 indicates the sectors with the greatest impact on the regional economy. For example, the SAM Multiplier for veterinary services is the highest multiplier at 1.38. This indicates that for every dollar spent in the local veterinary industry that \$0.38 is generated in other indirect and induced sectors of the economy.

Table 4.4: Agriculture, Food, and Food Processing Sector Type I and Type SAM Multipliers

Industry Code	Description	Type I Multiplier	Type SAM Multiplier
1	Oilseed farming	1.21	1.32
2	Grain farming	1.23	1.30
3	Vegetable and melon farming	1.05	1.28
6	Greenhouse, nursery, and floriculture production	1.07	1.37
10	All other crop farming	1.12	1.34
11	Beef cattle ranching and farming	1.17	1.26
12	Dairy cattle and milk production	1.18	1.29
13	Poultry and egg production	1.12	1.21
14	Animal production, except cattle and poultry and eggs	1.14	1.32
16	Commercial logging	1.22	1.29
18	Commercial hunting and trapping	1.15	1.24
66	Other animal food manufacturing	1.22	1.26
71	Soybean and other oilseed processing	1.25	1.29
84	Fluid milk manufacturing	1.18	1.23
89	Animal, except poultry, slaughtering	1.10	1.15
94	Bread and bakery product, except frozen, manufacturing	1.14	1.27
95	Frozen cakes and other pastries manufacturing	1.18	1.27
104	Spice and extract manufacturing	1.15	1.29
169	Nitrogenous fertilizer manufacturing	1.26	1.32
262	Farm machinery and equipment manufacturing	1.18	1.25
459	Veterinary services	1.25	1.38
469	Landscape and horticultural services	1.18	1.34

4.2 Sub-Objective 1, Status Quo Scenario

The completion of an economic impact analysis for the status quo situation in the GMD #4 area is predicated on the following information: an eight-year average of irrigated acreage for the proposed LEMA, as well as a five-year average of landowner gross income for irrigated cropping practices in northwest Kansas. Based upon information from the Water Information Management and Analysis System managed by the Kansas Department of Agriculture, Division of Water Resources and the Kansas Geological Survey, the 8-year average of irrigated acreage in the proposed GMD #4 LEMA area from 2009 to 2016 is reported in Table 4.5.

Table 4.5: Average Irrigated Acreage – GMD #4 Proposed LEMA, 2009-2016

Crop	Acreage	Percentage
Alfalfa	5,856.7	1.59%
Sunflowers	4,062.3	1.10%
Corn	232,897.4	63.29%
Grain Sorghum	6,863.5	1.87%
Soybeans	36,459.4	9.91%
Wheat	32,114.9	8.73%
Other	49,753.8	13.52%
Total	368,008.0	100.00%

For the purposes of this research, only irrigated corn, grain sorghum, soybeans, and wheat are included in the model. They comprise 83.8% of the current crop mix in the area. Additional crops grown in the area are alfalfa, sunflowers, and “other,” including rye, barley, dry beans, nursery, and unreported acreage.

A five-year average of gross income per acre is determined for the five most recent years available (2012-2016), based on information available from the Kansas State University Department of Agricultural Economics and K-State Research and Extension. The revenue per acre in 2016 in northwest Kansas for irrigated corn, grain sorghum, soybeans, and wheat was \$915.37, \$391.14, \$506.91, and \$314.60 per acre, respectively (Table 4.6). The five-year average revenue for the four irrigated crops is \$1,103.62 per acre for corn, \$539.71 per acre for grain sorghum, \$617.29 per acre for soybeans, and \$445.67 per acre for wheat (Table 4.7).

Table 4.6: Revenue / Net Income per Acre for Irrigated Crops in Northwest Kansas, 2016

	Corn	Grain Sorghum	Soybeans	Wheat
Yield per acre	239	106	61	65
Price per unit	\$3.83	\$3.69	\$8.31	\$4.84
Net government payment	\$0.00	\$0.00	\$0.00	\$0.00
Indemnity payments	\$0.00	\$0.00	\$0.00	\$0.00
Miscellaneous income	\$0.00	\$0.00	\$0.00	\$0.00
Revenue per Acre	\$915.37	\$391.14	\$506.91	\$314.60
Costs per Acre				
Seed	\$128.00	\$13.33	\$63.21	\$25.71
Herbicide	\$51.16	\$43.71	\$30.70	\$7.80
Insecticide / Fungicide	\$15.47	\$0.00	\$0.00	\$10.32
Fertilizer and Lime	\$116.02	\$52.55	\$23.62	\$50.83
Crop Consulting	\$6.50	\$6.25	\$6.25	\$6.00
Crop Insurance	\$23.53	\$0.00	\$3.57	\$0.00
Drying	\$15.06	\$6.36	\$0.00	\$0.00
Miscellaneous	\$10.00	\$10.00	\$10.00	\$10.00
Custom Hire / Machinery	\$165.75	\$107.89	\$96.31	\$81.95
Non-machinery Labor	\$28.80	\$25.20	\$27.00	\$24.00
Irrigation				
Labor				
Fuel and Oil	\$74.33	\$49.55	\$61.94	\$41.30
Repairs and Maintenance	\$5.94	\$3.96	\$4.95	\$3.30
Depreciation	\$76.67	\$76.67	\$76.67	\$76.67
Interest on Equipment	\$59.22	\$59.22	\$59.22	\$59.22
Land Charge / Rent	\$95.00	\$86.00	\$86.00	\$86.00
Interest	\$19.22	\$9.56	\$9.83	\$7.84
Total Cost per Acre	\$890.67	\$550.25	\$559.27	\$490.94
Returns per Acre	\$24.70	-\$159.11	-\$52.36	-\$176.34

Source: KSU Ag Econ Farm Management Guide

Table 4.7: Five-Year Average Gross Income per Acre for Irrigated Crops in Northwest Kansas, 2012-2016

	2012	2013	2014	2015	2016	Average
Corn	\$1,190.53	\$1,330.53	\$1,123.30	\$958.39	\$915.37	\$1,103.62
Grain Sorghum	\$694.93	\$736.93	\$470.64	\$404.92	\$391.14	\$539.71
Soybeans	\$645.23	\$722.23	\$652.70	\$559.37	\$506.91	\$617.29
Wheat	\$478.43	\$616.33	\$447.20	\$371.80	\$314.60	\$445.67

Source: KSU Ag Econ Farm Management Guide

Based on the 8-year average acreage for irrigated corn, grain sorghum, soybeans, and wheat in the proposed district-wide LEMA in GMD #4, the direct output of the crops computed for purposes of the IMPLAN model is \$257.0 million for corn, \$3.7 million for grain sorghum, \$22.5 million for soybeans, and \$14.3 million for wheat, for a total direct output of \$297.6 million (Table 4.8).

Table 4.8: Direct Sales / Output Calculation for Irrigated Crops in Northwest Kansas, 2016

	Acres	Average Gross	Direct Sales / Output
Corn	232,897.4	\$1,103.62	\$257,030,228.59
Grain Sorghum	6,863.5	\$539.71	\$3,704,299.59
Soybeans	36,459.4	\$617.29	\$22,506,023.03
Wheat	32,114.9	\$445.67	\$14,312,647.48
Total	308,335.2		\$297,553,198.69

Within IMPLAN, the direct sales / output of corn, grain sorghum, and wheat are considered “grain farming” (IMPLAN Sector 1), while “oilseed farming” or soybeans lies within Sector 2. Therefore, \$275.0 million (\$257.0 million for corn, \$3.7 million for grain sorghum, and \$14.3 million for wheat, respectively) was entered into industry sales in the model in Sector 2, while the remaining \$22.5 million was entered as industry sales for Sector 1. Table 4.9 shows the total impact summary of the current status quo model of irrigated cropping in the GMD #4 region.

Table 4.9: Impact Summary of Status Quo Irrigation in GMD #4 Region

Impact Type	Employment	Labor	Total Value	
		Income	Added	Output
Direct Effect	443	\$24,103,049	\$53,480,082	\$297,553,204
Indirect Effect	481	\$33,410,558	\$45,498,184	\$78,227,748
Induced Effect	227	\$5,972,338	\$12,780,902	\$24,743,676
Total Effect	1,151	\$63,485,945	\$111,759,169	\$400,524,628

The irrigated cropping industry in the proposed district-wide LEMA area provides a total output effect of over \$400.5 million and 1,151 jobs (Table 4.9). Additionally, total value added by direct, indirect, and induced effects is almost \$111.8 million. As a percentage of the GRP of the study region, total employment is 4.3%, total value added is 7.2%, and total output is 25.8% of the total economy.

Other industries that are the most impacted by the grain and oilseed industry in the GMD #4 study area by both employment and output are reported in Tables 4.10 and 4.11. Table 4.10 exhibits that support activities for agriculture and forestry, wholesale trade, and real estate are highly dependent on grain and oilseed farming for employment purposes, while Table 4.11 illustrates that grain and oilseed farming are the largest sectors of output in the model, while large indirect and induced amounts are created in wholesale trade, support activities for agriculture and forestry, real estate, and owner-occupied dwellings.

Total employment, value added, and output figures are in Appendix I – Status Quo Scenario.

Table 4.10: Top Ten Industries Affected by Grain and Oilseed Sectors by Employment

Sector	Description	Employment
2	Grain farming	433
19	Support activities for agriculture and forestry	105
395	Wholesale trade	94
440	Real estate	53
62	Maintenance and repair construction of nonresidential structures	32
433	Monetary authorities and depository credit intermediation	26
10	All other crop farming	22
502	Limited-service restaurants	20
448	Accounting, tax preparation, bookkeeping, and payroll services	19
501	Full-service restaurants	18

Table 4.11: Top Ten Industries Affected by Grain and Oilseed Sectors by Output

Sector	Description	Output
2	Grain farming	\$275,047,180
1	Oilseed farming	\$22,506,023
395	Wholesale trade	\$20,090,949
19	Support activities for agriculture and forestry	\$20,077,702
440	Real estate	\$5,251,314
441	Owner-occupied dwellings	\$5,165,767
433	Monetary authorities and depository credit intermediation	\$4,176,177
62	Maintenance and repair construction of nonresidential structures	\$3,800,296
11	Beef cattle ranching and farming	\$3,171,292
411	Truck transportation	\$3,077,327

4.3 Sub-Objective 2, District-Wide LEMA under Limited Irrigation Conditions

For sub-objective 2, an IMPLAN analysis was conducted under the assumptions that 75% of the original irrigated acres remained at their original allocation amount, while 25% of the original irrigated acres were converted to dryland production, providing a 25% reduction in agricultural crop irrigation water usage. Irrigated acres are based on the same information used in the status quo scenario (economic assumptions based on Tables 4.7 and 4.8), while acres transitioned to non-irrigated production are modeled based on information contained in Table 4.12. The five-year average revenue for the four non-irrigated crops is

\$412.03 per acre for corn, \$372.92 per acre for grain sorghum, \$289.44 per acre for soybeans, and \$319.65 per acre for wheat (Table 4.12).

Table 4.12: 5-Year Average Revenue per Acre for Non-Irrigated Crops in Northwest Kansas, 2012-2016

	2012	2013	2014	2015	2016	Average
Corn	\$475.40	\$531.40	\$394.80	\$336.84	\$321.72	\$412.03
Grain Sorghum	\$453.80	\$481.80	\$347.10	\$298.74	\$283.14	\$372.92
Soybeans	\$312.98	\$350.78	\$297.64	\$255.36	\$230.44	\$289.44
Wheat	\$302.91	\$391.56	\$356.72	\$297.96	\$249.08	\$319.65

In the status quo scenario, there were 232,897.4 acres of irrigated corn, 6,863.5 acres of irrigated grain sorghum, 36,459.4 acres of irrigated soybeans, and 32,114.9 acres of irrigated wheat. According to the 75%/25% irrigated/non-irrigated split, the IMPLAN analysis for sub-objective 2 is based on a reduction to 174,673.1 acres of irrigated corn, 5,147.6 acres of irrigated grain sorghum, 27,344.6 acres of irrigated soybeans, and 24,086.2 acres of irrigated wheat. The remaining acres are 58,224.4 acres of non-irrigated corn, 1,715.9 acres of non-irrigated grain sorghum, 9,114.9 acres of non-irrigated soybeans, and 8,028.7 acres of non-irrigated wheat.

Table 4.13: Sub-Objective 2 Irrigated and Non-Irrigated Direct Sales / Output

	Acres	Average Gross	Direct Sales / Output
Irr. Corn	174,673.1	\$1,103.62	\$192,772,726.62
Irr. Grain Sorghum	5,147.6	\$539.71	\$2,778,211.20
Irr. Soybeans	27,344.6	\$617.29	\$16,879,548.13
Irr. Wheat	24,086.2	\$445.67	\$10,734,496.75
Non-Irr. Corn	58,224.4	\$412.03	\$23,990,199.53
Non-Irr. Grain Sorghum	1,715.9	\$372.92	\$639,893.43
Non-Irr. Soybeans	9,114.9	\$289.44	\$2,638,216.66
Non-Irr. Wheat	8,028.7	\$319.65	\$2,566,373.96
Total	308,335.4		\$252,999,666.28

Figures for irrigated production and non-irrigated production for each crop were summed to determine the direct sales / output of each industry entered into IMPLAN. \$233.5 million (\$216.8 million for irrigated and non-irrigated corn, \$3.4 million for irrigated and non-irrigated grain sorghum, and \$13.3 million for irrigated and non-irrigated wheat) was entered into industry sales in the model in Sector 2, and \$19.5 million was entered as industry sales for Sector 1 (irrigated and non-irrigated soybeans). The IMPLAN total impact summary for this 25% reduction in water usage and shift to non-irrigated cropping practice reported in Table 4.14.

Table 4.14: Impact Summary of Sub-Objective 2 IMPLAN Model

Impact Type	Employment	Labor	Total Value	
		Income	Added	Output
Direct Effect	376	\$20,529,003	\$45,534,570	\$252,999,670
Indirect Effect	409	\$28,401,662	\$38,678,423	\$66,506,849
Induced Effect	193	\$5,081,047	\$10,873,572	\$21,051,079
Total Effect	978	\$54,011,712	\$95,086,565	\$340,557,598

From Table 4.14, the direct output in the 10-county model area is slightly less than \$253.0 million. Taking into account indirect and induced effects, the total economic impact of grain and oilseed farming with the 25% reduction in water usage is nearly \$340.6 million. The two industries directly employ 376 individuals and have a total employment effect of 978 employees. Total value added by the two industries is \$45.5 million at the farm-gate level and roughly \$95.1 million in total impact. Comparing the impact summary of sub-objective 2 (reduced water use for irrigation purposes) to the status quo scenario, Table 4.15 shows that there are approximately 67 less individuals employed at the direct level and 173 less individuals employed at the total effect level. Furthermore, output is reduced by \$44.6 million at the direct level, \$11.7 million at the indirect level, \$3.7 million at the induced level, for a total reduction of \$60.0 million. On a per-acre basis, this is a

reduction of \$194.49 per acre. As a percentage of the GRP of the study region, total employment comprises 3.7%, total value added comprises 6.1%, and total output comprises 21.9% of the total economy. This equates to a roughly 15% reduction in total employment, total value added, and total output due to the 25% reduction in irrigation water as an objective of the implementation of a district-wide LEMA in GMD #4.

