WATER CONSERVATION RESERVE PROGRAM ALTERNATIVES FOR THE SOUTHERN OGALLALA AQUIFER

by

ERIN ALEXIS WHEELER, B.S., M.S.

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Jeffrey Johnson
Co-Chairperson of the Committee

Eduardo Segarra
Co-Chairperson of the Committee

Phillip Johnson

Dennis Patterson

Chenggang Wang

Fred Hatmeister
Dean of the Graduate School

May, 2008

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ABSTRACT

The Ogallala Aquifer is a vast resource underlying parts of eight states. The southern portion of the Ogallala Aquifer is considered to be an exhaustible resource due to the relatively low level of recharge compared to the quantities of water pumped annually for the production of agricultural commodities. As the resource continues to be depleted, policy makers in several states including Texas are considering water conservation legislation. Society is likely to benefit more from water conservation policies in certain high water use counties which are rapidly depleting the saturated thickness of the aquifer, rather than a policy for the region as a whole. This study evaluates two water conservation policies for nine high water use counties in the Southern High Plains.

The water conservation policies considered in this study include a ten year water rights buyout policy and a twenty year water rights buyout policy. The two policy scenarios require that 25% of a county's irrigated acreage be transitioned into dryland production for the respective term of the buyout. After the term of the buyout has expired, enrolled acres are allowed to return to irrigated production. The basis for the two policy scenarios is the Conservation Reserve Program (CRP) policy enacted for soil conservation, but with a goal of water conservation.

The models developed for this study were county level non-linear dynamic optimization models. Baseline scenario models where no change is made to current water policy were estimated along with the ten year and twenty year water rights buyout policy scenarios for three discount rates (3%, 6%, and 9%) in order to evaluate the role

the chosen discount rate has on the net present value of net returns (NPV) and aquifer drawdown. The models differ from previous studies conducted on the Ogallala Aquifer due to the technological advancement parameters included. Results of the study indicate that the twenty year water rights buyout saves more water at a lower cost per foot of saturated thickness than the ten year buyout, but neither policy is restrictive enough to achieve significant conservation in the most depleting central counties of the study area.

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CHAPTER I

INTRODUCTION

General Problem Description

Irrigated agriculture has played a vital role in the development and growth of the Great Plains Region of the United States. The primary source of water for irrigation in this region is the Ogallala Aquifer, which encompasses 174,000 square miles and underlies parts of eight states: Texas, New Mexico, Oklahoma, Colorado, Kansas, Nebraska, South Dakota, and Wyoming (Alley, Riley, and Franke, 1999). In the Great Plains Region, the water pumped from the Ogallala Aquifer accounts for approximately 65% of the total water used for irrigation in the U.S. annually (High Plains Water District #1, 2004).

The Great Plains region produces approximately 45% of the national production of wheat, 25% of the national production of corn, over 88% of the national production of grain sorghum, and 32% of the national production of cotton (NASS, 1999). Another important agricultural activity in the Great Plains is the cattle feeding industry, composed of feedlots and beef packing plants, where over 15 million head of cattle, or 18% of the national production, are produced annually (Dennehy, 2002).

Ninety percent of the recharge in the aquifer is percolated through the soil through small playa lakes that dot the landscape from Texas to Nebraska (Alley, Riley, and Franke, 1999). In the early 1950's, approximately 480 million cubic feet of groundwater per day was used for irrigation from the Ogallala Aquifer. By 1980, that amount had increased to 2,150 million cubic feet per day (Alley, Reilly and Franke, 1999). Water

table levels in the Ogallala currently decline in a range from approximately half a foot to several feet annually. The effect of recharge when compared to the rate of depletion is insignificant (Birkenfeld, 2003). Many believe that a decline in the aquifer toward economic depletion will likely have a dramatic detrimental impact on the irrigated agriculture dependent regional economy of the Great Plains.

As the decline of the aquifer becomes a timely topic in state legislatures across the Great Plains, researchers have found it necessary to sub-divide the aquifer into regions where more specialized and accurate information can be analyzed. This study focuses primarily on the Southern sub-region of the Ogallala Aquifer (see Figure 1.1) which lies on the 100th meridian and is the second largest water use area, behind Nebraska, accounting for approximately 12% of annual extraction (National Research Council, 1996).

The Southern portion of the Ogallala Aquifer is considered exhaustible due to the relatively low rate of recharge when compared to the quantities of water pumped annually for agricultural production of cotton, corn, grain sorghum, wheat, and peanuts. Sources vary on the exact amount of recharge in the Southern portion of the Ogallala Aquifer, but many agree on a range from half an inch to several inches per year per surface acre (High Plains Water District #1, 2004). Additionally, the most recent water use projection made by the Amosson Group for the Texas Water Development Board Groundwater Availability Model estimated water used for irrigation in the Southern

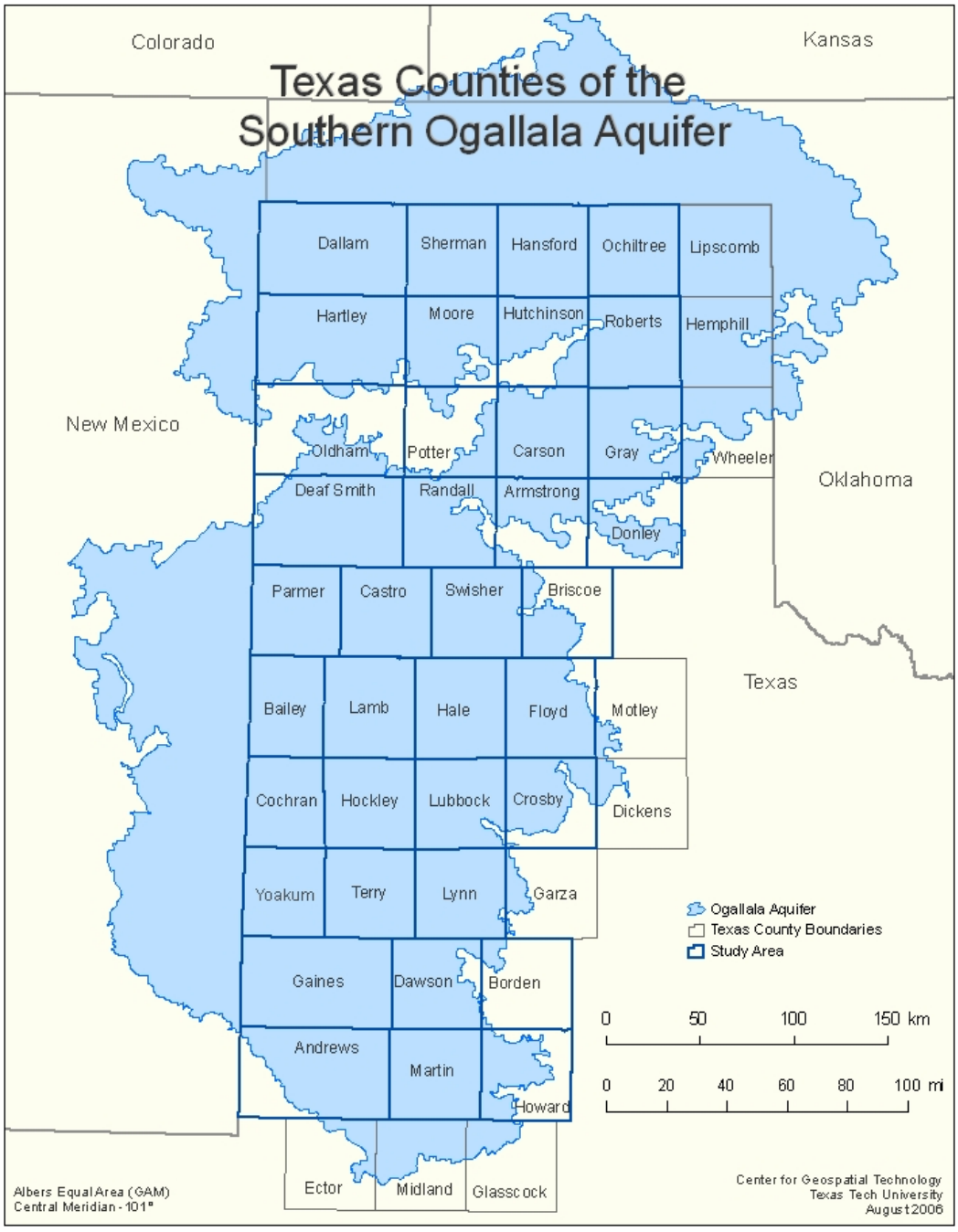

Figure 1.1. Texas Counties of the Southern Ogallala Aquifer.
Source: Barbato and Mulligan: Texas Tech University Center for Geospatial Technology. gis.ttu.edu/ogallalaatlas/

Ogallala Aquifer to be approximately 3,800,000 acre feet annually which are used to irrigate 3,500,000 acres per year (Amosson et. al., 2003).