Table 4.15: Net Economic Impact of Sub-Objective 1 and Sub-Objective 2

Impact Type	Employment	Labor	Total Value	
		Income	Added	Output
Direct Effect	-67	-\$3,574,046	-\$7,945,512	-\$44,553,534
Indirect Effect	-72	-\$5,007,896	-\$6,819,761	-\$11,720,899
Induced Effect	-34	-\$891,291	-\$1,907,330	-\$3,692,597
Total Effect	-173	-\$9,474,233	-\$16,672,604	-\$59,967,030

On a sector-level basis, a 25% reduction in groundwater usage for irrigation also causes changes in other industries in the 10-county region outside of grain and oilseed production themselves. For example, with a 25% reduction in groundwater use scenario (or sub-objective 2) that employment in the grain farming sector has changed to 367 (Table 4.16), relative to 433 (Table 4.10) in the status quo scenario. It is important to note that it would not be unreasonable to adjust the final employment numbers in the analysis, because it is highly unlikely that 66 less individuals would be employed in the grain farming sector due to a 25% transition to dryland production. For the illustrative purposes of this model, no modifications are made to any of the employment numbers, both direct and non-direct.

For sectors that are only in the indirect and induced effects (sectors other than grain and oilseed farming), there are significant impacts. In Sector 395, wholesale trade, total employment has decreased from 94 (Table 4.10) to 80 (Table 4.16), a reduction of 14 total employees. Another sector only in the indirect and induced effects, real estate (Sector 440) has a total employment reduction of 8 from 53 (Table 4.10) to 45 (Table 4.16) total

employees. Not only does grain and oilseed farming have a significant impact on the employment numbers in the GMD #4 analysis area – the output from these sectors is also substantial.

Table 4.16: Top Ten Industries Affected by Grain and Oilseed Sectors by Employment, 25% Reduction in Groundwater Usage Scenario

Sector	Description	Employment
2	Grain farming	367
19	Support activities for agriculture and forestry	89
395	Wholesale trade	80
440	Real estate	45
62	Maintenance and repair construction of nonresidential structures	27
433	Monetary authorities and depository credit intermediation	22
10	All other crop farming	19
502	Limited-service restaurants	17
448	Accounting, tax preparation, bookkeeping, and payroll services	16
501	Full-service restaurants	15

Table 4.17: Top Ten Industries Affected by Grain and Oilseed Sectors by Output, 25% Reduction in Groundwater Usage Scenario

Sector	Description	Output
2	Grain farming	\$233,481,905
1	Oilseed farming	\$19,517,765
395	Wholesale trade	\$17,082,690
19	Support activities for agriculture and forestry	\$17,063,260
440	Real estate	\$4,463,416
441	Owner-occupied dwellings	\$4,394,924
433	Monetary authorities and depository credit intermediation	\$3,550,289
62	Maintenance and repair of nonresidential structures	\$3,233,585
11	Beef cattle ranching and farming	\$2,694,845
411	Truck transportation	\$2,617,569

A reduction in groundwater use of 25% in the GMD #4 area has significant consequences on additional sectors in the economy, both in the agricultural and non-agricultural sectors. While the grain farming sector exhibits a total decrease of \$41.6 million (a 15% reduction), other sectors in the economy also show decreases. The

wholesale trade sector has a decrease in total output from \$20,090,949 (Table 4.11) to \$17,082,690 (Table 4.17), a total reduction of about \$3 million. This reduction in the wholesale trade sector is a 15% reduction in the sector, leading to contraction and shrinkage in an industry outside of the primary studied industries (grain and oilseed). Total employment, value added, and output figures are found in Appendix II – District-Wide LEMA under Limited Irrigation Conditions Scenario.

4.4 Sub-Objective 3, District-Wide LEMA with Optimal Crop-Mix Shift

In the current LEMA in northwest Kansas, the Sheridan 6 LEMA, data has been collected from participating producers, both within the boundaries of the LEMA and a control area, to determine the shift in crop-mix to capture economic profit from differing agricultural commodities that use less groundwater resources. Irrigated corn has been a staple commodity in the crop-mix ratio for northwest Kansas, but requires large groundwater resources to grow an economically viable crop. Other crops, such as grain sorghum, have been shown to be more drought-resistant, therefore making them a potential candidate in the crop-mix ratio when conservation of water resources is a consideration. The hydrology, evapotranspiration, and additional water conservation methodologies are not considered in this scenario. The goal of sub-objective 3 is to determine the economic impact, should the producers in GMD #4 adjust their crop-mix similar to those in the Sheridan 6 LEMA. As stated in Table 3.3, it is hypothesized that irrigated corn acreage would decrease from 232,897 to 180,000 (reduction of 23%), irrigated grain sorghum acreage would increase from 6,864 to 30,900 (increase of 350%), irrigated soybean acreage would remain unchanged at 36,459, and irrigated wheat acreage would increase from 32,115 to 60,976 (increase of 90%). Using the 5-year average irrigated gross revenue of \$1,103.62, \$539.71, \$617.29, and \$445.67 for corn, grain sorghum, soybeans, and wheat,

respectively, the direct total output for each crop was calculated to be \$198.7 million (corn), \$16.7 million (grain sorghum), \$22.5 million (soybeans), and \$27.2 million (wheat), as shown in Table 4.18. The direct sales for irrigated corn, irrigated grain sorghum, and irrigated wheat combine to a total of \$242.5 million, which was entered for Sector 2, grain farming, in IMPLAN. The remaining \$22.5 million for irrigated soybeans was entered for industry sales for oilseed farming.

Table 4.18: Sub-Objective 3 Crop Mix Direct Sales / Output for IMPLAN

	Acres	Average Gross	Direct Sales / Output
Irr. Corn	180,000.00	\$1,103.62	\$198,651,600.00
Irr. Grain Sorghum	30,900.00	\$539.71	\$16,677,039.00
Irr. Soybeans	36,459.00	\$617.29	\$22,505,776.11
Irr. Wheat	60,976.00	\$445.67	\$27,175,173.92
Total	308,335.0		\$265,009,589.03

Based on this direct total output, the impact summary in Table 4.19 was determined.

Table 4.19: Impact Summary of Sub-Objective 3 IMPLAN Model

Impact Type	Employment	Labor	Total Value	
		Income	Added	Output
Direct Effect	392	\$21,691,702	\$48,030,523	\$264,999,593
Indirect Effect	427	\$29,017,132	\$39,909,328	\$70,242,985
Induced Effect	200	\$5,265,863	\$11,268,599	\$21,816,331
Total Effect	1,018	\$55,974,697	\$99,208,450	\$357,058,910

From Table 4.19, it can be determined that the direct effect of the grain and oilseed sectors is employment of 392 individuals, total value added of over \$48.0 million, and a total output of \$265.0 million. When taking into account indirect and induced effects, the total effect of the sectors contribute 1,018 employees, \$99.2 million in total value added, and \$357.1 million in output to the GMD #4 region.

Table 4.20: Net Economic Impact of Sub-Objective 1 and Sub-Objective 3

Impact Type	Employment	Labor	Total Value	Output
		Income	Added	
Direct Effect	-51	-\$2,411,347	-\$5,449,559	-\$32,553,611
Indirect Effect	-54	-\$4,393,426	-\$5,588,856	-\$7,984,763
Induced Effect	-27	-\$706,475	-\$1,512,303	-\$2,927,345
Total Effect	-133	-\$7,511,248	-\$12,550,719	-\$43,465,718

Compared to the status quo scenario, there is a 133-person reduction in total employment (Table 4.20); however, compared to the scenario with a 25% reduction in groundwater usage, there are 40 less jobs lost (1,018 employees vs. 978), as shown in Table 4.21.

Table 4.21: Net Economic Impact of Sub-Objective 2 and Sub-Objective 3

Impact Type	Employment	Labor	Total Value	Output
		Income	Added	
Direct Effect	16	\$1,162,699	\$2,495,953	\$11,999,923
Indirect Effect	18	\$614,470	\$1,230,905	\$3,736,136
Induced Effect	7	\$184,816	\$395,027	\$765,252
Total Effect	40	\$1,962,985	\$4,121,885	\$16,501,312

Therefore, the transition to a crop-mix ratio consistent with the Sheridan 6 LEMA would be beneficial to employment in the GMD #4 study area. The status quo scenario calculates a \$400.5 million total output from the grain and oilseed industry, a 25% reduction in total groundwater use equates to a \$340.6 million total output, and a shift in the crop-mix ratio to exhibit current evidence as shown by the Sheridan 6 LEMA would be a total output of \$357.1 million. Therefore, while any shift away from current full water-use practices will result in a reduction in the cash flow and economics due to the loss in productive capability, certain modifications to crop-mix ratio and irrigation practices can be made to reduce some of the negative ramifications of these policy changes at the farm-gate level.

At the local sector level, the employment for Sector 2, grain farming, saw an overall reduction of 49 employees, going from 433 to 384. However, when compared to the model with a 25% reduction in groundwater usage, the sub-objective 3 model (crop-mix shift scenario) provided an additional 17 jobs in the sector. The same analysis can be made for additional sectors outside of grain and oilseed farming. For example, wholesale trade has an overall reduction of 10 employees when comparing the status quo scenario to the model with adjusted crop-mix ratios. Compared to the model with reduced groundwater usage, the adjusted crop-mix ratio scenario lessens the impact by 4 individuals, alleviating the net loss in employment in that one sector by 40%.

Table 4.22: Top Ten Industries Affected by Grain and Oilseed Sectors by Employment, Optimal Crop-Mix Ratio Scenario

Sector	Description	Employment
2	Grain farming	384
19	Support activities for agriculture and forestry	88
395	Wholesale trade	84
440	Real estate	48
62	Maintenance and repair construction of nonresidential structures	29
433	Monetary authorities and depository credit intermediation	23
10	All other crop farming	20
502	Limited-service restaurants	18
448	Accounting, tax preparation, bookkeeping, and payroll services	17
501	Full-service restaurants	16

Table 4.23: Top Ten Industries Affected by Grain and Oilseed Sectors by Output, Optimal Crop-Mix Ratio Scenario

Sector	Description	Output
2	Grain farming	\$243,965,777
1	Oilseed farming	\$22,505,776
395	Wholesale trade	\$17,942,120
19	Support activities for agriculture and forestry	\$16,872,885
440	Real estate	\$4,683,050
441	Owner-occupied dwellings	\$4,553,920
433	Monetary authorities and depository credit intermediation	\$3,722,680
62	Maintenance and repair nonresidential structures	\$3,414,974
411	Truck transportation	\$2,752,054
11	Beef cattle ranching and farming	\$2,707,266

According to Tables 4.11 and 4.23, the grain farming sector saw a reduction of \$31.1 million over the status quo, while the oilseed farming sector saw little to no reduction because soybean acres were not changed in the model. In the overall model, direct output was reduced by \$32.6 million and total output was reduced by \$43.5 million. On a per-acre basis, this is a reduction of \$140.97. As specified earlier, the model with a 25% reduction on groundwater usage led to a \$194.49 loss per acre, so institution of the proposed optimal crop-mix ratio led to 27.5% less loss in revenue as compared to straight conversion to groundwater reduction. From a percentage viewpoint, total employment comprises 3.8% of the study region, total value added comprises 6.4% of GRP, and total output comprises 23.0% of the total economy. Compared to the status quo scenario, this equates to a 11.6% reduction in total employment, 11.2% reduction in total value added, and 10.9% reduction in total output due to the shift in crop-mix. However, compared to the scenario with 25% reduction in irrigation water as an objective of the implementation of a district-wide LEMA in GMD #4, this model provides 4.1% greater total employment, 4.3% greater value added, and 4.8% greater total output. Total employment, value added, and output figures are found in Appendix II – Optimal Crop-Mix Shift Scenario.

CHAPTER V: CONCLUSIONS AND FURTHER RESEARCH

5.1 Conclusions

Within the Ogallala Aquifer region, farmers and ranchers are making economic-based management decisions to not only maintain, but preserve, the life of the aquifer for the use of the current generation and those to come. The basis of this research was to determine the economic impact of a proposed policy change in northwest Kansas. More specifically, the overarching goal was to determine the economic impact of crop production in the Groundwater Management District #4 region and the economic ramification of instituting a district-wide Local Enhanced Management Area (LEMA). Additional analysis was completed to determine if use of an adjusted crop-mix ratio that occurred in the Sheridan 6 LEMA could mitigate any possible economic loss from a district-wide LEMA.

Overall, the analysis concluded that the direct effect of the status quo scenario in the GMD #4 region was 443 employees, \$53.5 million in value added, and \$297.6 million in output. Taking into account indirect and induced effects, the total effect for the status quo scenario employed 1,151 individuals and generated \$111.8 million in value added and \$400.5 million in output. The largest industries affected, other than the direct industries of grain and oilseed farming, were support activities for agriculture and forestry, wholesale trade, and real estate.

For sub-objective 2, a scenario was studied with a 25% reduction of groundwater applied equally across all irrigated acres in the 10-county area. This scenario provided a direct output of 376 employees, \$45.5 million in value added, and \$253.0 million in output. The total effect of the two sectors (grain farming and oilseed farming) provided a total of 978 employees, \$95.1 million in value added, and \$340.6 million in output. Compared to

the status quo scenario, this scenario creates a 15% loss in total employees, value added, and output.

For sub-objective 3, a scenario was studied in which acres were re-directed from water-intensive crops to less water-intensive crops, as has occurred in the Sheridan 6 LEMA. This scenario provided a direct output of 392 employees, \$48.0 million in value added, and \$265.0 million in output. The total effect of the two direct sectors provided a total of 1,018 employees, \$99.2 million in value added, and \$357.1 million in output. Compared to the status quo scenario, this scenario creates a 11.6% loss in total employees, 11.2% loss in value added, and 10.9% loss in output. Compared to the 25% groundwater reduction model, this scenario creates 27.5% less loss, or a savings of \$53.52 per acre.

5.2 Further Research

While this research seeks to answer the basic economic analysis regarding the status quo scenario and two possible policy / management practices, there are many additional areas of research. First and foremost, as with any economic analysis, assumptions were required to be made. Further research and development of this topic should obtain additional data from producers within LEMA boundaries to determine their willingness to grow certain crops, optimal crop-mix shift, etc. While some producers in the current Sheridan 6 LEMA have been forthcoming with information for research and educational purposes, the future of economic analysis can only be as vigorous as the information provided.

Another area of further research is that of the value of irrigation water, utilization of water conservation practices, hydrological data, etc. A multi-disciplined approach to this topic would most likely include current water levels, water management strategies employed, etc.

This topic could also be viewed in the lens of a Net Present Value (NPV) approach over a long-run planning horizon, as most farming and water-use decisions are viewed as long-run decisions. Economic impact analysis is often completed at a certain point in time and not discounted for any net present value considerations. However, within this context, a NPV approach could be completed over a long-run planning horizon with economic impact analysis determined for specific points in the future, including the benefits of an extended aquifer life.

Lastly, this project was conducted because GMD #4 is currently considering a district-wide LEMA as a policy approach. While work has been completed in the past concerning other policy implications in northwest Kansas (Golden, Peterson and O'Brien 2012), it would be beneficial to the producers of GMD #4 to take a holistic view of all water conservation and management approaches available to determine which would make the most feasible, practical, economic sense.

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APPENDIX I – SUB-OBJECTIVE 1

Sub-Objective 1, Status Quo Scenario – Employment Numbers

Sector	Description	Direct	Indirect	Induced	Total
0	Total	443	481	227	1,150
1	Oilseed farming	10	0	0	10
2	Grain farming	433	0	0	433
3	Vegetable and melon farming	0	0	0	0
6	Greenhouse, nursery, and floriculture production	0	0	0	0
10	All other crop farming	0	22	0	22
11	Beef cattle ranching and farming	0	12	0	12
12	Dairy cattle and milk production	0	0	0	0
13	Poultry and egg production	0	0	0	0
14	Animal production, except cattle and poultry and eggs	0	3	0	3
18	Commercial hunting and trapping	0	0	0	0
19	Support activities for agriculture and forestry	0	105	0	105
20	Extraction of natural gas and crude petroleum	0	10	0	10
31	Sand and gravel mining	0	0	0	0
37	Drilling oil and gas wells	0	0	0	0
38	Support activities for oil and gas operations	0	0	0	0
49	Electric power transmission and distribution	0	1	0	1
50	Natural gas distribution	0	1	0	1
51	Water, sewage and other systems	0	0	0	0
62	Maintenance and repair construction of nonresidential structures	0	31	1	32
63	Maintenance and repair construction of residential structures	0	1	2	3
66	Other animal food manufacturing	0	0	0	0
84	Fluid milk manufacturing	0	0	0	0
94	Bread and bakery product, except frozen, manufacturing	0	0	0	0
154	Printing	0	0	0	0
198	Other rubber product manufacturing	0	0	0	0
206	Ready-mix concrete manufacturing	0	0	0	0
257	Small arms ammunition manufacturing	0	0	0	0
262	Farm machinery and equipment manufacturing	0	5	0	5
388	Sign manufacturing	0	0	0	0
395	Wholesale trade	0	85	9	94
396	Retail - Motor vehicle and parts dealers	0	1	5	6
397	Retail - Furniture and home furnishings stores	0	0	1	1
398	Retail - Electronics and appliance stores	0	1	1	2
399	Retail - Building material and garden equipment and supplies stores	0	1	3	4
400	Retail - Food and beverage stores	0	0	10	10
401	Retail - Health and personal care stores	0	1	3	4
402	Retail - Gasoline stores	0	1	3	3
403	Retail - Clothing and clothing accessories stores	0	1	3	3
404	Retail - Sporting goods, hobby, musical instrument and book stores	0	0	1	2
405	Retail - General merchandise stores	0	0	7	7
406	Retail - Miscellaneous store retailers	0	2	7	9
407	Retail - Nonstore retailers	0	1	9	10

Sector	Description	Direct	Indirect	Induced	Total
408	Air transportation	0	0	0	0
409	Rail transportation	0	2	0	2
410	Water transportation	0	0	0	0
411	Truck transportation	0	13	2	15
412	Transit and ground passenger transportation	0	0	0	0
413	Pipeline transportation	0	1	0	1
414	Scenic and sightseeing transportation	0	1	0	1
415	Couriers and messengers	0	2	0	3
416	Warehousing and storage	0	10	1	12
417	Newspaper publishers	0	1	1	2
423	Motion picture and video industries	0	0	0	0
425	Radio and television broadcasting	0	0	0	1
427	Wired telecommunications carriers	0	1	2	2
428	Wireless telecommunications carriers (except satellite)	0	0	0	1
430	Data processing, hosting, and related services	0	0	0	0
432	Internet publishing and broadcasting and web search portals	0	0	0	0
433	Monetary authorities and depository credit intermediation	0	21	4	26
434	Nondepository credit intermediation and related activities	0	1	0	2
435	Securities and commodity contracts intermediation and brokerage	0	7	5	12
436	Other financial investment activities	0	2	2	3
438	Insurance agencies, brokerages, and related activities	0	2	1	3
439	Funds, trusts, and other financial vehicles	0	0	1	1
440	Real estate	0	48	6	53
443	General and consumer goods rental except video tapes and discs	0	0	0	0
445	Commercial and industrial machinery and equipment rental and leasing	0	5	0	5
446	Lessors of nonfinancial intangible assets	0	1	0	1
447	Legal services	0	7	4	11
448	Accounting, tax preparation, bookkeeping, and payroll services	0	16	3	19
449	Architectural, engineering, and related services	0	0	0	0
451	Custom computer programming services	0	0	0	0
452	Computer systems design services	0	1	0	1
453	Other computer related services, including facilities management	0	0	0	1
454	Management consulting services	0	1	0	1
455	Environmental and other technical consulting services	0	2	1	3
456	Scientific research and development services	0	0	0	0
457	Advertising, public relations, and related services	0	1	0	1
458	Photographic services	0	0	1	1
459	Veterinary services	0	0	1	1
460	Marketing research and all other miscellaneous	0	4	0	5
461	Management of companies and enterprises	0	1	0	1
462	Office administrative services	0	1	0	1
464	Employment services	0	2	1	2
465	Business support services	0	1	0	1
466	Travel arrangement and reservation services	0	0	0	0
468	Services to buildings	0	4	1	5

Sector	Description	Direct	Indirect	Induced	Total
469	Landscape and horticultural services	0	2	1	3
470	Other support services	0	0	0	0
471	Waste management and remediation services	0	0	0	0
472	Elementary and secondary schools	0	0	1	1
474	Other educational services	0	0	3	3
475	Offices of physicians	0	0	1	1
476	Offices of dentists	0	0	3	3
477	Offices of other health practitioners	0	0	5	5
478	Outpatient care centers	0	0	1	1
480	Home health care services	0	0	1	1
481	Other ambulatory health care services	0	0	1	1
482	Hospitals	0	0	11	11
483	Nursing and community care facilities	0	0	7	7
484	Residential mental retardation, mental health, substance abuse	0	0	0	0
485	Individual and family services	0	0	7	7
486	Community food, housing, and other relief services	0	0	2	2
487	Child day care services	0	0	3	3
488	Performing arts companies	0	0	0	0
491	Promoters of performing arts and sports and agents for public figures	0	1	2	2
492	Independent artists, writers, and performers	0	3	3	6
493	Museums, historical sites, zoos, and parks	0	0	0	0
495	Gambling industries (except casino hotels)	0	0	2	2
496	Other amusement and recreation industries	0	1	2	3
497	Fitness and recreational sports centers	0	0	1	1
498	Bowling centers	0	0	1	1
499	Hotels and motels, including casino hotels	0	2	0	2
500	Other accommodations	0	0	0	0
501	Full-service restaurants	0	3	15	18
502	Limited-service restaurants	0	4	17	20
503	All other food and drinking places	0	1	4	5
504	Automotive repair and maintenance, except car washes	0	4	5	9
505	Car washes	0	0	1	1
506	Electronic and precision equipment repair and maintenance	0	1	0	2
507	Commercial and industrial machinery and equipment repair	0	2	0	2
508	Personal and household goods repair and maintenance	0	0	0	1
509	Personal care services	0	0	4	4
510	Death care services	0	0	0	0
511	Dry-cleaning and laundry services	0	0	0	0
512	Other personal services	0	1	6	7
514	Grantmaking, giving, and social advocacy organizations	0	0	0	0
515	Business and professional associations	0	2	1	3
516	Labor and civic organizations	0	0	2	2
517	Private households	0	0	4	4
518	Postal service	0	3	1	4
525	Local government electric utilities	0	0	0	1
526	Other local government enterprises	0	3	1	4

Sub-Objective 1, Status Quo Scenario – Total Value Added Numbers

Sector	Description	Direct	Indirect	Induced	Total
0	Total	53,480,082	45,498,184	12,780,902	111,759,169
1	Oilseed farming	7,436,807	0	0	7,436,807
2	Grain farming	46,043,276	0	0	46,043,276
3	Vegetable and melon farming	0	369	1,864	2,233
6	Greenhouse, nursery, and floriculture production	0	2,874	253	3,128
10	All other crop farming	0	1,720,021	4,367	1,724,388
11	Beef cattle ranching and farming	0	742,813	454	743,267
12	Dairy cattle and milk production	0	30,221	10,618	40,840
13	Poultry and egg production	0	3,271	607	3,878
14	Animal production, except cattle and poultry and eggs	0	256,187	4,838	261,026
16	Commercial logging	0	0	0	0
18	Commercial hunting and trapping	0	0	2,505	2,505
19	Support activities for agriculture and forestry	0	18,662,370	1,593	18,663,964
20	Extraction of natural gas and crude petroleum	0	310,078	14,011	324,089
31	Sand and gravel mining	0	1,609	391	2,000
37	Drilling oil and gas wells	0	322	16	338
38	Support activities for oil and gas operations	0	18,581	918	19,498
39	Metal mining services	0	20	1	22
40	Other nonmetallic minerals services	0	34	3	37
49	Electric power transmission and distribution	0	375,733	156,939	532,672
50	Natural gas distribution	0	64,084	3,643	67,727
51	Water, sewage and other systems	0	10,447	640	11,087
62	Maintenance and repair construction - nonresidential	0	981,366	33,785	1,015,151
63	Maintenance and repair construction - residential	0	23,964	73,261	97,225
66	Other animal food manufacturing	0	7,961	415	8,375
71	Soybean and other oilseed processing	0	23	10	32
84	Fluid milk manufacturing	0	39	4,811	4,851
89	Animal, except poultry, slaughtering	0	6	99	104
94	Bread and bakery product, except frozen, manufacturing	0	7	202	209
95	Frozen cakes and other pastries manufacturing	0	1	21	22
104	Spice and extract manufacturing	0	6	83	89
121	Textile bag and canvas mills	0	10	3	14
137	Engineered wood member and truss manufacturing	0	1	0	1
154	Printing	0	27	7	34
162	Industrial gas manufacturing	0	1,820	831	2,651
165	Other basic organic chemical manufacturing	0	219	135	355
169	Nitrogenous fertilizer manufacturing	0	133	2	135
177	Paint and coating manufacturing	0	350	1	351
195	Other plastics product manufacturing	0	156	32	187
198	Other rubber product manufacturing	0	3,768	384	4,152
206	Ready-mix concrete manufacturing	0	9,416	2,478	11,895
236	Handtool manufacturing	0	69	3	71
248	Spring and wire product manufacturing	0	178	7	185
249	Machine shops	0	391	52	443
257	Small arms ammunition manufacturing	0	26	411	437

Sector	Description	Direct	Indirect	Induced	Total
259	Small arms, ordnance, and accessories manufacturing	0	10	18	28
262	Farm machinery and equipment manufacturing	0	368,919	61	368,980
266	Oil and gas field machinery, equipment manufacturing	0	4	0	4
279	Special tool, die, jig, and fixture manufacturing	0	1	1	2
347	Truck trailer manufacturing	0	1	9	10
350	Motor vehicle gasoline / engine parts manufacturing	0	72	5	77
368	Wood kitchen cabinet and countertop manufacturing	0	4	4	8
388	Sign manufacturing	0	8,687	3,996	12,683
395	Wholesale trade	0	10,384,233	1,074,838	11,459,071
396	Retail - Motor vehicle and parts dealers	0	42,390	379,209	421,598
397	Retail - Furniture and home furnishings stores	0	13,194	48,486	61,680
398	Retail - Electronics and appliance stores	0	25,681	43,098	68,778
399	Retail - Building material and garden equipment	0	58,498	196,507	255,005
400	Retail - Food and beverage stores	0	8,680	440,216	448,896
401	Retail - Health and personal care stores	0	43,118	121,190	164,309
402	Retail - Gasoline stores	0	33,051	114,337	147,389
403	Retail - Clothing and clothing accessories stores	0	22,164	93,965	116,129
404	Retail - Sporting goods, hobby	0	13,081	46,156	59,238
405	Retail - General merchandise stores	0	16,453	346,111	362,564
406	Retail - Miscellaneous store retailers	0	30,267	96,600	126,867
407	Retail - Nonstore retailers	0	33,563	296,199	329,762
408	Air transportation	0	2,906	1,844	4,749
409	Rail transportation	0	603,130	10,178	613,307
411	Truck transportation	0	1,429,791	165,726	1,595,517
412	Transit and ground passenger transportation	0	171	563	734
413	Pipeline transportation	0	183,535	4,534	188,069
414	Scenic and sightseeing transportation	0	40,895	11,387	52,282
415	Couriers and messengers	0	109,309	21,954	131,263
416	Warehousing and storage	0	562,079	75,720	637,798
417	Newspaper publishers	0	89,245	52,240	141,485
423	Motion picture and video industries	0	3,052	13,500	16,552
425	Radio and television broadcasting	0	3,680	2,017	5,697
427	Wired telecommunications carriers	0	93,843	161,862	255,705
428	Wireless telecommunications carriers (except satellite)	0	181,938	216,494	398,432
430	Data processing, hosting, and related services	0	98	54	152
431	News syndicates, libraries, archives	0	113	282	395
432	Internet publishing and broadcasting and web search	0	4,450	2,927	7,377
433	Monetary authorities and depository credit int.	0	1,653,923	347,574	2,001,497
434	Nondepository credit intermediation	0	130,135	39,181	169,316
435	Securities and commodity contracts intermediation	0	203,974	131,305	335,279
436	Other financial investment activities	0	26,035	26,267	52,301
438	Insurance agencies, brokerages, and related activities	0	98,084	25,842	123,927
439	Funds, trusts, and other financial vehicles	0	1,351	75,155	76,506
440	Real estate	0	2,199,966	254,321	2,454,288
441	Owner-occupied dwellings	0	0	3,457,534	3,457,534