The 3,500,000 irrigated acres overlying the Southern Ogallala Aquifer in Texas account for a significant proportion of the state's agricultural crop production including 59% cotton, 10% corn, 26% grain sorghum, and 40% peanut, and 46% wheat of the state's total production (National Agricultural Statistics Service, 2006). Within the vast area including forty-six counties that overlie the Southern Ogallala Aquifer, some areas are more heavily irrigated than other areas. These areas generally have higher levels of saturated thickness, but much more rapid rates of depletion. Other areas have minute amounts of irrigation and actually show an increase in saturated thickness occurring through time.

Society is likely to benefit more from water conservation policies in certain high water use counties which are rapidly depleting the saturated thickness of the aquifer, rather than a policy for the region as a whole. Thus, nine counties in the Southern sub-region which were identified by Wheeler (2005) as the counties in the region which are expected to drawdown the aquifer to less than 30 ft of saturated thickness over the next sixty years are the focus of this study. These Texas counties include: Cochran, Floyd, Gaines, Hale, Hockley, Lamb, Lubbock, Terry, and Yoakum. These counties accounted for 1,243,800 irrigated cotton acres, 25,800 irrigated grain sorghum acres, and 38,400 irrigated wheat acres in 2006 (National Agricultural Statistics Service, 2006).

Texas Water Law

In Texas, the water doctrine for percolating groundwater management is based on the Rule of Capture, also known as the rule of the biggest pump (i.e., the landowner with the biggest pump can extract the most water). The Rule of Capture is inherited from English common law and was adopted by the Texas Supreme Court in 1904 when the landmark ruling of *Houston and Central Texas Railway vs. East* took place. Mr. W.A. East sued Houston and Central Texas Railway for damages resulting from a well they drilled near Denison, Texas to provide water for their locomotives and machine shops that caused his well to go dry. When the Texas Supreme Court ruled against Mr. East, the Rule of Capture was established (Texas Water Development Board, 2004). The Rule of Capture guarantees a landowner the right to extract any and all water underlying his land without being liable for injury caused to other landowners pumping capability as long as the injury is not intentional (Texas Living Waters Project, 2003).

The Rule of Capture has remained the primary law for governing groundwater in the state; however, underground water conservation districts (UWCD) were established by the Fifty-First Texas Legislature in 1949, and play a vital role in the management and regulation of groundwater resources in the State of Texas. Senate Bill 1, approved in 1997, recognized that Texas is a vast state and therefore water needs and uses often occur far from the state capitol and the legislative process. For this reason, the Texas Legislature believes water regulation should be implemented by a "grassroots" approach through local UWCDs. In addition to promoting a grassroots approach to water conservation and management under Senate Bill 1, the Texas Water Development Board designated sixteen regional water-planning groups. These planning groups were required

to provide to the State their regional water plans consisting of water management plans during drought conditions, protection of existing water rights, current groundwater conservation district plans, and several additional provisions.

The Texas Legislature approved Senate Bill 2 in 2001, which again focused on UWCDs. Senate Bill 2 gave UWCDs the right to charge a production fee on agricultural water uses not to exceed $1 per acre foot and not to exceed $10 per acre foot for non-agricultural purposes. Though the primary law governing water in the State of Texas is the Rule of Capture, Senate Bills 1 and 2 give UWCDs the right to regulate underground water pumpage (Johnson, 2003).

Specific Problem Description

Water conservation policies may effectively extend the economic life of the Ogallala Aquifer in the Southern High Plains of Texas and maintain the viability of a regional economy which critically depends on agriculture. This study evaluates the effect of voluntary incentive based temporary water rights buyout policies along with an evaluation of the potential impacts of expected technological advances in agriculture which could justify a reduction of aquifer drawdown caused by the extraction of groundwater for agricultural purposes in the short run. The temporary buyout policies are popular within producer, industry, and political groups likely due to the fact that the policies follow practical political reasoning relatively closely.

According to Bickers and Williams (2001), practical political reasoning takes into account the notion that people exist to achieve individual and social goals. One area of practical political reasoning that can be used in the water policy analysis is the political

economy approach which is based on three assumptions: 1) human behavior is purposive; 2) people's behavior is based on incentives and constraints; and 3) people are intelligent and creative. The first assumption explains why agricultural producers continue to irrigate knowing that they are depleting the aquifer: irrigating advances their personal goal of maximizing profit.

The second assumption lends itself to the types of policies that could result in producers decreasing water use; in the form of either an incentive based policy to reduce water use or a restriction placed on water usage. Finally, the third assumption helps explain why certain policies have failed in their goal of water conservation in the past. For example, the EQIP policy provides incentives for producers to adopt more efficient irrigation systems; however, it places no restriction on acreages or water use amounts. Producers, being both intelligent and creative, found that they could use the EQIP incentives, adopt a more efficient irrigation technology, and use as much or more water on a greater number of acres than with the more efficient system and increase their profits.

The specific water conservation policies to be evaluated in this study, the temporary-incentive based water rights buyout policies, are often referred to as Water CRP due to the fact the policies could be enacted and implemented in a similar manner to the Conservation Reserve Program (CRP) established by the 1985 Farm Bill for the purpose of conserving soil resources, but with a goal of water conservation.

The Water rights buyouts would be voluntary incentive based programs in which willing landowners would convert irrigated cropland to dryland temporarily; for example ten or twenty years. At the end of the ten or twenty year term of the buyout, landowners

could be given the choice to either re-enroll in the program or resume irrigation practices. The goal of these policies would be to reduce water used by agriculture in the short-run by temporarily leasing water rights from agreeable landowners. In order for a policy to be effective, the rules and regulations of the policy must take into account the producers' goal to maximize profit, the fact that their behavior is shaped by incentives, and that they are intelligent and creative.

In addition to water conservation policies, future technological progress could also be an important aspect in the justification for the reduction of water pumped from the Ogallala Aquifer in the short-run. Irrigation systems such as sub-surface drip irrigation (SDI) are generally more efficient than traditional furrow and center pivot systems and in theory require less water. Similarly, biotechnological advances which emphasize the development of drought resistant varieties of crops produced in areas overlying the aquifer are coming to the forefront and are expected to be available to producers in the near future. Drought resistant crops could be used in conjunction with SDI and other irrigation systems to irrigate crops at much lower water use levels in the future.

Temporarily purchasing water rights from landowners for ten or twenty year increments would not only conserve water during that specified time period, but it would also potentially allow for technological progress to accumulate which then would allow producers to resume irrigation after the term of the buyout expires at lower water use levels with better technology than previously used. The goal of the water rights buyout policies is to allow water to be available further into the future at which time it could be

extracted and used with improved and more efficient technologies than would be used under the current state of technology and water extraction practices.