Sector	Description	Direct	Indirect	Induced	Total
443	General and consumer goods rental	0	1,755	2,551	4,306
445	Commercial / industrial machinery and equipment rental	0	1,031,890	15,601	1,047,491
446	Lessors of nonfinancial intangible assets	0	36,185	6,641	42,826
447	Legal services	0	148,434	93,136	241,569
448	Accounting, tax preparation, bookkeeping	0	326,262	57,941	384,203
449	Architectural, engineering, and related services	0	8,535	3,172	11,708
451	Custom computer programming services	0	814	181	995
452	Computer systems design services	0	3,421	663	4,083
453	Other computer related services	0	3,291	436	3,727
454	Management consulting services	0	12,462	5,739	18,201
455	Environmental and other technical consulting services	0	9,949	4,265	14,214
456	Scientific research and development services	0	440	3,364	3,805
457	Advertising, public relations, and related services	0	11,674	5,372	17,046
458	Photographic services	0	1,086	4,041	5,128
459	Veterinary services	0	2,058	30,647	32,704
460	Marketing research and all other miscellaneous	0	25,784	1,735	27,519
461	Management of companies and enterprises	0	37,271	13,372	50,642
462	Office administrative services	0	12,238	5,528	17,767
464	Employment services	0	119,912	43,526	163,438
465	Business support services	0	12,430	3,929	16,359
466	Travel arrangement and reservation services	0	595	904	1,499
468	Services to buildings	0	60,370	22,962	83,332
469	Landscape and horticultural services	0	26,339	12,050	38,389
470	Other support services	0	5,360	1,590	6,950
471	Waste management and remediation services	0	10,936	8,458	19,393
472	Elementary and secondary schools	0	0	23,339	23,339
474	Other educational services	0	1,118	36,827	37,946
475	Offices of physicians	0	0	38,211	38,211
476	Offices of dentists	0	0	188,778	188,778
477	Offices of other health practitioners	0	0	198,449	198,449
478	Outpatient care centers	0	0	35,837	35,837
480	Home health care services	0	0	37,494	37,494
481	Other ambulatory health care services	0	25	15,339	15,364
482	Hospitals	0	0	745,550	745,550
483	Nursing and community care facilities	0	0	249,686	249,686
484	Residential mental retardation, mental health	0	0	10,610	10,610
485	Individual and family services	0	0	103,737	103,737
486	Community food, housing, and other relief services	0	0	72,735	72,735
487	Child day care services	0	0	28,330	28,330
488	Performing arts companies	0	507	1,473	1,980
491	Promoters of performing arts and sports and agents	0	6,742	16,323	23,065
492	Independent artists, writers, and performers	0	4,913	4,769	9,682
493	Museums, historical sites, zoos, and parks	0	0	1,979	1,979
495	Gambling industries (except casino hotels)	0	208	90,748	90,956
496	Other amusement and recreation industries	0	7,944	11,741	19,684

Sector	Description	Direct	Indirect	Induced	Total
497	Fitness and recreational sports centers	0	1,004	6,845	7,850
498	Bowling centers	0	0	9,272	9,272
499	Hotels and motels, including casino hotels	0	68,799	7,998	76,797
500	Other accommodations	0	422	95	517
501	Full-service restaurants	0	41,710	226,339	268,049
502	Limited-service restaurants	0	124,473	560,342	684,815
503	All other food and drinking places	0	20,304	81,708	102,012
504	Automotive repair and maintenance, except car washes	0	266,669	339,047	605,715
505	Car washes	0	3,719	28,647	32,366
506	Electronic and precision equipment repair	0	110,355	20,751	131,107
507	Commercial and industrial machinery equipment repair	0	151,185	43,797	194,982
508	Personal and household goods repair and maintenance	0	23,105	24,108	47,213
509	Personal care services	0	0	70,121	70,121
510	Death care services	0	0	13,220	13,220
511	Dry-cleaning and laundry services	0	3,016	9,100	12,116
512	Other personal services	0	6,391	31,906	38,297
514	Grantmaking, giving, and social advocacy organizations	0	343	20,943	21,286
515	Business and professional associations	0	152,854	51,981	204,834
516	Labor and civic organizations	0	182	40,140	40,323
517	Private households	0	0	35,134	35,134
518	Postal service	0	231,952	61,367	293,319
525	Local government electric utilities	0	100,042	41,786	141,829
526	Other local government enterprises	0	307,839	76,314	384,153

Sub-Objective 1, Status Quo Scenario– Total Output

Sector	Description	Direct	Indirect	Induced	Total
0	Total	297,553,204	78,227,748	24,743,676	400,524,628
1	Oilseed farming	22,506,023	0	0	22,506,023
2	Grain farming	275,047,180	0	0	275,047,180
3	Vegetable and melon farming	0	443	2,236	2,679
6	Greenhouse, nursery, and floriculture production	0	4,014	354	4,368
10	All other crop farming	0	2,900,556	7,364	2,907,921
11	Beef cattle ranching and farming	0	3,169,354	1,938	3,171,292
12	Dairy cattle and milk production	0	75,505	26,528	102,033
13	Poultry and egg production	0	13,866	2,574	16,440
14	Animal production, except cattle and poultry and eggs	0	538,100	10,162	548,262
16	Commercial logging	0	0	0	1
18	Commercial hunting and trapping	0	0	4,660	4,660
19	Support activities for agriculture and forestry	0	20,075,988	1,714	20,077,702
20	Extraction of natural gas and crude petroleum	0	960,217	43,387	1,003,604
31	Sand and gravel mining	0	3,654	887	4,541
37	Drilling oil and gas wells	0	1,039	51	1,090
38	Support activities for oil and gas operations	0	44,962	2,221	47,183
39	Metal mining services	0	63	4	68
40	Other nonmetallic minerals services	0	84	8	92
49	Electric power transmission and distribution	0	1,290,520	539,034	1,829,554
50	Natural gas distribution	0	391,957	22,281	414,239
51	Water, sewage and other systems	0	31,785	1,948	33,733
62	Maintenance and repair construction - nonresidential	0	3,673,817	126,478	3,800,296
63	Maintenance and repair construction - residential	0	97,456	297,934	395,389
66	Other animal food manufacturing	0	126,001	6,561	132,562
71	Soybean and other oilseed processing	0	888	384	1,272
84	Fluid milk manufacturing	0	435	53,435	53,870
89	Animal, except poultry, slaughtering	0	48	857	905
94	Bread and bakery product, except frozen, manufacturing	0	20	566	587
95	Frozen cakes and other pastries manufacturing	0	2	75	77
104	Spice and extract manufacturing	0	18	273	291
121	Textile bag and canvas mills	0	181	60	240
126	Cut and sew apparel contractors	0	13	5	18
137	Engineered wood member and truss manufacturing	0	117	32	149
154	Printing	0	4,213	1,923	6,136
162	Industrial gas manufacturing	0	1,280	790	2,070
165	Other basic organic chemical manufacturing	0	1,997	31	2,027
169	Nitrogenous fertilizer manufacturing	0	2,798	5	2,804
177	Paint and coating manufacturing	0	822	126	948
195	Other plastics product manufacturing	0	745	151	896
198	Other rubber product manufacturing	0	12,983	1,322	14,305
206	Ready-mix concrete manufacturing	0	65,633	17,274	82,907
236	Handtool manufacturing	0	169	6	175
248	Spring and wire product manufacturing	0	387	15	402
249	Machine shops	0	636	84	720

Sector	Description	Direct	Indirect	Induced	Total
257	Small arms ammunition manufacturing	0	88	1,401	1,490
259	Small arms, ordnance, and accessories manufacturing	0	23	41	64
262	Farm machinery and equipment manufacturing	0	2,473,954	411	2,474,365
266	Oil and gas field machinery manufacturing	0	33	2	35
279	Special tool, die, jig, and fixture manufacturing	0	3	9	12
347	Truck trailer manufacturing	0	3	42	45
350	Motor vehicle gasoline engine parts manufacturing	0	459	33	492
368	Wood kitchen cabinet and countertop manufacturing	0	15	17	32
388	Sign manufacturing	0	22,153	10,191	32,345
395	Wholesale trade	0	18,206,458	1,884,491	20,090,949
396	Retail - Motor vehicle and parts dealers	0	57,345	513,000	570,345
397	Retail - Furniture and home furnishings stores	0	24,428	89,770	114,198
398	Retail - Electronics and appliance stores	0	39,988	67,107	107,095
399	Retail - Building material and garden equipment	0	91,881	308,647	400,527
400	Retail - Food and beverage stores	0	13,046	661,639	674,686
401	Retail - Health and personal care stores	0	74,217	208,596	282,813
402	Retail - Gasoline stores	0	50,881	176,015	226,896
403	Retail - Clothing and clothing accessories stores	0	40,473	171,590	212,063
404	Retail - Sporting goods, hobby	0	21,362	75,375	96,737
405	Retail - General merchandise stores	0	24,817	522,063	546,880
406	Retail - Miscellaneous store retailers	0	59,547	190,047	249,595
407	Retail - Nonstore retailers	0	83,017	732,638	815,654
408	Air transportation	0	4,965	3,151	8,116
409	Rail transportation	0	946,982	15,980	962,963
411	Truck transportation	0	2,757,686	319,641	3,077,327
412	Transit and ground passenger transportation	0	756	2,491	3,247
413	Pipeline transportation	0	450,058	11,118	461,175
414	Scenic and sightseeing transportation	0	96,869	26,972	123,841
415	Couriers and messengers	0	222,883	44,764	267,647
416	Warehousing and storage	0	1,019,406	137,328	1,156,733
417	Newspaper publishers	0	160,869	94,166	255,035
423	Motion picture and video industries	0	9,035	39,957	48,991
425	Radio and television broadcasting	0	72,535	39,759	112,294
427	Wired telecommunications carriers	0	289,465	499,272	788,737
428	Wireless telecommunications carriers (except satellite)	0	586,849	698,312	1,285,162
430	Data processing, hosting, and related services	0	5,757	3,153	8,910
431	News syndicates, libraries, archives	0	486	1,211	1,698
432	Internet publishing and broadcasting and web search	0	21,961	14,448	36,409
433	Monetary authorities and depository credit	0	3,450,953	725,223	4,176,177
434	Nondepository credit intermediation	0	244,508	73,616	318,123
435	Securities and commodity contracts intermediation	0	662,610	426,545	1,089,155
436	Other financial investment activities	0	207,793	209,647	417,440
438	Insurance agencies, brokerages, and related activities	0	292,575	77,085	369,660
439	Funds, trusts, and other financial vehicles	0	6,581	366,106	372,686
440	Real estate	0	4,707,156	544,159	5,251,314

Sector	Description	Direct	Indirect	Induced	Total
441	Owner-occupied dwellings	0	0	5,165,767	5,165,767
443	General and consumer goods rental	0	3,183	4,626	7,809
445	Commercial / industrial machinery and equipment rental	0	1,471,483	22,248	1,493,730
446	Lessors of nonfinancial intangible assets	0	403,556	74,065	477,621
447	Legal services	0	491,731	308,539	800,270
448	Accounting, tax preparation, bookkeeping	0	687,164	122,034	809,199
449	Architectural, engineering, and related services	0	31,025	11,531	42,555
451	Custom computer programming services	0	2,078	463	2,541
452	Computer systems design services	0	50,404	9,767	60,171
453	Other computer related services	0	28,483	3,769	32,252
454	Management consulting services	0	50,640	23,320	73,959
455	Environmental and other technical consulting services	0	73,706	31,601	105,307
456	Scientific research and development services	0	1,490	11,386	12,875
457	Advertising, public relations, and related services	0	69,140	31,815	100,955
458	Photographic services	0	5,264	19,579	24,842
459	Veterinary services	0	7,015	104,477	111,492
460	Marketing research and all other miscellaneous	0	140,344	9,442	149,787
461	Management of companies and enterprises	0	98,749	35,429	134,178
462	Office administrative services	0	27,993	12,645	40,638
464	Employment services	0	145,081	52,662	197,744
465	Business support services	0	36,160	11,430	47,590
466	Travel arrangement and reservation services	0	1,171	1,781	2,952
468	Services to buildings	0	117,484	44,685	162,169
469	Landscape and horticultural services	0	71,055	32,506	103,560
470	Other support services	0	13,726	4,071	17,797
471	Waste management and remediation services	0	35,255	27,265	62,520
472	Elementary and secondary schools	0	0	37,347	37,347
474	Other educational services	0	2,614	86,070	88,684
475	Offices of physicians	0	0	94,438	94,438
476	Offices of dentists	0	0	328,976	328,976
477	Offices of other health practitioners	0	0	330,767	330,767
478	Outpatient care centers	0	0	92,634	92,634
480	Home health care services	0	0	52,717	52,717
481	Other ambulatory health care services	0	60	37,442	37,502
482	Hospitals	0	0	1,437,647	1,437,647
483	Nursing and community care facilities	0	0	432,727	432,727
484	Mental retardation, mental health, substance abuse	0	0	15,167	15,167
485	Individual and family services	0	0	174,288	174,288
486	Community food, housing, and other relief services	0	0	151,482	151,482
487	Child day care services	0	0	66,467	66,467
488	Performing arts companies	0	1,524	4,426	5,950
491	Promoters of performing arts and sports and agents	0	51,894	125,649	177,543
492	Independent artists, writers, and performers	0	52,927	51,369	104,295
493	Museums, historical sites, zoos, and parks	0	0	6,422	6,422
495	Gambling industries (except casino hotels)	0	538	234,707	235,245

Sector	Description	Direct	Indirect	Induced	Total
496	Other amusement and recreation industries	0	41,616	61,509	103,124
497	Fitness and recreational sports centers	0	3,391	23,109	26,499
498	Bowling centers	0	1	24,549	24,550
499	Hotels and motels, including casino hotels	0	151,348	17,595	168,942
500	Other accommodations	0	966	217	1,183
501	Full-service restaurants	0	104,120	565,009	669,129
502	Limited-service restaurants	0	252,017	1,134,504	1,386,520
503	All other food and drinking places	0	38,119	153,395	191,514
504	Automotive repair and maintenance, except car washes	0	396,068	503,567	899,635
505	Car washes	0	6,367	49,049	55,416
506	Electronic and precision equipment repair	0	184,425	34,680	219,104
507	Commercial / industrial machinery and equipment repair	0	220,892	63,991	284,882
508	Personal and household goods repair and maintenance	0	34,386	35,879	70,265
509	Personal care services	0	0	136,916	136,916
510	Death care services	0	0	32,918	32,918
511	Dry-cleaning and laundry services	0	6,298	19,003	25,302
512	Other personal services	0	25,130	125,459	150,588
514	Grantmaking, giving, and social advocacy organizations	0	940	57,352	58,292
515	Business and professional associations	0	340,232	115,702	455,933
516	Labor and civic organizations	0	458	100,737	101,195
517	Private households	0	0	35,153	35,153
518	Postal service	0	292,062	77,271	369,333
525	Local government electric utilities	0	220,544	92,118	312,662
526	Other local government enterprises	0	739,738	183,382	923,120

APPENDIX II – SUB-OBJECTIVE 2

Sub-Objective 2, District-Wide LEMA under Limited Irrigation Conditions Scenario – Total Employment Numbers

Sector	Description	Direct	Indirect	Induced	Total
0	Total	376	409	193	978
1	Oilseed farming	9	0	0	9
2	Grain farming	367	0	0	367
3	Vegetable and melon farming	0	0	0	0
6	Greenhouse, nursery, and floriculture production	0	0	0	0
10	All other crop farming	0	18	0	19
11	Beef cattle ranching and farming	0	10	0	10
12	Dairy cattle and milk production	0	0	0	0
13	Poultry and egg production	0	0	0	0
14	Animal production, except cattle and poultry and eggs	0	2	0	3
18	Commercial hunting and trapping	0	0	0	0
19	Support activities for agriculture and forestry	0	89	0	89
20	Extraction of natural gas and crude petroleum	0	8	0	9
31	Sand and gravel mining	0	0	0	0
37	Drilling oil and gas wells	0	0	0	0
38	Support activities for oil and gas operations	0	0	0	0
49	Electric power transmission and distribution	0	1	0	1
50	Natural gas distribution	0	1	0	1
51	Water, sewage and other systems	0	0	0	0
62	Maintenance and repair construction - nonresidential	0	26	1	27
63	Maintenance and repair construction - residential	0	1	2	3
66	Other animal food manufacturing	0	0	0	0
84	Fluid milk manufacturing	0	0	0	0
154	Printing	0	0	0	0
198	Other rubber product manufacturing	0	0	0	0
206	Ready-mix concrete manufacturing	0	0	0	0
262	Farm machinery and equipment manufacturing	0	4	0	4
388	Sign manufacturing	0	0	0	0
395	Wholesale trade	0	72	7	80
396	Retail - Motor vehicle and parts dealers	0	0	4	5
397	Retail - Furniture and home furnishings stores	0	0	1	1
398	Retail - Electronics and appliance stores	0	1	1	1
399	Retail - Building material and garden equipment	0	1	3	4
400	Retail - Food and beverage stores	0	0	9	9
401	Retail - Health and personal care stores	0	1	2	3
402	Retail - Gasoline stores	0	1	2	3
403	Retail - Clothing and clothing accessories stores	0	1	2	3
404	Retail - Sporting goods, hobby	0	0	1	2
405	Retail - General merchandise stores	0	0	6	6
406	Retail - Miscellaneous store retailers	0	2	6	7
407	Retail - Nonstore retailers	0	1	8	9
408	Air transportation	0	0	0	0
409	Rail transportation	0	2	0	2
411	Truck transportation	0	11	1	13
412	Transit and ground passenger transportation	0	0	0	0

Sector	Description	Direct	Indirect	Induced	Total
413	Pipeline transportation	0	1	0	1
414	Scenic and sightseeing transportation	0	1	0	1
415	Couriers and messengers	0	2	0	2
416	Warehousing and storage	0	9	1	10
417	Newspaper publishers	0	1	1	2
423	Motion picture and video industries	0	0	0	0
424	Sound recording industries	0	0	0	0
425	Radio and television broadcasting	0	0	0	1
426	Cable and other subscription programming	0	0	0	0
427	Wired telecommunications carriers	0	1	1	2
428	Wireless telecommunications carriers (except satellite)	0	0	0	1
430	Data processing, hosting, and related services	0	0	0	0
432	Internet publishing and broadcasting and web search	0	0	0	0
433	Monetary authorities and depository credit	0	18	4	22
434	Nondepository credit intermediatio	0	1	0	2
435	Securities and commodity contracts intermedia	0	6	4	10
436	Other financial investment activities	0	1	1	3
438	Insurance agencies, brokerages, and related activities	0	2	0	2
439	Funds, trusts, and other financial vehicles	0	0	1	1
440	Real estate	0	41	5	45
443	General and consumer goods rental	0	0	0	0
445	Commercial and industrial machinery and equipment rental	0	4	0	5
446	Lessors of nonfinancial intangible assets	0	0	0	1
447	Legal services	0	6	4	9
448	Accounting, tax preparation, bookkeeping	0	14	2	16
449	Architectural, engineering, and related services	0	0	0	0
451	Custom computer programming services	0	0	0	0
452	Computer systems design services	0	1	0	1
453	Other computer related service	0	0	0	0
454	Management consulting services	0	1	0	1
455	Environmental and other technical consulting services	0	2	1	2
456	Scientific research and development services	0	0	0	0
457	Advertising, public relations, and related services	0	0	0	1
458	Photographic services	0	0	0	1
459	Veterinary services	0	0	1	1
460	Marketing research and all other miscellaneous professional	0	4	0	4
461	Management of companies and enterprises	0	1	0	1
462	Office administrative services	0	1	0	1
463	Facilities support services	0	0	0	0
464	Employment services	0	1	0	2
465	Business support services	0	1	0	1
466	Travel arrangement and reservation services	0	0	0	0
468	Services to buildings	0	3	1	5
469	Landscape and horticultural services	0	2	1	3
470	Other support services	0	0	0	0

Sector	Description	Direct	Indirect	Induced	Total
471	Waste management and remediation services	0	0	0	0
472	Elementary and secondary schools	0	0	1	1
474	Other educational services	0	0	3	3
475	Offices of physicians	0	0	1	1
476	Offices of dentists	0	0	3	3
477	Offices of other health practitioners	0	0	4	4
478	Outpatient care centers	0	0	1	1
480	Home health care services	0	0	1	1
481	Other ambulatory health care services	0	0	0	0
482	Hospitals	0	0	9	9
483	Nursing and community care facilities	0	0	6	6
484	Mental retardation, mental health, substance abuse	0	0	0	0
485	Individual and family services	0	0	6	6
486	Community food, housing, and other relief services	0	0	2	2
487	Child day care services	0	0	2	2
488	Performing arts companies	0	0	0	0
491	Promoters of performing arts and sports and agents	0	1	1	2
492	Independent artists, writers, and performers	0	2	2	5
493	Museums, historical sites, zoos, and parks	0	0	0	0
495	Gambling industries (except casino hotels)	0	0	2	2
496	Other amusement and recreation industries	0	1	2	3
497	Fitness and recreational sports centers	0	0	1	1
498	Bowling centers	0	0	1	1
499	Hotels and motels, including casino hotels	0	2	0	2
500	Other accommodations	0	0	0	0
501	Full-service restaurants	0	2	13	15
502	Limited-service restaurants	0	3	14	17
503	All other food and drinking places	0	1	4	5
504	Automotive repair and maintenance, except car washes	0	3	4	8
505	Car washes	0	0	1	1
506	Electronic and precision equipment repair and maintenance	0	1	0	1
507	Commercial and industrial machinery and equipment repair	0	1	0	2
508	Personal and household goods repair and maintenance	0	0	0	1
509	Personal care services	0	0	3	3
510	Death care services	0	0	0	0
511	Dry-cleaning and laundry services	0	0	0	0
512	Other personal services	0	1	5	6
514	Grantmaking, giving, and social advocacy organizations	0	0	0	0
515	Business and professional associations	0	2	1	3
516	Labor and civic organizations	0	0	2	2
517	Private households	0	0	3	3
518	Postal service	0	3	1	4
525	Local government electric utilities	0	0	0	0
526	Other local government enterprises	0	2	1	3

Sub-Objective 2, District-Wide LEMA under Limited Irrigation Conditions Scenario
– Total Value Added Numbers

Sector	Description	Direct	Indirect	Induced	Total
0	Total	45,534,570	38,678,423	10,873,572	95,086,565
1	Oilseed farming	6,449,378	0	0	6,449,378
2	Grain farming	39,085,193	0	0	39,085,193
3	Vegetable and melon farming	0	314	1,585	1,899
6	Greenhouse, nursery, and floriculture production	0	2,443	216	2,658
10	All other crop farming	0	1,463,157	3,715	1,466,872
11	Beef cattle ranching and farming	0	631,214	386	631,601
12	Dairy cattle and milk production	0	25,685	9,033	34,718
13	Poultry and egg production	0	2,785	517	3,301
14	Animal production, except cattle and poultry and eggs	0	217,668	4,116	221,784
16	Commercial logging	0	0	0	0
18	Commercial hunting and trapping	0	0	2,131	2,131
19	Support activities for agriculture and forestry	0	15,860,423	1,355	15,861,778
20	Extraction of natural gas and crude petroleum	0	263,525	11,920	275,445
31	Sand and gravel mining	0	1,368	332	1,701
37	Drilling oil and gas wells	0	273	14	287
38	Support activities for oil and gas operations	0	15,791	781	16,572
39	Metal mining services	0	17	1	18
40	Other nonmetallic minerals services	0	29	3	32
49	Electric power transmission and distribution	0	319,712	133,516	453,228
50	Natural gas distribution	0	54,423	3,099	57,522
51	Water, sewage and other systems	0	8,878	545	9,423
62	Maintenance and repair construction - nonresidential	0	835,026	28,743	863,769
63	Maintenance and repair construction - residential	0	20,366	62,329	82,695
66	Other animal food manufacturing	0	6,765	353	7,118
71	Soybean and other oilseed processing	0	19	8	28
84	Fluid milk manufacturing	0	33	4,093	4,127
89	Animal, except poultry, slaughtering	0	5	84	89
94	Bread and bakery product, except frozen, manufacturing	0	6	171	178
95	Frozen cakes and other pastries manufacturing	0	1	18	18
104	Spice and extract manufacturing	0	5	71	75
121	Textile bag and canvas mills	0	9	3	12
126	Cut and sew apparel contractors	0	1	0	1
137	Engineered wood member and truss manufacturing	0	23	6	29
154	Printing	0	1,548	707	2,254
162	Industrial gas manufacturing	0	187	115	302
165	Other basic organic chemical manufacturing	0	113	2	115
169	Nitrogenous fertilizer manufacturing	0	297	1	298
177	Paint and coating manufacturing	0	107	16	124
195	Other plastics product manufacturing	0	132	27	159
198	Other rubber product manufacturing	0	3,204	326	3,530
206	Ready-mix concrete manufacturing	0	8,011	2,108	10,120
236	Handtool manufacturing	0	58	2	60
248	Spring and wire product manufacturing	0	152	6	158
249	Machine shops	0	333	44	377

Sector	Description	Direct	Indirect	Induced	Total
257	Small arms ammunition manufacturing	0	22	350	372
259	Small arms, ordnance, and accessories manufacturing	0	9	16	24
262	Farm machinery and equipment manufacturing	0	313,647	52	313,699
266	Oil and gas field machinery and equipment manufacturing	0	3	0	3
279	Special tool, die, jig, and fixture manufacturing	0	0	1	2
347	Truck trailer manufacturing	0	1	8	8
350	Motor vehicle gasoline engine parts manufacturing	0	61	4	65
368	Wood kitchen cabinet and countertop manufacturing	0	3	3	6
388	Sign manufacturing	0	7,386	3,400	10,786
395	Wholesale trade	0	8,828,849	914,433	9,743,282
396	Retail - Motor vehicle and parts dealers	0	36,047	322,618	358,665
397	Retail - Furniture and home furnishings stores	0	11,222	41,251	52,473
398	Retail - Electronics and appliance stores	0	21,843	36,666	58,509
399	Retail - Building material and garden equipment	0	49,755	167,181	216,936
400	Retail - Food and beverage stores	0	7,374	374,520	381,894
401	Retail - Health and personal care stores	0	36,674	103,104	139,779
402	Retail - Gasoline stores	0	28,112	97,274	125,386
403	Retail - Clothing and clothing accessories stores	0	18,851	79,942	98,793
404	Retail - Sporting goods, hobby	0	11,126	39,268	50,394
405	Retail - General merchandise stores	0	13,997	294,460	308,456
406	Retail - Miscellaneous store retailers	0	25,744	82,184	107,928
407	Retail - Nonstore retailers	0	28,547	251,997	280,543
408	Air transportation	0	2,470	1,569	4,039
409	Rail transportation	0	512,565	8,659	521,224
411	Truck transportation	0	1,216,149	140,994	1,357,144
412	Transit and ground passenger transportation	0	145	479	624
413	Pipeline transportation	0	155,927	3,857	159,784
414	Scenic and sightseeing transportation	0	34,774	9,687	44,462
415	Couriers and messengers	0	92,953	18,678	111,631
416	Warehousing and storage	0	479,299	64,420	543,719
417	Newspaper publishers	0	75,880	44,444	120,324
423	Motion picture and video industries	0	2,596	11,485	14,081
425	Radio and television broadcasting	0	3,129	1,716	4,845
427	Wired telecommunications carriers	0	79,812	137,704	217,516
428	Wireless telecommunications carriers (except satellite)	0	154,749	184,183	338,932
430	Data processing, hosting, and related services	0	83	46	129
431	News syndicates, libraries, archives	0	96	240	336
432	Internet publishing and broadcasting and web search	0	3,783	2,490	6,274
433	Monetary authorities and depository credit intermediation	0	1,405,829	295,702	1,701,531
434	Nondepository credit intermediation	0	110,596	33,334	143,930
435	Securities and commodity contracts intermediation	0	173,358	111,709	285,067
436	Other financial investment activities	0	22,134	22,347	44,481
438	Insurance agencies, brokerages, and related activities	0	83,534	21,986	105,520
439	Funds, trusts, and other financial vehicles	0	1,149	63,939	65,088
440	Real estate	0	1,869,687	216,364	2,086,051