Objectives

The primary objective of this study is to analyze and evaluate the impacts of ten and twenty year voluntary incentive based water rights buyouts, and the potential effect of technological progress in agriculture on water conservation for specific counties in the Southern High Plains of Texas overlying the Ogallala Aquifer. This is relevant given the high level of dependence of the regional economy on irrigated agriculture. The specific objectives are to:

1. Evaluate the effectiveness and efficiency of temporary water rights buyout policies for ten and twenty years; and
2. Evaluate the impacts of postponing the use of underground water resources to be used with improved technologies in the future.

CHAPTER II

LITERATURE REVIEW

Beginning in the early 1960's, researchers focused efforts on evaluating the depletion of the Ogallala Aquifer and the effect depletion would have on regional economies which are heavily dependent upon the revenues produced from irrigated agriculture. This chapter reviews and groups water depletion studies and policies into one of six areas: 1) early research concerning resource management, 2) advancement in irrigation technology: LEPA and SDI, 3) groundwater depletion and irrigation technology adoption, 4) policy and economic implications concerning depletion, 5) public policy analyses, and 6) temporary water rights buyout policies.

Early Research Concerning Resource Management

Oscar Burt was a leader in research involving temporal allocation of exhaustible resources in the 1960s and 1970s. Burt (1964) addressed the optimal allocation of non-renewable or partially renewable resources as a common property problem by deriving two functions using an empirical-theoretical model to estimate an optimal rate of use and the expected present value of the resource under a socially optimal policy. Primarily, he equated the marginal social value of water at a point in time to the marginal social value of water as a stock resource in the following period. Burt (1966) expanded this research using sequential decision theory to derive policies focused on optimal groundwater usage. This study discusses the net social benefit of water use and the common property issue,

which bases the optimal groundwater extraction rate on the net present value of water in a specified basin.

Burt (1970) furthered his research focusing on institutional restrictions and their effect on groundwater storage. Options Burt used in the study ranged from unrestricted optimization to limiting pumping to equal the amount of recharge. The first option looks at water pricing by a central regulating agency in which he assumed producers would use water to the point where its marginal revenue product equals price. The second option discusses non-pricing by a central regulating agency in which, through perfect knowledge, the market would identify a price for a limited quantity of water. The third option is a compromise by the central regulating agency in which optimality is based on decision criteria other than economic efficiency and the principle of second best from welfare economics is used. This third scenario would be used in a situation such as in New Mexico where water rights are based on prior appropriation and the goal is to supply water to the priority right holders.

Lacewell and Grubb (1971) investigated the implications of alternative levels of irrigation water utilization from the Ogallala Aquifer in the Texas High Plains. Their study focused on an individual's decision concerning how much land to irrigate each year and how to develop "capital-valuation estimates" of the aquifer. Lacewell and Grubb stated that the objective of the farmer should be to develop water use plans that maximize the monetary value of the water supply. Their study analyzed the impacts of selected financial factors on aquifer use through time. They specifically looked at the impacts specific discount rates and crop prices had on optimal aquifer management. Linear programming was used to estimate the optimal allocation of dryland and irrigated crops

subject to a water availability constraint. Lacewell and Grubb's model showed that the discount rate used had a significant effect in determining the optimal rate of water use. As the discount rate falls, so does water usage in the current period. In conclusion, they noted that a producer's goal is to maximize profit in the short run. When looking at the long run, the producer will often underestimate the value of the resource and continue to deplete the water supply in order to maximize short-run profit.

Advancements in Irrigation Technology: LEPA and SDI

Beginning in the 1950's, the area overlying the Ogallala Aquifer began to be irrigated with inefficient furrow systems. Since that time, irrigation technology has continued to evolve offering greater water use efficiencies and higher yields. The most widely used system in the Southern portion of the Ogallala today is the center pivot system; however, sub-surface drip systems, the latest and most efficient irrigation technology, are being adopted at increasing rates.

Phene (1999) discussed the advantages and disadvantages of sub-surface drip irrigation (SDI). According to Phene, when compared to other irrigation systems, SDI can produce the highest yields and water use efficiency rates. Another benefit discussed is the fact that unlike other types of irrigation systems which water the crop from above the surface and keep topsoil wet, SDI uses pipes and lateral buried below the surface. The topsoil is therefore kept dry which decreases the incidence of soil borne diseases and weeds. There are many economic and hydrologic advantages of SDI; however, increased management costs associated with water and nutrient application accuracy and the high initial cost of SDI installation have hampered adoption.

Lansford, Segarra, and Bordovsky (2004) compared the differences in cotton lint yield, cotton fiber quality, and net returns with SDI and Low Energy Precision Application (LEPA) center pivot systems. The study concluded that even though initial cost of installation and fixed costs are higher with SDI, net returns of LEPA and SDI were comparable. Additionally, Bordovsky, Lyle, and Segarra (2000) evaluated net revenues for both LEPA and SDI by using revenue from lint yield less variable and fixed production costs. The study concluded that SDI resulted in higher cotton lint yield and water use efficiencies especially at low rates of water use. However, LEPA resulted in a higher net revenue due to the discounted cost of installation when compared to SDI.

Colaizzi, Evett, and Howell (2004) compared LEPA and SDI for cotton production using the USDA Conservation and Production Research Laboratory in Bushland, Texas. Their study concluded that at lower irrigation levels, SDI resulted in a higher yield than LEPA; however, at higher irrigation levels, LEPA resulted in higher yields.

Groundwater Depletion and Irrigation Technology Adoption

As the United States became more concerned with conservation and resource management in the 1970s, companies began to develop more efficient irrigation systems compared to traditional furrow irrigation systems. Feng (1992) looked at the efficient path of irrigation technology adoption on the Ogallala Aquifer in the High Plains of Texas. She used Lubbock County as a study area and developed a dynamic optimization model that maximized the net present value of returns to water, land, and risk. The model evaluated the effects of changing water levels, saturated thickness of the aquifer,

crop prices, technology, energy prices, and cultivated irrigated acres over a fifty year planning horizon.

Feng found that as a producer's risk aversion increased, irrigated acres went out of production. As expected, the research also showed that as the water supply becomes scarcer and the discount rate decreases, fewer acres are irrigated. In the current period, higher crop prices and lower energy prices will increase irrigated acres as will improved technology. When looking at groundwater withdrawal, it was concluded that new developments in technology and higher crop prices increased irrigation, and the depletion of the aquifer and the discount rate had little effect on the pumping rate. Feng concluded that as improved irrigation technologies are developed, producers, whose goal is to maximize profit, would use new technologies to increase irrigated acres and in turn deplete the aquifer at a more rapid rate.

Arabiyat (1998) used a dynamic optimization model to evaluate the effects of new irrigation technologies and biotechnology on groundwater use and net present value of agricultural returns for three counties in the Texas High Plains. Her study focused on how these improvements could help sustain irrigated agriculture and the Ogallala Aquifer. Arabiyat considered three scenarios: (1) improved irrigation technology, (2) improved biotechnology, and (3) improvements in irrigation technology and biotechnology while holding net returns constant.

She concluded that technology advancement and the controlled use of groundwater could significantly contribute to the sustainability of agriculture in the Texas High Plains. She encouraged the adoption of these new technologies and concluded that

they could help prolong the life of the aquifer and irrigation in the area through increased efficiency.

Niewiadomy (1985) investigated the oversimplification of water pricing using a hydro-economic model. The research concluded that water delivery and irrigation efficiency were a function of water supply. As expected, when water prices begin to rise, producers will invest in more efficient irrigation technologies. Niewiadomy warned however, that if the price elasticity of irrigation technologies were greater than the price elasticity of water demanded, water demand would increase.

Stanaland, et al. (1996) evaluated the potential water conservation impacts of a low interest loan program for the purchase of water conservation equipment in the State of Texas. The study used qualitative choice modeling to analyze program characteristics and socio-economic factors that lead producers to participate in such programs. The study concluded that educating producers about the goals and objectives of loan programs and the purpose and financing of such programs would increase the greater participation rate.