Sector	Description	Direct	Indirect	Induced	Total
441	Owner-occupied dwellings	0	0	2,941,596	2,941,596
443	General and consumer goods renta	0	1,492	2,170	3,662
445	Commercial and industrial machinery and equipment rental	0	876,629	13,273	889,902
446	Lessors of nonfinancial intangible assets	0	30,752	5,650	36,402
447	Legal services	0	126,127	79,238	205,365
448	Accounting, tax preparation, bookkeepin	0	277,504	49,295	326,798
449	Architectural, engineering, and related services	0	7,258	2,699	9,957
451	Custom computer programming services	0	692	154	846
452	Computer systems design services	0	2,906	564	3,470
453	Other computer related services	0	2,795	371	3,166
454	Management consulting services	0	10,600	4,882	15,482
455	Environmental and other technical consulting services	0	8,460	3,629	12,088
456	Scientific research and development services	0	374	2,862	3,236
457	Advertising, public relations, and related services	0	9,926	4,570	14,496
458	Photographic services	0	924	3,438	4,362
459	Veterinary services	0	1,748	26,073	27,822
460	Marketing research and all other miscellaneous	0	21,894	1,476	23,370
461	Management of companies and enterprises	0	31,688	11,376	43,064
462	Office administrative services	0	10,409	4,703	15,112
464	Employment services	0	101,945	37,030	138,975
465	Business support services	0	10,568	3,343	13,911
466	Travel arrangement and reservation services	0	505	770	1,275
468	Services to buildings	0	51,287	19,535	70,822
469	Landscape and horticultural services	0	22,377	10,251	32,629
470	Other support services	0	4,558	1,353	5,911
471	Waste management and remediation services	0	9,317	7,195	16,512
472	Elementary and secondary schools	0	0	19,857	19,857
474	Other educational services	0	951	31,332	32,283
475	Offices of physicians	0	0	32,508	32,508
476	Offices of dentists	0	0	160,604	160,604
477	Offices of other health practitioners	0	0	168,835	168,835
478	Outpatient care centers	0	0	30,489	30,489
480	Home health care services	0	0	31,899	31,899
481	Other ambulatory health care services	0	21	13,050	13,071
482	Hospitals	0	0	634,280	634,280
483	Nursing and community care facilities	0	0	212,420	212,420
484	Mental retardation, mental health, substance abuse	0	0	9,027	9,027
485	Individual and family services	0	0	88,257	88,257
486	Community food, housing, and other relief services	0	0	61,881	61,881
487	Child day care services	0	0	24,103	24,103
488	Performing arts companies	0	431	1,253	1,684
491	Promoters of performing arts and sports and agents	0	5,732	13,888	19,620
492	Independent artists, writers, and performers	0	4,177	4,057	8,234
493	Museums, historical sites, zoos, and parks	0	0	1,683	1,683
495	Gambling industries (except casino hotels)	0	177	77,204	77,381

Sector	Description	Direct	Indirect	Induced	Total
496	Other amusement and recreation industries	0	6,759	9,989	16,747
497	Fitness and recreational sports centers	0	854	5,824	6,678
498	Bowling centers	0	0	7,888	7,889
499	Hotels and motels, including casino hotels	0	58,470	6,804	65,274
500	Other accommodations	0	359	81	440
501	Full-service restaurants	0	35,460	192,562	228,022
502	Limited-service restaurants	0	105,856	476,720	582,576
503	All other food and drinking places	0	17,268	69,514	86,783
504	Automotive repair and maintenance, except car washes	0	226,737	288,447	515,184
505	Car washes	0	3,162	24,372	27,534
506	Electronic and precision equipment repair and maintenance	0	93,832	17,655	111,487
507	Commercial and industrial machinery and equipment repair	0	128,553	37,261	165,814
508	Personal and household goods repair and maintenance	0	19,645	20,510	40,155
509	Personal care services	0	0	59,657	59,657
510	Death care services	0	0	11,246	11,246
511	Dry-cleaning and laundry services	0	2,565	7,742	10,307
512	Other personal services	0	5,434	27,145	32,579
514	Grantmaking, giving, and social advocacy organizations	0	294	17,818	18,111
515	Business and professional associations	0	130,741	44,223	174,965
516	Labor and civic organizations	0	155	34,150	34,305
517	Private households	0	0	29,891	29,891
518	Postal service	0	197,234	52,209	249,443
525	Local government electric utilities	0	85,126	35,550	120,676
526	Other local government enterprises	0	261,620	64,924	326,544

Sub-Objective 2, District-Wide LEMA under Limited Irrigation Conditions Scenario
– Total Output Numbers

Sector	Description	Direct	Indirect	Induced	Total
0	Total	252,999,670	66,506,849	21,051,079	340,557,598
1	Oilseed farming	19,517,765	0	0	19,517,765
2	Grain farming	233,481,905	0	0	233,481,905
3	Vegetable and melon farming	0	377	1,903	2,279
6	Greenhouse, nursery, and floriculture production	0	3,411	301	3,713
10	All other crop farming	0	2,467,394	6,265	2,473,659
11	Beef cattle ranching and farming	0	2,693,196	1,649	2,694,845
12	Dairy cattle and milk production	0	64,171	22,569	86,741
13	Poultry and egg production	0	11,804	2,189	13,993
14	Animal production, except cattle and poultry and eggs	0	457,193	8,646	465,838
16	Commercial logging	0	0	0	1
18	Commercial hunting and trapping	0	0	3,965	3,965
19	Support activities for agriculture and forestry	0	17,061,801	1,458	17,063,260
20	Extraction of natural gas and crude petroleum	0	816,056	36,912	852,968
31	Sand and gravel mining	0	3,106	755	3,861
37	Drilling oil and gas wells	0	883	44	927
38	Support activities for oil and gas operations	0	38,212	1,890	40,102
39	Metal mining services	0	54	4	57
40	Other nonmetallic minerals services	0	72	7	78
49	Electric power transmission and distribution	0	1,098,106	458,585	1,556,691
50	Natural gas distribution	0	332,864	18,956	351,820
51	Water, sewage and other systems	0	27,013	1,658	28,671
62	Maintenance and repair construction - nonresidential	0	3,125,982	107,603	3,233,585
63	Maintenance and repair construction - residential	0	82,824	253,475	336,299
66	Other animal food manufacturing	0	107,074	5,582	112,656
71	Soybean and other oilseed processing	0	754	327	1,081
84	Fluid milk manufacturing	0	370	45,461	45,830
89	Animal, except poultry, slaughtering	0	41	729	770
94	Bread and bakery product, except frozen, manufacturing	0	17	482	499
95	Frozen cakes and other pastries manufacturing	0	2	64	66
104	Spice and extract manufacturing	0	15	232	247
121	Textile bag and canvas mills	0	153	51	204
126	Cut and sew apparel contractors	0	11	4	15
137	Engineered wood member and truss manufacturing	0	99	27	127
154	Printing	0	3,582	1,636	5,218
162	Industrial gas manufacturing	0	1,089	672	1,761
165	Other basic organic chemical manufacturing	0	1,699	26	1,725
169	Nitrogenous fertilizer manufacturing	0	2,377	4	2,381
177	Paint and coating manufacturing	0	699	107	806
195	Other plastics product manufacturing	0	634	129	762
198	Other rubber product manufacturing	0	11,039	1,125	12,164
206	Ready-mix concrete manufacturing	0	55,840	14,697	70,537
236	Handtool manufacturing	0	143	5	149
248	Spring and wire product manufacturing	0	329	13	342
249	Machine shops	0	541	71	612

Sector	Description	Direct	Indirect	Induced	Total
257	Small arms ammunition manufacturing	0	75	1,192	1,267
259	Small arms, ordnance, and accessories manufacturing	0	20	35	55
262	Farm machinery and equipment manufacturing	0	2,103,307	350	2,103,657
266	Oil and gas field machinery / equipment manufacturing	0	28	2	30
279	Special tool, die, jig, and fixture manufacturing	0	3	8	10
347	Truck trailer manufacturing	0	2	35	38
350	Motor vehicle gasoline engine manufacturing	0	391	28	418
368	Wood kitchen cabinet and countertop manufacturing	0	13	14	27
388	Sign manufacturing	0	18,836	8,670	27,506
395	Wholesale trade	0	15,479,434	1,603,256	17,082,690
396	Retail - Motor vehicle and parts dealers	0	48,765	436,443	485,207
397	Retail - Furniture and home furnishings stores	0	20,777	76,373	97,150
398	Retail - Electronics and appliance stores	0	34,011	57,093	91,104
399	Retail - Building material and garden equipment	0	78,149	262,586	340,735
400	Retail - Food and beverage stores	0	11,083	562,900	573,983
401	Retail - Health and personal care stores	0	63,125	177,467	240,592
402	Retail - Gasoline stores	0	43,276	149,748	193,024
403	Retail - Clothing and clothing accessories stores	0	34,424	145,983	180,407
404	Retail - Sporting goods, hobby	0	18,170	64,126	82,296
405	Retail - General merchandise stores	0	21,112	444,154	465,266
406	Retail - Miscellaneous store retailers	0	50,648	161,686	212,334
407	Retail - Nonstore retailers	0	70,610	623,303	693,913
408	Air transportation	0	4,221	2,681	6,902
409	Rail transportation	0	804,785	13,595	818,381
411	Truck transportation	0	2,345,629	271,941	2,617,569
412	Transit and ground passenger transportation	0	643	2,119	2,762
413	Pipeline transportation	0	382,357	9,459	391,815
414	Scenic and sightseeing transportation	0	82,371	22,947	105,318
415	Couriers and messengers	0	189,533	38,084	227,617
416	Warehousing and storage	0	869,274	116,834	986,108
417	Newspaper publishers	0	136,777	80,113	216,890
423	Motion picture and video industries	0	7,683	33,994	41,677
425	Radio and television broadcasting	0	61,673	33,826	95,498
427	Wired telecommunications carriers	0	246,185	424,757	670,942
428	Wireless telecommunications carriers (except satellite)	0	499,149	594,091	1,093,241
430	Data processing, hosting, and related services	0	4,895	2,683	7,577
431	News syndicates, libraries, archives	0	413	1,031	1,444
432	Internet publishing and broadcasting and web search	0	18,671	12,292	30,963
433	Monetary authorities and depository credit	0	2,933,299	616,990	3,550,289
434	Nondepository credit intermediation	0	207,797	62,630	270,427
435	Securities and commodity contracts intermediatio	0	563,155	362,886	926,041
436	Other financial investment activities	0	176,660	178,358	355,018
438	Insurance agencies, brokerages, and related activities	0	249,174	65,582	314,756
439	Funds, trusts, and other financial vehicles	0	5,599	311,465	317,064
440	Real estate	0	4,000,473	462,944	4,463,416

Sector	Description	Direct	Indirect	Induced	Total
441	Owner-occupied dwellings	0	0	4,394,924	4,394,924
443	General and consumer goods rental	0	2,706	3,936	6,641
445	Commercial / industrial machinery and equipment rental	0	1,250,080	18,928	1,269,008
446	Lessors of nonfinancial intangible assets	0	342,967	63,012	405,979
447	Legal services	0	417,832	262,499	680,331
448	Accounting, tax preparation, bookkeeping	0	584,471	103,823	688,294
449	Architectural, engineering, and related services	0	26,382	9,810	36,192
451	Custom computer programming services	0	1,766	394	2,160
452	Computer systems design services	0	42,819	8,309	51,128
453	Other computer related services	0	24,192	3,207	27,399
454	Management consulting services	0	43,071	19,839	62,910
455	Environmental and other technical consulting services	0	62,674	26,885	89,559
456	Scientific research and development services	0	1,266	9,686	10,953
457	Advertising, public relations, and related services	0	58,785	27,067	85,853
458	Photographic services	0	4,475	16,657	21,132
459	Veterinary services	0	5,961	88,885	94,846
460	Marketing research and all other miscellaneous	0	119,173	8,033	127,206
461	Management of companies and enterprises	0	83,957	30,142	114,099
462	Office administrative services	0	23,808	10,758	34,566
464	Employment services	0	123,343	44,803	168,147
465	Business support services	0	30,745	9,724	40,469
466	Travel arrangement and reservation services	0	995	1,515	2,510
468	Services to buildings	0	99,807	38,017	137,824
469	Landscape and horticultural services	0	60,366	27,655	88,021
470	Other support services	0	11,670	3,464	15,134
471	Waste management and remediation services	0	30,035	23,196	53,231
472	Elementary and secondary schools	0	0	31,775	31,775
474	Other educational services	0	2,223	73,228	75,451
475	Offices of physicians	0	0	80,345	80,345
476	Offices of dentists	0	0	279,879	279,879
477	Offices of other health practitioners	0	0	281,407	281,407
478	Outpatient care centers	0	0	78,810	78,810
480	Home health care services	0	0	44,851	44,851
481	Other ambulatory health care services	0	51	31,854	31,905
482	Hospitals	0	0	1,223,085	1,223,085
483	Nursing and community care facilities	0	0	368,142	368,142
484	Mental retardation, mental health, substance abuse	0	0	12,903	12,903
485	Individual and family services	0	0	148,279	148,279
486	Community food, housing, and other relief services	0	0	128,877	128,877
487	Child day care services	0	0	56,549	56,549
488	Performing arts companies	0	1,296	3,766	5,062
491	Promoters of performing arts and sports and agents	0	44,123	106,900	151,023
492	Independent artists, writers, and performers	0	44,997	43,703	88,700
493	Museums, historical sites, zoos, and parks	0	0	5,464	5,464
495	Gambling industries (except casino hotels)	0	458	199,678	200,135

Sector	Description	Direct	Indirect	Induced	Total
496	Other amusement and recreation industries	0	35,407	52,331	87,738
497	Fitness and recreational sports centers	0	2,883	19,661	22,543
498	Bowling centers	0	1	20,886	20,887
499	Hotels and motels, including casino hotels	0	128,626	14,969	143,595
500	Other accommodations	0	821	185	1,006
501	Full-service restaurants	0	88,520	480,691	569,210
502	Limited-service restaurants	0	214,323	965,199	1,179,522
503	All other food and drinking places	0	32,418	130,504	162,922
504	Automotive repair and maintenance, except car washes	0	336,759	428,414	765,173
505	Car washes	0	5,414	41,729	47,143
506	Electronic and precision equipment repair	0	156,811	29,504	186,315
507	Commercial / industrial machinery and equipment repair	0	187,824	54,441	242,265
508	Personal and household goods repair and maintenance	0	29,237	30,525	59,762
509	Personal care services	0	0	116,483	116,483
510	Death care services	0	0	28,005	28,005
511	Dry-cleaning and laundry services	0	5,356	16,168	21,523
512	Other personal services	0	21,366	106,736	128,102
514	Grantmaking, giving, and social advocacy organizations	0	804	48,793	49,596
515	Business and professional associations	0	291,013	98,435	389,448
516	Labor and civic organizations	0	389	85,704	86,094
517	Private households	0	0	29,907	29,907
518	Postal service	0	248,347	65,739	314,086
525	Local government electric utilities	0	187,661	78,370	266,031
526	Other local government enterprises	0	628,673	156,013	784,686