The National Research Council (1996) published a book entitled A New Era for Irrigation which addresses the impact of irrigated agriculture's effect on the settlement of the Western United States, the current role of irrigated agriculture in the country, and how it is expected to change in the future. The authors identified the underlying premise of the study as being increased competition for water supplies from sources other than agriculture and how irrigated agriculture will change in order to cope. The authors note that irrigation is not just a practice that takes place in certain areas of the country; rather,

it is a culture and a way of life that has helped settle, transform, and support large regions of the United States.

There are many forces leading to change for irrigation, including increased urbanization of the country, increasing energy costs, competitors such as urban areas and the environment, and globalization. The authors conclude that availability and costs of water will remain the key determinants of the extent and viability of irrigation in the United States. The National Research Council concluded that, though irrigation has been an asset to the country for the past several decades, "to continue in a new era… irrigation must evolve" (The National Research Council, p. 7).

Policy and Economic Implications Concerning Depletion

Focusing more on the economic impacts of depletion, Osborn (1973) centered his study on the direct, indirect, and induced economic impacts of the depletion of the Ogallala Aquifer in the Texas High Plains for 1970-2020 in forty-two counties. The model used for this study was an input/output model based on the procedures developed by Leontief and assumed that the producer's goal is to maximize profit in any given production period. Economic impacts from irrigation were first analyzed based on increases in economic activity when irrigation water was applied to dryland. The economic impacts were then divided into direct, indirect, induced, and total impacts.

Estimated income effects were also considered, along with employment effects from the declining irrigated crop production. Osborn concluded that because producers' focus is on profit maximization, the water supply would be economically exhausted; and as a consequence, the economy is likely to suffer significantly in all areas analyzed. It

was evident from his estimations that economic development in the region would inevitably decline due to water exhaustion and the interrelation of industries in the economy. Osborn recommended natural resource management policies be implemented to stabilize the economy. However, he warned that any management practices would likely not strike a balance between withdrawals and recharge, and that the Ogallala will inevitably be exhausted.

Feinerman and Knapp (1983) investigated the effect that alternative groundwater management policies were likely to have on producers in Kern County, California. The first scenario evaluated the different effects on users when using quotas and taxes. In this scenario, the research concluded that groundwater users would be better off under quotas and much worse off under taxes. The two most significant factors affecting the impact on management were energy costs and the discount rate used for analysis. The study concluded that as energy costs continue to rise, the benefits obtained from groundwater management would also increase.

Terrell (1998) used optimization models and expanded Feng's model (1992) to focus on the economic impacts to the High Plains of Texas as the Ogallala Aquifer is exhausted and irrigated agriculture declines. She used dynamic linear programming and the input/output model IMPLAN to forecast groundwater depletion, cropping patterns, and subsequent economic impacts over a thirty-year planning horizon in nineteen counties of the Texas High Plains. The research focused on the fact that the current cropping patterns are not optimal. Terrell noted that in the original runs of the model, the optimal cropping pattern switched to cotton almost immediately in all nineteen counties.

Knowing that this outcome was not likely to be feasible, she added a constraint limiting the amount of acres that could be converted to cotton annually.

The study concluded that as the water supply decreases, producers would transition from irrigated crops to dryland cotton, and the net revenue of the surrounding economy would suffer. Due to the interrelation among industries in the region, Terrell found that almost all sectors of the economy would be adversely affected by the decreased agricultural production. One limitation of Terrell's research is that she assumed producers would produce what is optimal in the long run. However, producers are likely not to produce optimally because their goal generally is to maximize short-run profit, not long run profitability.

In addition to Texas, other states have also been concerned with aquifer depletion and economic impacts. Lansford, et al. (1983) studied the portion of the Ogallala Aquifer from which Eastern New Mexican farmers pump irrigation water for agricultural purposes. This study focused on the on-farm economic impacts from the declining water supply, and found that irrigated acres would move to dry-land practices over a forty year planning horizon. An interesting conclusion to the study was that mandatory water conservation practices were no more effective than voluntary water conservation practices.

In the 1990s, Texas lawmakers began to question the "Rule of Capture," the primary water law in the state. Many believe the law is no longer applicable in today's world, and that its continued existence is counter-productive to conservation efforts. Johnson (2003) expanded on the works of Feng (1992) and Terrell (1998) by considering nonlinear crop production functions. He used a dynamic optimization model and an

input/output model to look at the effect of different policy alternatives on the Texas High Plains economy and the saturated thickness of the Ogallala Aquifer. The study included a baseline scenario and three policy alternatives in response to the depletion of the aquifer using a fifty-year planning horizon. The policy alternatives were: (1) a production fee on water extracted, (2) a water pumping quota restriction, and (3) a water drawdown restriction.

As expected, the baseline scenario, or status quo policy, resulted in the most rapid exhaustion of the water supply and caused the most dramatic decrease in net income for the economy over time. The first policy alternative, a production fee, showed little change from the baseline due to the fact that Senate Bill 2 placed a $1 per acre-foot cap on possible production fees. A one dollar per acre-foot fee was insufficient to induce producers to significantly decrease their water use. This alternative also showed a similar drop in net revenue at the point of exhaustion. A water pumping quota restriction that placed a 50% reduction relative to current annual water use, revealed that the aquifer's depletion could be pushed back by approximately ten years. A drawdown restriction requiring aquifer saturated thickness level to be greater than or equal to 50% of the present saturated thickness resulted in slightly lower net income than the quota restriction. However, it was found that the water supply would be preserved throughout the planning horizon. Johnson concluded that possibly the most effective alternative to conserve the water supply may be the aquifer drawdown restriction because it likely strikes the best balance between producer profit, water conservation, and effects to the regional economy.

Das, et al (2004) expanded the work of Johnson (2003) in a study focusing on the Ogallala Aquifer using a dynamic economic water planning model to compare simulated economic and hydrologic implications to output from a water policy model that links a dynamic model to a temporally disaggregated hydrology model. The goal of his study was to provide water policy analysts with a tool for targeting specific areas and water users of the aquifer in order to better implement conservation policies.

Wheeler (2005) furthered the work by Das, et al (2004) and evaluated the economic and hydrologic implications of four water conservation policy alternatives in the Southern portion of the Ogallala Aquifer in twenty-two Texas counties and two Eastern New Mexico counties. Specifically, a baseline scenario calculated total water use, net revenue per acre, and saturated thickness of the aquifer for a sixty year period assuming no change in water use practices. Wheeler then evaluated the effects of policies which limited drawdown of the aquifer over the planning horizon relative to drawdown in the baseline scenario for each of the twenty-four counties in the study area.

The policies evaluated were a 0% drawdown policy, a 50% drawdown policy, a 75% drawdown policy, and a 50% annual drawdown policy. The results from Wheeler's study indicated that because of the significant differences in hydrologic characteristics and current irrigation levels across the study area, blanket water conservation policies for the region as a whole are likely to be inefficient. She found that the cost of conserving an additional acre foot of water in low water use counties is extremely high. Legislative time and tax money would be more efficiently spent enacting policies to conserve water in those counties that significantly utilize the aquifer underlying the county.

Wheeler concluded that water conservation policies should focus on counties that deplete the aquifer to less than 30 ft. of saturated thickness in the unconstrained baseline scenario; where the implicit cost of conserving a foot of saturated thickness is relatively low. These are the most heavily irrigated counties in the study region, and society as a whole would most likely benefit from the focus of water conservation being in these high water use counties.

Public Policy Analyses

Agricultural economists and economists in general tend to underestimate the importance of the political process and what it takes for a policy to be implemented successfully when they evaluate the effectiveness and efficiency of the alternatives. It is important to understand that if a policy is approved by legislators, then the issue becomes whether it can be implemented or not. In the case that the policy is indeed implemented successfully, then the question becomes whether or not the policy's goal can be achieved. Generalizing policy and evaluating effects is an important first step in analysis of a proposed solution to a collective problem; however, detailed analysis of an executable policy is important for researchers to provide to lawmakers in order for them to make more informed decision regarding water conservation policies.