APPENDIX III – SUB-OBJECTIVE 3

Sub-Objective 3, Optimal Crop-Mix Shift Scenario – Total Employment Numbers

Sector	Description	Direct	Indirect	Induced	Total
0	Total	391	426	200	1,018
1	Oilseed farming	10	0	0	10
2	Grain farming	381	2	0	384
3	Vegetable and melon farming	0	0	0	0
6	Greenhouse, nursery, and floriculture production	0	0	0	0
10	All other crop farming	0	19	0	20
11	Beef cattle ranching and farming	0	10	0	10
12	Dairy cattle and milk production	0	0	0	0
13	Poultry and egg production	0	0	0	0
14	Animal production, except cattle and poultry and eggs	0	3	0	3
18	Commercial hunting and trapping	0	0	0	0
19	Support activities for agriculture and forestry	0	88	0	88
20	Extraction of natural gas and crude petroleum	0	9	0	9
31	Sand and gravel mining	0	0	0	0
37	Drilling oil and gas wells	0	0	0	0
38	Support activities for oil and gas operations	0	0	0	0
49	Electric power transmission and distribution	0	1	0	1
50	Natural gas distribution	0	1	0	1
51	Water, sewage and other systems	0	0	0	0
62	Maintenance and repair construction - nonresidential	0	28	1	29
63	Maintenance and repair construction - residential	0	1	2	3
66	Other animal food manufacturing	0	0	0	0
84	Fluid milk manufacturing	0	0	0	0
154	Printing	0	0	0	0
198	Other rubber product manufacturing	0	0	0	0
206	Ready-mix concrete manufacturing	0	0	0	0
262	Farm machinery and equipment manufacturing	0	4	0	4
395	Wholesale trade	0	76	8	84
396	Retail - Motor vehicle and parts dealers	0	1	5	5
397	Retail - Furniture and home furnishings stores	0	0	1	1
398	Retail - Electronics and appliance stores	0	1	1	1
399	Retail - Building material and garden equipment	0	1	3	4
400	Retail - Food and beverage stores	0	0	9	9
401	Retail - Health and personal care stores	0	1	3	3
402	Retail - Gasoline stores	0	1	2	3
403	Retail - Clothing and clothing accessories stores	0	1	2	3
404	Retail - Sporting goods, hobby	0	0	1	2
405	Retail - General merchandise stores	0	0	6	7
406	Retail - Miscellaneous store retailers	0	2	6	8
407	Retail - Nonstore retailers	0	1	8	9
408	Air transportation	0	0	0	0
409	Rail transportation	0	2	0	2
411	Truck transportation	0	12	1	13
412	Transit and ground passenger transportation	0	0	0	0
413	Pipeline transportation	0	1	0	1

Sector	Description	Direct	Indirect	Induced	Total
414	Scenic and sightseeing transportation	0	1	0	1
415	Couriers and messengers	0	2	0	2
416	Warehousing and storage	0	9	1	11
417	Newspaper publishers	0	1	1	2
423	Motion picture and video industries	0	0	0	0
425	Radio and television broadcasting	0	0	0	1
426	Cable and other subscription programming	0	0	0	0
427	Wired telecommunications carriers	0	1	1	2
428	Wireless telecommunications carriers	0	0	0	1
430	Data processing, hosting, and related services	0	0	0	0
432	Internet publishing and broadcasting and web search	0	0	0	0
433	Monetary authorities and depository credit	0	19	4	23
434	Nondepository credit intermediation	0	1	0	2
435	Securities and commodity contracts intermediation	0	7	4	11
436	Other financial investment activities	0	1	1	3
438	Insurance agencies, brokerages, and related activities	0	2	0	2
439	Funds, trusts, and other financial vehicles	0	0	1	1
440	Real estate	0	43	5	48
443	General and consumer goods rental	0	0	0	0
445	Commercial / industrial machinery and equipment rental	0	5	0	5
446	Lessors of nonfinancial intangible assets	0	0	0	1
447	Legal services	0	6	4	10
448	Accounting, tax preparation, bookkeeping	0	15	3	17
449	Architectural, engineering, and related services	0	0	0	0
451	Custom computer programming services	0	0	0	0
452	Computer systems design services	0	1	0	1
453	Other computer related services	0	0	0	0
454	Management consulting services	0	1	0	1
455	Environmental and other technical consulting services	0	2	1	2
456	Scientific research and development services	0	0	0	0
457	Advertising, public relations, and related services	0	1	0	1
458	Photographic services	0	0	0	1
459	Veterinary services	0	0	1	1
460	Marketing research and all other miscellaneous	0	4	0	4
461	Management of companies and enterprises	0	1	0	1
462	Office administrative services	0	1	0	1
464	Employment services	0	1	1	2
465	Business support services	0	1	0	1
466	Travel arrangement and reservation services	0	0	0	0
468	Services to buildings	0	3	1	5
469	Landscape and horticultural services	0	2	1	3
470	Other support services	0	0	0	0
471	Waste management and remediation services	0	0	0	0
472	Elementary and secondary schools	0	0	1	1
474	Other educational services	0	0	3	3

Sector	Description	Direct	Indirect	Induced	Total
475	Offices of physicians	0	0	1	1
476	Offices of dentists	0	0	3	3
477	Offices of other health practitioners	0	0	5	5
478	Outpatient care centers	0	0	1	1
480	Home health care services	0	0	1	1
481	Other ambulatory health care services	0	0	0	0
482	Hospitals	0	0	9	9
483	Nursing and community care facilities	0	0	6	6
484	Mental retardation, mental health, substance abuse	0	0	0	0
485	Individual and family services	0	0	6	6
486	Community food, housing, and other relief services	0	0	2	2
487	Child day care services	0	0	2	2
488	Performing arts companies	0	0	0	0
491	Promoters of performing arts and sports and agents	0	1	1	2
492	Independent artists, writers, and performers	0	3	3	5
493	Museums, historical sites, zoos, and parks	0	0	0	0
495	Gambling industries (except casino hotels)	0	0	2	2
496	Other amusement and recreation industries	0	1	2	3
497	Fitness and recreational sports centers	0	0	1	1
498	Bowling centers	0	0	1	1
499	Hotels and motels, including casino hotels	0	2	0	2
500	Other accommodations	0	0	0	0
501	Full-service restaurants	0	2	13	16
502	Limited-service restaurants	0	3	15	18
503	All other food and drinking places	0	1	4	5
504	Automotive repair and maintenance, except car washes	0	3	4	8
505	Car washes	0	0	1	1
506	Electronic and precision equipment repair	0	1	0	1
507	Commercial / industrial machinery and equipment repair	0	1	0	2
508	Personal and household goods repair and maintenance	0	0	0	1
509	Personal care services	0	0	3	3
510	Death care services	0	0	0	0
511	Dry-cleaning and laundry services	0	0	0	0
512	Other personal services	0	1	5	7
514	Grantmaking, giving, and social advocacy organizations	0	0	0	0
515	Business and professional associations	0	2	1	3
516	Labor and civic organizations	0	0	2	2
517	Private households	0	0	3	3
518	Postal service	0	3	1	4
525	Local government electric utilities	0	0	0	0
526	Other local government enterprises	0	3	1	3

Sub-Objective 3, Optimal Crop-Mix Shift Scenario – Total Value Added Numbers

Sector	Description	Direct	Indirect	Induced	Total
0	Total	48,030,523	39,909,328	11,268,599	99,208,450
1	Oilseed farming	7,436,725	0	0	7,436,725
2	Grain farming	40,593,798	246,387	21	40,840,206
3	Vegetable and melon farming	0	311	1,643	1,955
6	Greenhouse, nursery, and floriculture production	0	2,421	223	2,644
10	All other crop farming	0	1,542,482	3,850	1,546,333
11	Beef cattle ranching and farming	0	634,113	398	634,512
12	Dairy cattle and milk production	0	25,460	9,362	34,822
13	Poultry and egg production	0	2,796	535	3,332
14	Animal production, except cattle and poultry and eggs	0	224,535	4,266	228,801
16	Commercial logging	0	0	0	0
18	Commercial hunting and trapping	0	0	2,208	2,208
19	Support activities for agriculture and forestry	0	15,683,479	1,329	15,684,809
20	Extraction of natural gas and crude petroleum	0	276,759	12,355	289,114
31	Sand and gravel mining	0	1,440	345	1,785
37	Drilling oil and gas wells	0	287	14	301
38	Support activities for oil and gas operations	0	16,585	809	17,394
39	Metal mining services	0	18	1	19
40	Other nonmetallic minerals services	0	30	3	33
49	Electric power transmission and distribution	0	337,656	138,393	476,049
50	Natural gas distribution	0	56,966	3,212	60,178
51	Water, sewage and other systems	0	9,331	565	9,895
62	Maintenance and repair construction - nonresidential	0	882,432	29,791	912,223
63	Maintenance and repair construction - residential	0	21,398	64,585	85,983
66	Other animal food manufacturing	0	6,816	365	7,182
71	Soybean and other oilseed processing	0	19	9	28
84	Fluid milk manufacturing	0	35	4,243	4,278
89	Animal, except poultry, slaughtering	0	5	87	92
94	Bread and bakery product, except frozen, manufacturing	0	7	178	184
95	Frozen cakes and other pastries manufacturing	0	1	18	19
104	Spice and extract manufacturing	0	5	73	78
121	Textile bag and canvas mills	0	9	3	12
126	Cut and sew apparel contractors	0	1	0	1
137	Engineered wood member and truss manufacturing	0	24	7	31
154	Printing	0	1,628	732	2,360
162	Industrial gas manufacturing	0	197	119	316
165	Other basic organic chemical manufacturing	0	120	2	122
169	Nitrogenous fertilizer manufacturing	0	311	1	312
177	Paint and coating manufacturing	0	113	17	130
195	Other plastics product manufacturing	0	139	28	167
198	Other rubber product manufacturing	0	3,373	338	3,711
206	Ready-mix concrete manufacturing	0	8,462	2,185	10,647
236	Handtool manufacturing	0	61	2	64
248	Spring and wire product manufacturing	0	154	6	160
249	Machine shops	0	350	46	395

Sector	Description	Direct	Indirect	Induced	Total
257	Small arms ammunition manufacturing	0	23	362	386
259	Small arms, ordnance, and accessories manufacturing	0	9	16	25
262	Farm machinery and equipment manufacturing	0	330,158	54	330,212
266	Oil and gas field machinery and equipment manufacturing	0	3	0	4
279	Special tool, die, jig, and fixture manufacturing	0	0	1	2
347	Truck trailer manufacturing	0	1	8	9
350	Motor vehicle gasoline engine and engine parts manufacturing	0	64	4	69
368	Wood kitchen cabinet and countertop manufacturing	0	3	3	7
388	Sign manufacturing	0	7,770	3,524	11,294
395	Wholesale trade	0	9,285,760	947,706	10,233,466
396	Retail - Motor vehicle and parts dealers	0	37,944	334,346	372,289
397	Retail - Furniture and home furnishings stores	0	11,836	42,750	54,586
398	Retail - Electronics and appliance stores	0	23,038	37,998	61,036
399	Retail - Building material and garden equipment	0	52,476	173,257	225,733
400	Retail - Food and beverage stores	0	7,730	388,134	395,864
401	Retail - Health and personal care stores	0	38,680	106,852	145,532
402	Retail - Gasoline stores	0	29,649	100,810	130,458
403	Retail - Clothing and clothing accessories stores	0	19,882	82,848	102,730
404	Retail - Sporting goods, hobby	0	11,735	40,695	52,430
405	Retail - General merchandise stores	0	14,770	305,163	319,933
406	Retail - Miscellaneous store retailers	0	27,152	85,171	112,322
407	Retail - Nonstore retailers	0	30,108	261,156	291,264
408	Air transportation	0	2,596	1,625	4,221
409	Rail transportation	0	538,185	8,974	547,158
411	Truck transportation	0	1,280,757	146,113	1,426,871
412	Transit and ground passenger transportation	0	153	497	649
413	Pipeline transportation	0	163,503	3,998	167,501
414	Scenic and sightseeing transportation	0	36,583	10,040	46,622
415	Couriers and messengers	0	97,833	19,357	117,189
416	Warehousing and storage	0	511,597	66,762	578,359
417	Newspaper publishers	0	79,828	46,061	125,889
423	Motion picture and video industries	0	2,735	11,902	14,637
425	Radio and television broadcasting	0	3,292	1,778	5,070
427	Wired telecommunications carriers	0	84,104	142,735	226,839
428	Wireless telecommunications carriers	0	163,169	190,911	354,080
430	Data processing, hosting, and related services	0	88	47	135
431	News syndicates, libraries, archives	0	101	249	350
432	Internet publishing and broadcasting and web search	0	3,979	2,581	6,560
433	Monetary authorities and depository credit	0	1,477,671	306,481	1,784,152
434	Nondepository credit intermediation	0	116,158	34,545	150,703
435	Securities and commodity contracts intermediation	0	181,903	115,785	297,688
436	Other financial investment activities	0	23,284	23,163	46,447
438	Insurance agencies, brokerages, and related activities	0	88,556	22,785	111,341
439	Funds, trusts, and other financial vehicles	0	1,213	66,275	67,488
440	Real estate	0	1,964,427	224,273	2,188,700