Cochran and Malone (1995) state that public policy consists of political decisions for implementing programs to achieve societal goals. The depletion of the Ogallala Aquifer in the High Plains of Texas is a collective problem in which individually rational actions produce outcomes at a societal level which may not appear to be rational. By producers using water to produce irrigated crops today, the aquifer is being depleted and

will not be available to society in the future. Bickers and Williams (2001) discuss an area of practical political reasoning dealing with collective problems known as the political economy approach to policy analysis. The political economy approach to practical political reasoning assumes that human behavior has a purpose that is shaped by incentives and constraints. Additionally, the authors acknowledge that humans are both creative and intelligent. By keeping these three assumptions in mind, policies will be more apt to achieve their goals.

Bickers and Williams point out that individuals' can act in very intelligent manners, such as producers using irrigation water to increase profit, but may lead to problems for society. The authors claim that solutions to these types of problems often revolve around providing incentives to individuals to act differently. According to Bickers and Williams, "solving problems at the group level, then, depends on policies that change incentives so that individuals, when acting in their own interest, will also be acting in the group's interest (pg. 61).

Bardach (2006) discuses practical steps for analyzing policy. He believes that policy analysis is more art than science and that it "draws on intuition as much as method." Bardach lays out an eightfold path to policy analysis. The eightfold path includes 1) defining the problem, 2) assembling evidence, 3) constructing alternatives, 4) selecting criteria, 5) projecting outcomes, 6) confronting trade-offs, 7) deciding, and 8) telling your story. Bardach points out that not every analysis will go through all eights steps; however, it is a guideline.

For the purposes of this study, the first two steps of Bardach's guidelines including defining the problem and assembling evidence have already been completed.

Wheeler (2005) discussed the inefficient over-exploitation of the aquifer, estimated the county level drawdown of the aquifer over sixty years, and selected county characteristic criteria in order to identify which counties in the study area warranted a conservation policy. Therefore, in this study, from the Bardach eightfold path for policy analysis the focus will be on projecting outcomes, confronting tradeoffs, and deciding whether or not the policy should be implemented and informing policy makers why.

Temporary Water Rights Buyout Policies

In the past, government entities have encouraged the development of irrigated agriculture as a way to settle much of the United States (Golden, 2005). However in recent decades, especially in the West, the once vast amounts of water available for irrigation have dwindled and government agencies are now considering water rights buyout policies to protect the remaining water. The temporary retirement of water rights is an area in which literature is limited; therefore, many citations relate to the temporary buyout of surface rights, such as the Conservation Reserve Program (CRP) for soil conservation by the Food Security Act of 1985.

Golden (2005) conducted a study in which he attempted to determine the value of water rights in the Rattlesnake Creek sub-basin region in Western Kansas using a spatial-hedonic analysis in order to establish a base value for the State to purchase water rights. If the value of the water rights can be established, the State would be able to more accurately purchase the water right from willing landowners at an effective and efficient value. Similarly, the Federal government determined the value of agricultural production on environmentally sensitive lands and offered to rent the land based on a fair market bid

value for ten year increments in the CRP program. According to Golden, at a minimum, landowners must feel they are receiving the fair market value of their asset in order to consider retiring their water right, either permanently or temporarily.

Similar to Feng (1992), Golden et al (2006) discussed the problems with state policies in Kansas and federal policies that encourage the adoption of more efficient irrigation technologies, but that do not necessarily achieve the goal of water use reduction and, in turn, aquifer conservation. The authors point out that more efficient technological adoption is important and should continue because it helps maintain the profitability of irrigated agriculture; however, it must be done in conjunction with a water conservation policy that will reduce water consumed from the Ogallala Aquifer for agricultural purposes.

Leatherman et al (2006) discuss a policy alternative being considered in Kansas and used in other states including Nebraska and Idaho known as the Conservation Reserve Enhancement Program or CREP. The CREP is similar in structure to the CRP program in that it requires both federal and state partnerships and is a voluntary program. CREP allows willing landowners to temporarily retire water rights for periods of approximately 15 years. At the end of the buyout period, landowners can resume irrigation; however, as CREP is proposed in these states, no dryland production can take place during the buyout period and the land is subject to conventional CRP requirements.

CHAPTER III

CONCEPTUAL FRAMEWORK

General Optimality of Groundwater Use

Optimally allocating groundwater is a natural resource economics problem. Under static neo-classical economic theory, optimal resource allocation occurs at a single point in time when the marginal value of benefits is equal to the marginal cost of using the natural resource. Time is an important factor when determining how to optimally allocate groundwater. The Ogallala Aquifer is an exhaustible natural resource that continues to be depleted by irrigated agriculture because the rate of water withdrawal is greater than the rate of recharge. The fact that the resource is being used less than efficiently and water levels continue to decline implies that the resource will likely be inefficiently exhausted.

Marginal user costs (MUC) are referred to as the physical effects of today's utilization on resource availability in future time periods that result in different benefits and costs. It is clear that time plays a critical role in the optimal decision criteria; therefore, a dynamically efficient allocation rule for groundwater use must be used to optimally allocate groundwater use over time. The optimal amount of annual extraction is dependent upon the maximum net present value of returns across the planning horizon that in turn depends upon the discount rate used. The discount rate chosen plays a critical role in determining the optimal annual usage. Generally, the greater the rate of discount, the faster an exhaustible resource is depleted. Producers tend to have a higher discount rate than society because they prefer to use the water today rather then conserve it for the

future. The discount rate chosen for analysis can have a dramatic affect on the results of a study. Therefore, for the results of this study, the models will be solved using varying rates of discount.

This study addresses the issue of the possible depletion of the Southern portion of the Ogallala Aquifer and the economic and hydrologic effects that depletion could cause in the future. As stated earlier, the overall goal is to maximize the net present value of net returns. A simple dynamic optimization model can be stated as follows (Howe, 1979):

$$\text{Max } Z = \int_0^{\infty} \int_0^{Rt} \{D(R_t)dR + A(S_t) - WR_t\} e^{-rt}\, dt \tag{3.1}$$

$$\text{S.T.} \qquad S_t^* = -R_t \tag{3.2}$$

$$S_t > 0,\ R_t \geq 0, \tag{3.3}$$

where Z represents the net present value of net returns; R represents the rate of groundwater extraction; R_t represents the rate of extraction at time t; S_t represents the water remaining at time t; S_t^* represents the rate of change of S_t over the planning horizon (t); $D(R_t)$ represents the derived demand function for groundwater, and the area under the demand function represents the social benefits received from the utilization of R_t; $A(S_t)$ represents the value of the unused groundwater stock; W represents the per unit cost of extraction; r represents the discount rate; and e^{-rt} is the continuous time discount factor chosen.

The above maximization problem can be solved using a Hamiltonian function for the net social benefit at time t plus the value of the change in the groundwater stock at the shadow price q_t, where the shadow price is the price that would prevail if the binding constraints were relaxed.

$$H = \int_{0}^{Rt} [D(R_t)dR + A(S_t) - WR_t] e^{-rt} - q_t R_t . \quad (3.5)$$

When the first order conditions of the Hamiltonian equation above are solved, they yield two basic conditions for dynamic efficiency.

Stock Condition:

$$P_t e^{-rt} = - \partial A/\partial R_t \, e^{-rt} + We^{-rt} + q_t, \quad (3.6)$$

Flow Condition:

$$q_t^* + [p_t - q_t] (\partial R_t/\partial S_t) + (\partial A/\partial S_t) = r \cdot q_t, \quad (3.7)$$

where q_t^* represents the rate of change of the shadow price, q_t, over time, and P_t represents the price of output. The stock condition, or the generalized efficiency condition, yields the optimal rate of resource utilization over time. At time t, resource utilization will be extended to the rate at which the present value of the marginal social value of groundwater, $P_t e^{-rt}$, is exactly equal to the sum of the present value of the unused groundwater stock, the marginal user cost, and the value of marginal extraction cost. The optimal condition is achieved where marginal benefits equal marginal costs. It is assumed that the marginal cost referred to is a marginal social cost including production, amenity, and marginal user costs.

The flow condition yields the optimal path of the stock of the resource through time, which states that the amount of the stock (groundwater) remaining in the aquifer is optimal when the sum of the increase in the shadow price, q_t , the increase in future marginal profit of production, $[p_t - q_t] (\partial R_t/\partial S_t)$, and the marginal value of environmental services, $\partial A/\partial S_t$, equals the social discount rate, r, times the shadow price, q_t. An

optimal time path requires that all points along the optimal path must be optimal at each point in time t.

Marginal User Cost

As defined previously, the stock effect is the physical effect of today's use of a natural resource on the availability or scarcity of that resource in the future. Scarcity considers the opportunity cost which is often referred to as the marginal user cost (the shadow price, q_t, in the stock and flow conditions). In the case that the natural resource is scarce, or non-renewable, current use implies future scarcity or exhaustion. The optimal allocation of a scarce resource requires the explicit recognition of this user cost.

Excessive exploitation of the resource will occur if user cost is not considered in current extraction practices. As shown in Figure 3.1, the equilibrium point under static efficiency criteria is represented by W^s and P^s, the point where marginal user benefit equals marginal extraction cost (MEC). The user cost imposes an additional cost on society because of the additional scarcity imposed on future generations. Following the stock condition holding at each point in time, the dynamically optimal rate of groundwater use occurs at the point where the marginal benefit equals the dynamically efficient marginal cost (MC_d), which is the sum of the MEC and the marginal user cost (MUC). The dynamically efficient equilibrium point is represented by W^d and P^d in Figure 3.1. As shown in the figure, under dynamic efficiency, the price of water increases from P^s to P^d and the quantity of water used decreases from W^s to W^d.

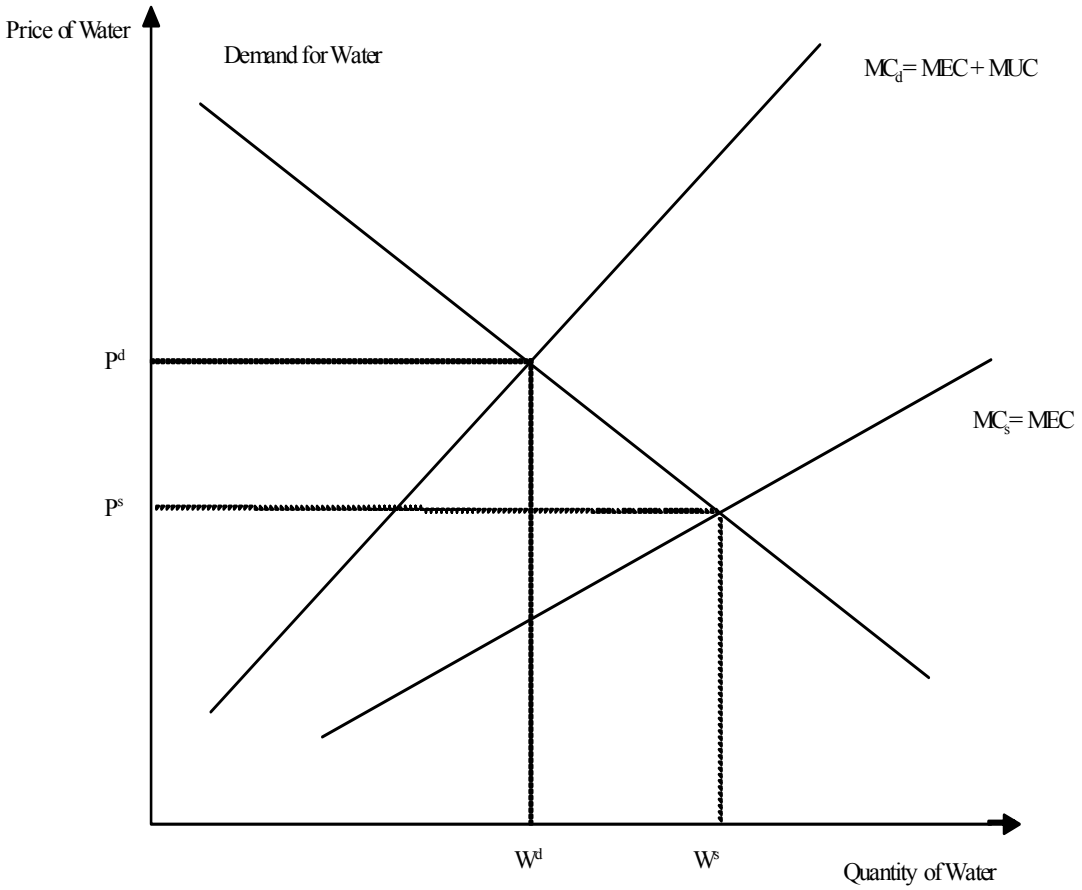

Figure 3.1. Optimal Rate of Groundwater Use under Dynamic Efficiency and Static Efficiency Criteria.

The static efficient solution causes greater utilization of water and less than efficient conservation because it fails to take into account the marginal user cost.

Common Property Rights and Natural Resource Use

A resource is said to be common property if a single user does not retain total control and access to the resource is not restricted. In such a case, externalities occur due to the over-extraction of the common resource by users with unrestricted access. These users, acting in their own self interest, consider only their private benefits when determining how much of the resource to extract (Msangi and Howitt, 2006). Under such a condition, the common resource belongs to society but is allocated under conditions of competitive production. Allocation of common resources is not efficient and generally not sustainable, because under sufficient demand and unrestricted access, the resource is generally over-used because MUC is ignored. Over-exploitation occurs in common properties because common property resources do not receive their share of return from production.

Groundwater from an aquifer is a common property resource because many users are pumping from the same reservoir. Users of a common property aquifer, such as the Ogallala Aquifer, consider the water to be a free input for agricultural production. The only costs associated with water utilization are the capital invested in the well and equipment, and the energy costs associated with pumping the water to the surface. A common property natural resource is said to be a free good for the individual and a scarce good to society (Gordon, 1993). Therefore, producers treat groundwater as a free input which receives no return from production causing inefficient usage and depletion.

Figure 3.2 depicts groundwater extraction with increasing marginal costs. Line AB represents the average benefit of groundwater in agricultural production and the line MB represents the marginal benefits from production. As expected, lines AB and MB show a diminishing marginal return of irrigated production for each additional unit of groundwater applied, *ceteris peribus*. The upward sloping line is the marginal cost (MC) of groundwater utilization.

Private optimality occurs at the point where marginal benefit equals marginal cost (W*). At W*, the net benefit from groundwater use is represented by area ABCD. The total benefits from irrigated production is equal to ABW*O where the total benefits include returns to producers for all inputs (area CDW*O) and the economic rent to groundwater, area ABCD. For producers using a common property resource, the rational behavior is to try to capture part of the return to the groundwater resource by expanding irrigation activities beyond W* to a point somewhere between W* and W^m. For this reason, common property groundwater resources receive no economic rent and are therefore inefficiently over-exploited.