Sector	Description	Direct	Indirect	Induced	Total
441	Owner-occupied dwellings	0	0	3,048,015	3,048,015
443	General and consumer goods rental	0	1,568	2,249	3,817
445	Commercial / industrial machinery and equipment rental	0	919,151	13,756	932,907
446	Lessors of nonfinancial intangible assets	0	32,286	5,855	38,141
447	Legal services	0	132,153	82,101	214,254
448	Accounting, tax preparation, bookkeeping	0	292,434	51,083	343,517
449	Architectural, engineering, and related services	0	7,574	2,797	10,371
451	Custom computer programming services	0	725	160	885
452	Computer systems design services	0	3,045	584	3,629
453	Other computer related services	0	2,927	384	3,311
454	Management consulting services	0	11,168	5,060	16,228
455	Environmental and other technical consulting services	0	8,904	3,761	12,665
456	Scientific research and development services	0	392	2,967	3,358
457	Advertising, public relations, and related services	0	10,442	4,736	15,179
458	Photographic services	0	971	3,563	4,534
459	Veterinary services	0	1,782	27,022	28,804
460	Marketing research and all other miscellaneous	0	22,907	1,530	24,436
461	Management of companies and enterprises	0	33,326	11,790	45,116
462	Office administrative services	0	10,964	4,875	15,838
464	Employment services	0	107,221	38,378	145,599
465	Business support services	0	11,117	3,464	14,581
466	Travel arrangement and reservation services	0	529	797	1,326
468	Services to buildings	0	53,754	20,244	73,998
469	Landscape and horticultural services	0	23,460	10,623	34,083
470	Other support services	0	4,794	1,402	6,195
471	Waste management and remediation services	0	9,901	7,458	17,359
472	Elementary and secondary schools	0	0	20,567	20,567
474	Other educational services	0	1,002	32,460	33,462
475	Offices of physicians	0	0	33,691	33,691
476	Offices of dentists	0	0	166,460	166,460
477	Offices of other health practitioners	0	0	174,958	174,958
478	Outpatient care centers	0	0	31,598	31,598
480	Home health care services	0	0	33,048	33,048
481	Other ambulatory health care services	0	22	13,525	13,547
482	Hospitals	0	0	657,437	657,437
483	Nursing and community care facilities	0	0	220,194	220,194
484	Mental retardation, mental health, substance abuse	0	0	9,356	9,356
485	Individual and family services	0	0	91,456	91,456
486	Community food, housing, and other relief services	0	0	64,127	64,127
487	Child day care services	0	0	24,974	24,974
488	Performing arts companies	0	455	1,298	1,753
491	Promoters of performing arts and sports and agents	0	6,033	14,389	20,422
492	Independent artists, writers, and performers	0	4,393	4,204	8,598
493	Museums, historical sites, zoos, and parks	0	0	1,744	1,744
495	Gambling industries (except casino hotels)	0	186	80,025	80,211

Sector	Description	Direct	Indirect	Induced	Total
496	Other amusement and recreation industries	0	7,138	10,349	17,487
497	Fitness and recreational sports centers	0	898	6,034	6,932
498	Bowling centers	0	0	8,171	8,171
499	Hotels and motels, including casino hotels	0	61,433	7,053	68,486
500	Other accommodations	0	377	84	461
501	Full-service restaurants	0	37,298	199,558	236,856
502	Limited-service restaurants	0	111,537	494,039	605,576
503	All other food and drinking places	0	18,200	72,040	90,240
504	Automotive repair and maintenance, except car washes	0	238,727	298,963	537,690
505	Car washes	0	3,328	25,261	28,589
506	Electronic and precision equipment repair and maintenance	0	98,796	18,298	117,094
507	Commercial / industrial machinery and equipment repair	0	135,330	38,617	173,947
508	Personal and household goods repair and maintenance	0	20,672	21,255	41,927
509	Personal care services	0	0	61,826	61,826
510	Death care services	0	0	11,659	11,659
511	Dry-cleaning and laundry services	0	2,664	8,023	10,687
512	Other personal services	0	5,716	28,131	33,848
514	Grantmaking, giving, and social advocacy organizations	0	318	18,467	18,785
515	Business and professional associations	0	141,614	45,829	187,443
516	Labor and civic organizations	0	163	35,388	35,552
517	Private households	0	0	30,973	30,973
518	Postal service	0	207,531	54,110	261,641
525	Local government electric utilities	0	89,904	36,848	126,753
526	Other local government enterprises	0	274,874	67,293	342,167

Sub-Objective 3, Optimal Crop-Mix Shift Scenario – Total Output Numbers

Sector	Description	Direct	Indirect	Induced	Total
0	Total	264,999,593	70,242,985	21,816,331	357,058,910
1	Oilseed farming	22,505,776	0	0	22,505,776
2	Grain farming	242,493,817	1,471,836	125	243,965,777
3	Vegetable and melon farming	0	374	1,972	2,346
6	Greenhouse, nursery, and floriculture production	0	3,381	312	3,693
10	All other crop farming	0	2,601,164	6,493	2,607,657
11	Beef cattle ranching and farming	0	2,705,566	1,700	2,707,266
12	Dairy cattle and milk production	0	63,609	23,391	87,000
13	Poultry and egg production	0	11,854	2,269	14,123
14	Animal production, except cattle and poultry and eggs	0	471,617	8,960	480,577
16	Commercial logging	0	0	0	1
18	Commercial hunting and trapping	0	0	4,109	4,109
19	Support activities for agriculture and forestry	0	16,871,455	1,430	16,872,885
20	Extraction of natural gas and crude petroleum	0	857,040	38,259	895,298
31	Sand and gravel mining	0	3,270	782	4,052
37	Drilling oil and gas wells	0	927	45	973
38	Support activities for oil and gas operations	0	40,132	1,959	42,091
39	Metal mining services	0	57	4	60
40	Other nonmetallic minerals services	0	75	7	82
49	Electric power transmission and distribution	0	1,159,738	475,335	1,635,073
50	Natural gas distribution	0	348,417	19,647	368,064
51	Water, sewage and other systems	0	28,389	1,718	30,107
62	Maintenance and repair construction - nonresidential	0	3,303,449	111,525	3,414,974
63	Maintenance and repair construction - residential	0	87,021	262,650	349,670
66	Other animal food manufacturing	0	107,888	5,785	113,673
71	Soybean and other oilseed processing	0	765	339	1,104
84	Fluid milk manufacturing	0	389	47,119	47,508
89	Animal, except poultry, slaughtering	0	43	756	798
94	Bread and bakery product, except frozen, manufacturing	0	18	499	518
95	Frozen cakes and other pastries manufacturing	0	2	66	68
104	Spice and extract manufacturing	0	16	240	257
121	Textile bag and canvas mills	0	158	53	211
126	Cut and sew apparel contractors	0	12	4	16
137	Engineered wood member and truss manufacturing	0	105	28	133
154	Printing	0	3,769	1,695	5,464
162	Industrial gas manufacturing	0	1,148	697	1,844
165	Other basic organic chemical manufacturing	0	1,799	27	1,826
169	Nitrogenous fertilizer manufacturing	0	2,489	4	2,493
177	Paint and coating manufacturing	0	737	111	848
195	Other plastics product manufacturing	0	667	133	800
198	Other rubber product manufacturing	0	11,622	1,166	12,788
206	Ready-mix concrete manufacturing	0	58,982	15,229	74,211
236	Handtool manufacturing	0	151	5	156
248	Spring and wire product manufacturing	0	334	13	347
249	Machine shops	0	568	74	642

Sector	Description	Direct	Indirect	Induced	Total
257	Small arms ammunition manufacturing	0	79	1,235	1,314
259	Small arms, ordnance, and accessories manufacturing	0	21	37	57
262	Farm machinery and equipment manufacturing	0	2,214,025	363	2,214,388
266	Oil and gas field machinery and equipment manufacturing	0	30	2	32
279	Special tool, die, jig, and fixture manufacturing	0	3	8	11
347	Truck trailer manufacturing	0	3	37	39
350	Motor vehicle gasoline engine manufacturing	0	411	29	440
368	Wood kitchen cabinet and countertop manufacturing	0	14	15	28
388	Sign manufacturing	0	19,816	8,986	28,802
395	Wholesale trade	0	16,280,527	1,661,593	17,942,120
396	Retail - Motor vehicle and parts dealers	0	51,331	452,308	503,639
397	Retail - Furniture and home furnishings stores	0	21,913	79,149	101,062
398	Retail - Electronics and appliance stores	0	35,872	59,167	95,039
399	Retail - Building material and garden equipment	0	82,422	272,130	354,552
400	Retail - Food and beverage stores	0	11,618	583,362	594,979
401	Retail - Health and personal care stores	0	66,578	183,916	250,494
402	Retail - Gasoline stores	0	45,643	155,190	200,833
403	Retail - Clothing and clothing accessories stores	0	36,307	151,289	187,596
404	Retail - Sporting goods, hobby	0	19,163	66,457	85,620
405	Retail - General merchandise stores	0	22,278	460,298	482,576
406	Retail - Miscellaneous store retailers	0	53,417	167,562	220,980
407	Retail - Nonstore retailers	0	74,471	645,959	720,430
408	Air transportation	0	4,436	2,778	7,214
409	Rail transportation	0	845,012	14,090	859,101
411	Truck transportation	0	2,470,240	281,814	2,752,054
412	Transit and ground passenger transportation	0	676	2,196	2,872
413	Pipeline transportation	0	400,934	9,804	410,738
414	Scenic and sightseeing transportation	0	86,655	23,781	110,436
415	Couriers and messengers	0	199,482	39,469	238,951
416	Warehousing and storage	0	927,850	121,081	1,048,931
417	Newspaper publishers	0	143,894	83,027	226,921
423	Motion picture and video industries	0	8,094	35,229	43,322
425	Radio and television broadcasting	0	64,882	35,057	99,939
427	Wired telecommunications carriers	0	259,423	440,275	699,698
428	Wireless telecommunications carriers	0	526,310	615,791	1,142,101
430	Data processing, hosting, and related services	0	5,149	2,781	7,930
431	News syndicates, libraries, archives	0	435	1,068	1,503
432	Internet publishing and broadcasting and web search	0	19,637	12,738	32,376
433	Monetary authorities and depository credit	0	3,083,199	639,481	3,722,680
434	Nondepository credit intermediation	0	218,246	64,906	283,152
435	Securities and commodity contracts intermediation	0	590,913	376,128	967,041
436	Other financial investment activities	0	185,842	184,871	370,713
438	Insurance agencies, brokerages, and related activities	0	264,154	67,965	332,119
439	Funds, trusts, and other financial vehicles	0	5,910	322,846	328,756
440	Real estate	0	4,203,185	479,865	4,683,050

Sector	Description	Direct	Indirect	Induced	Total
441	Owner-occupied dwellings	0	0	4,553,920	4,553,920
443	General and consumer goods rental	0	2,844	4,079	6,923
445	Commercial / industrial machinery and equipment rental	0	1,310,716	19,616	1,330,333
446	Lessors of nonfinancial intangible assets	0	360,073	65,302	425,375
447	Legal services	0	437,795	271,985	709,781
448	Accounting, tax preparation, bookkeeping	0	615,917	107,590	723,507
449	Architectural, engineering, and related services	0	27,530	10,166	37,696
451	Custom computer programming services	0	1,851	408	2,259
452	Computer systems design services	0	44,866	8,611	53,477
453	Other computer related services	0	25,334	3,323	28,657
454	Management consulting services	0	45,381	20,562	65,943
455	Environmental and other technical consulting services	0	65,969	27,863	93,832
456	Scientific research and development services	0	1,325	10,040	11,365
457	Advertising, public relations, and related services	0	61,845	28,052	89,896
458	Photographic services	0	4,704	17,261	21,965
459	Veterinary services	0	6,076	92,120	98,196
460	Marketing research and all other miscellaneous	0	124,683	8,326	133,009
461	Management of companies and enterprises	0	88,299	31,238	119,537
462	Office administrative services	0	25,078	11,150	36,228
464	Employment services	0	129,727	46,434	176,161
465	Business support services	0	32,342	10,077	42,419
466	Travel arrangement and reservation services	0	1,042	1,569	2,611
468	Services to buildings	0	104,609	39,396	144,004
469	Landscape and horticultural services	0	63,286	28,657	91,944
470	Other support services	0	12,274	3,590	15,864
471	Waste management and remediation services	0	31,919	24,041	55,960
472	Elementary and secondary schools	0	0	32,912	32,912
474	Other educational services	0	2,341	75,863	78,205
475	Offices of physicians	0	0	83,268	83,268
476	Offices of dentists	0	0	290,083	290,083
477	Offices of other health practitioners	0	0	291,613	291,613
478	Outpatient care centers	0	0	81,675	81,675
480	Home health care services	0	0	46,466	46,466
481	Other ambulatory health care services	0	54	33,013	33,067
482	Hospitals	0	0	1,267,739	1,267,739
483	Nursing and community care facilities	0	0	381,616	381,616
484	Mental retardation, mental health, substance abuse	0	0	13,373	13,373
485	Individual and family services	0	0	153,655	153,655
486	Community food, housing, and other relief services	0	0	133,555	133,555
487	Child day care services	0	0	58,593	58,593
488	Performing arts companies	0	1,367	3,901	5,268
491	Promoters of performing arts and sports and agents	0	46,440	110,755	157,195
492	Independent artists, writers, and performers	0	47,326	45,288	92,615
493	Museums, historical sites, zoos, and parks	0	0	5,663	5,663
495	Gambling industries (except casino hotels)	0	481	206,972	207,453

Sector	Description	Direct	Indirect	Induced	Total
496	Other amusement and recreation industries	0	37,395	54,218	91,612
497	Fitness and recreational sports centers	0	3,031	20,369	23,401
498	Bowling centers	0	1	21,635	21,636
499	Hotels and motels, including casino hotels	0	135,144	15,516	150,659
500	Other accommodations	0	863	192	1,054
501	Full-service restaurants	0	93,106	498,156	591,261
502	Limited-service restaurants	0	225,824	1,000,264	1,226,088
503	All other food and drinking places	0	34,168	135,245	169,413
504	Automotive repair and maintenance, except car washes	0	354,567	444,033	798,601
505	Car washes	0	5,699	43,250	48,949
506	Electronic and precision equipment repair and maintenance	0	165,107	30,579	195,685
507	Commercial / industrial machinery and equipment repair	0	197,726	56,422	254,148
508	Personal and household goods repair and maintenance	0	30,766	31,633	62,399
509	Personal care services	0	0	120,719	120,719
510	Death care services	0	0	29,032	29,032
511	Dry-cleaning and laundry services	0	5,564	16,754	22,318
512	Other personal services	0	22,477	110,615	133,092
514	Grantmaking, giving, and social advocacy organizations	0	871	50,571	51,441
515	Business and professional associations	0	315,214	102,008	417,223
516	Labor and civic organizations	0	410	88,812	89,222
517	Private households	0	0	30,990	30,990
518	Postal service	0	261,313	68,132	329,445
525	Local government electric utilities	0	198,194	81,233	279,427
526	Other local government enterprises	0	660,522	161,706	822,228