Groundwater Use Under Voluntary Incentive Based Policy and Technology Adoption

Producers pumping groundwater from a natural resource considered to be "common property" have no voluntary incentive to conserve because a competing user

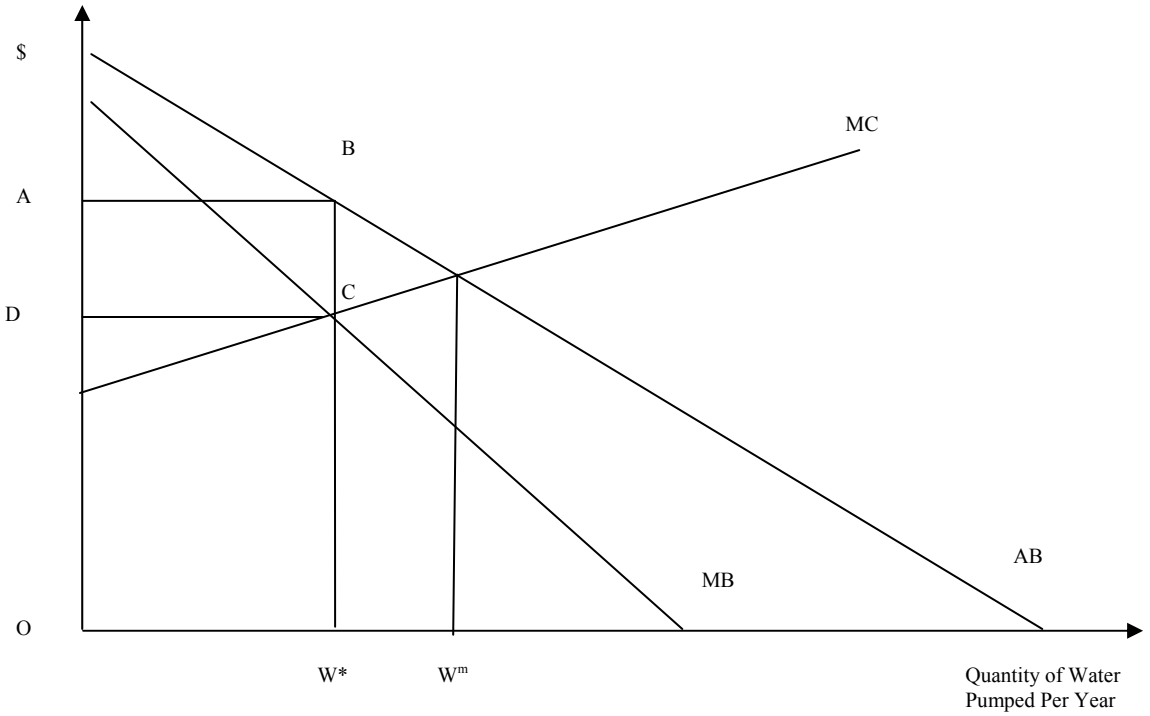

Figure 3.2. Exploitation of a Groundwater Resource.

is likely to use conserved water in their production. This common property management causes inefficient use of groundwater and leads to more rapid exhaustion of the natural resource. The policy alternative considered in this study uses an incentive program to encourage water conservation. The incentive program is similar to the Conservation Reserve Program (CRP) implemented for soil conservation and the Conservation Reserve Enhancement Program (CREP) for water conservation in Kansas, Idaho, and Nebraska. A subsidy can be used as an economic incentive for producers to discontinue the use of groundwater on a specific parcel of land for a specified time period. Output yields in such a program would decrease from an irrigated level to a dryland level causing profits to generally decrease. The payment would compensate the producer for their decreased water usage and in turn lost net revenues caused by decreased crop yields.

Another type of incentive based program used for conservation efforts for the Ogallala Aquifer in the past have been incentive based programs that cost-share with producers to adopt more water efficient technologies. More efficient irrigation systems can allow producers to achieve similar if not higher yields than with traditional systems. The recent adoption of sub-surface drip irrigation systems (SDI) have proven that higher yields can be attained with lower levels of water use.

Biotechnological innovations regarding drought resistant varieties of crops produced in areas overlying the Southern Ogallala Aquifer are also coming to the forefront. Producers could plant drought resistant varieties of crops on irrigated acres with the possibility of drastically reducing water use for irrigated production. The innovations in irrigation technology, biotechnology, and innovations in the animal feeding industry in the Texas High Plains are significant. When evaluating the economic

and hydrologic impacts of water conservation policies such as water rights buyouts, it is important to account for the advancement in technology that is likely to take place in the future.

Many economic assessments of the impacts of water conservation policies ignore technological advances and the accumulation of technology over time. These studies can be considered naïve to technological affects on water conservation. Advancements made in technology allow water to remain in the aquifer further into the future. By investing in technology and allowing more water to remain in the aquifer, the discount rate begins to decrease. The decreasing discount rate and technological investments imply that society values conserving the water remaining in the aquifer and its affect on future generations more and more through time. Including future technological advancements and changes in the discount rate in this study will allow for a more informed assessment relative to the naïve studies that ignore technological effects on water use and aquifer conservation.

Figure 3.3 shows crop yields given both private and social optimal rates of groundwater withdrawal excluding technological progress. Private optimality ignores the marginal user costs and therefore produces Y* level of output using W^s water input at point B on the lower panel. Conversely, again ignoring technological progress, social optimality occurs at point A where Y amount of output is produced using W^d water input.

Technological progress generally allows producers to increase yields and in turn, shift their production functions up. Technological progress that shifts the production

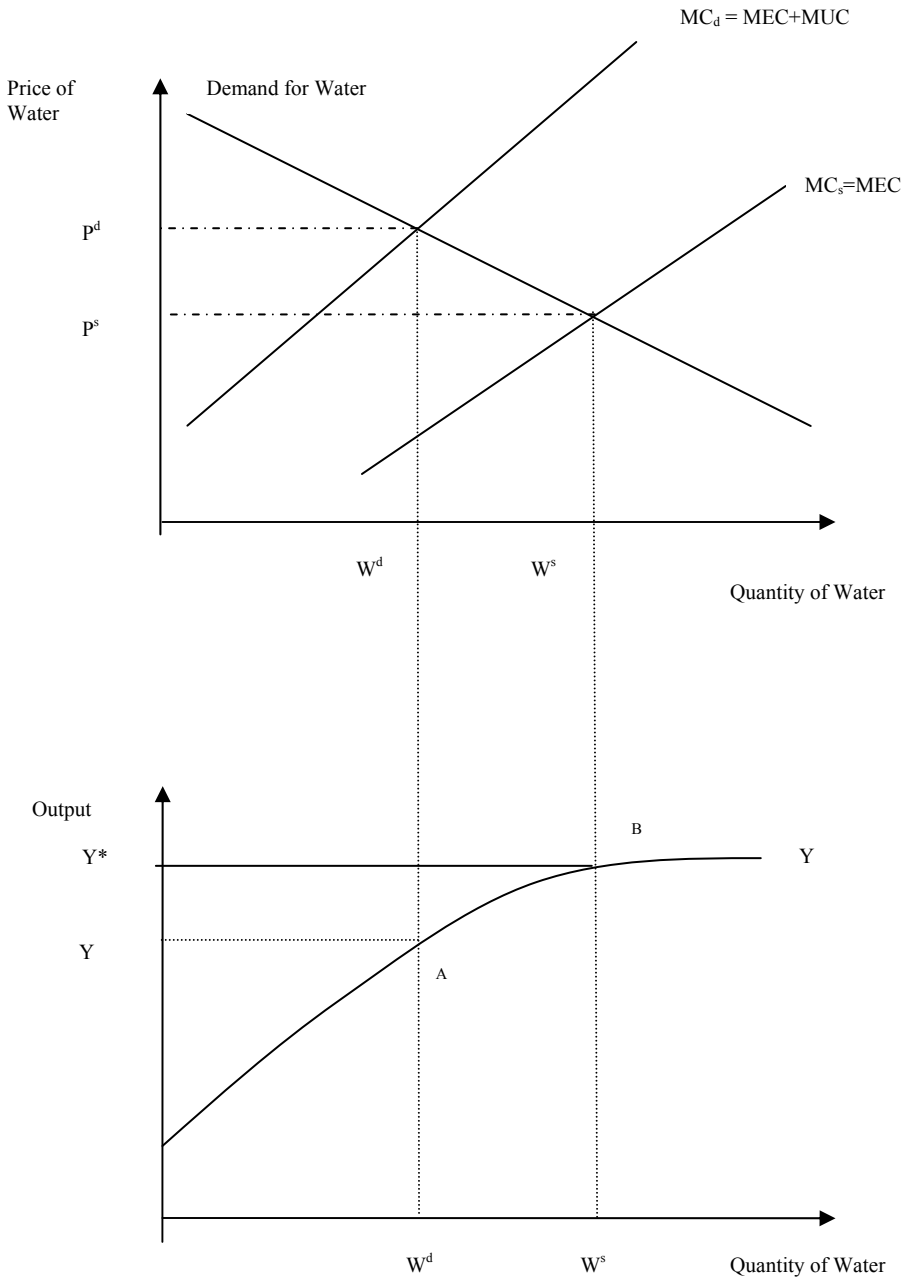

Figure 3.3. Yields Given Optimal Private and Social Rates of Groundwater Extraction.

function implies that producers can increase output using the same level of input, in this case water. The adoption of new technologies by producers shifts the production function up as seen in the bottom panel of Figure 3.4. Given the production function Y_0, the dynamically efficient social optimum point on the production function without the adoption of technology is point A. Point A corresponds to water use rate W^d with an output level of Y. With the adoption of technologies however, the production function shifts up to Y_1. As the production function shifts up, the dynamically efficient point moves from point A to point C. At point C, the same level of water use, W^d, results in a higher yield level, Y*. Producers, in the absence of a conservation policy, ignore the marginal user costs and adopt the new technology to produce at point D on the new production function using W^s amount of water. Therefore, producers likely use the same amount or more water than before the adoption of new technologies to increase yields and maximize profit.

Increasing yield levels are important and have helped the regional agriculturally dependent economy of the Texas Southern High Plains; however, they have done little for conservation of the aquifer. In other words, the incentive based cost-share programs that may have encouraged producers to adopt more efficient irrigation systems have not reached their intended goal of aquifer conservation. In order for conservation of the aquifer to take place, there must be a policy or strategy which specifically targets a decrease in the amount of water used.

Conservation will likely be achieved during the ten or twenty year term of the water rights buyout policy; however, conservation can still be achieved after the term of

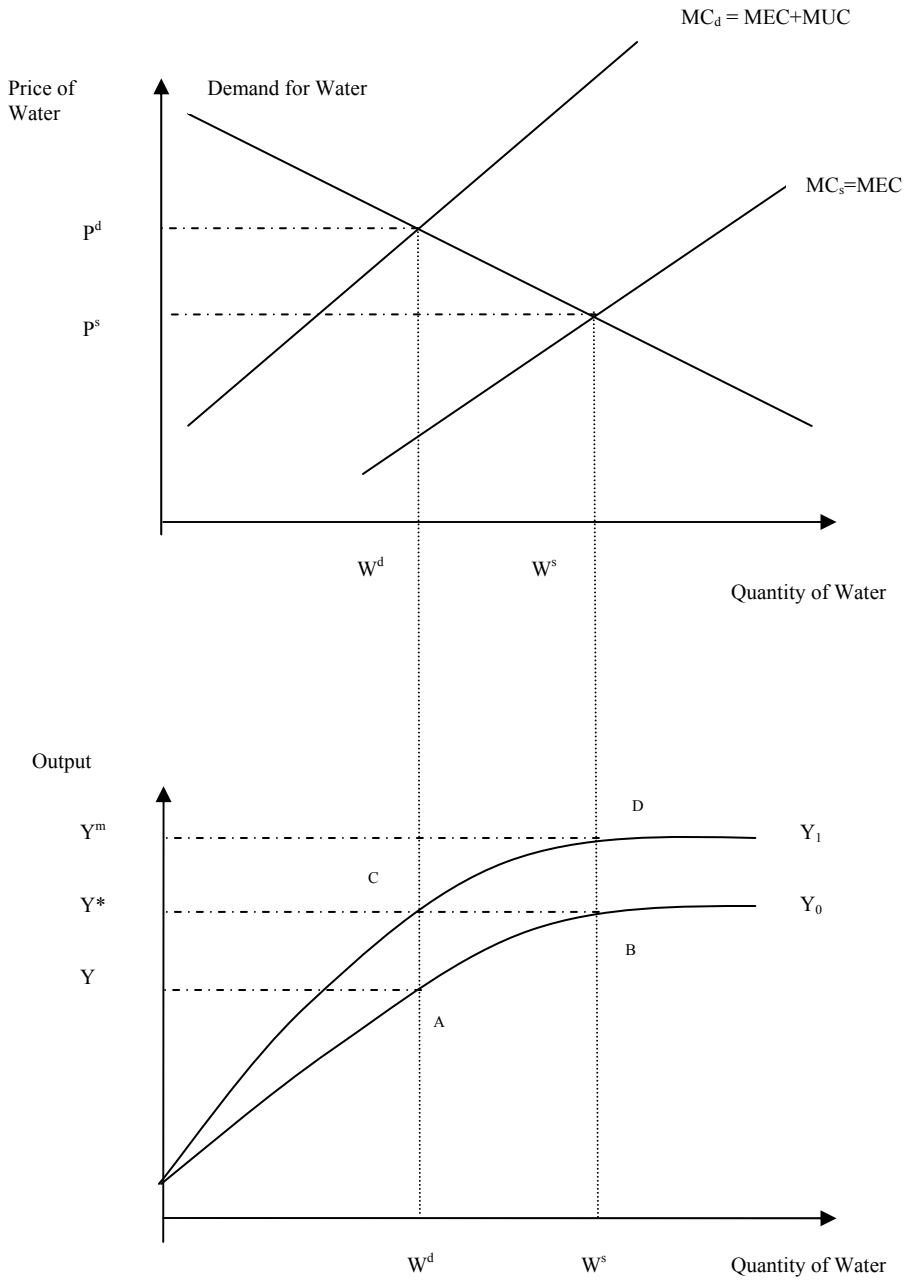

Figure 3.4. Optimal Rates of Groundwater Extraction with and without Technological Advancement.

the program if producers use the advancements in technology to reduce water usage. Figure 3.4 shows the effect of technology adoption on yield and water use. In Figure 3.4, with the adoption of advanced technologies after the term of the water rights buyout program, producers could produce at point C on the production function. Point C corresponds to the decreased water use level W^d , the yield level Y*, and accounts for the MUC. In other words, after the end of the water rights buyout, producers could achieve the same level of yield (as the one achieved with the old technology) with significantly lower water use levels by adopting new technologies. With the new technology however, producers will have the ability to produce at point D with a potential yield level of Y^m . Therefore in order for producers to use the lower water W^d, they will have to be compensated for some of the difference between their realized yield level Y*, and their potential yield level, Y^m.

CHAPTER IV

METHODS AND PROCEDURES

General Approach

The effects of a temporary water rights buyout policy in conjunction with the effects of technological advancement on water policy and water use was evaluated for the purposes of this study using county level dynamic optimization models. General Algebraic Modeling System (GAMS), a computer software optimization program, was used in the study to solve the optimization models formulated and to evaluate the water rights buyout policies (Brooke, 1998).

Study Area

The study area includes nine high water use Texas counties identified by Wheeler (2005) as counties that are expected to deplete the aquifer underlying their respective counties to less than 30 ft of saturated thickness over the next sixty years in the absence of a water conservation policy (see Figure 4.1). Specifically, the counties were: Cochran, Floyd, Gaines, Hale, Hockley, Lamb, Lubbock, Terry, and Yoakum.

Previous Dynamic Optimization Models

The framework of the optimization model used in this study was originally developed by Feng (1992) and has been expanded and modified by Arabiyat (1998), Terrell (1998), Johnson (2003), Das (2004), and Wheeler (2005). Feng used a composite

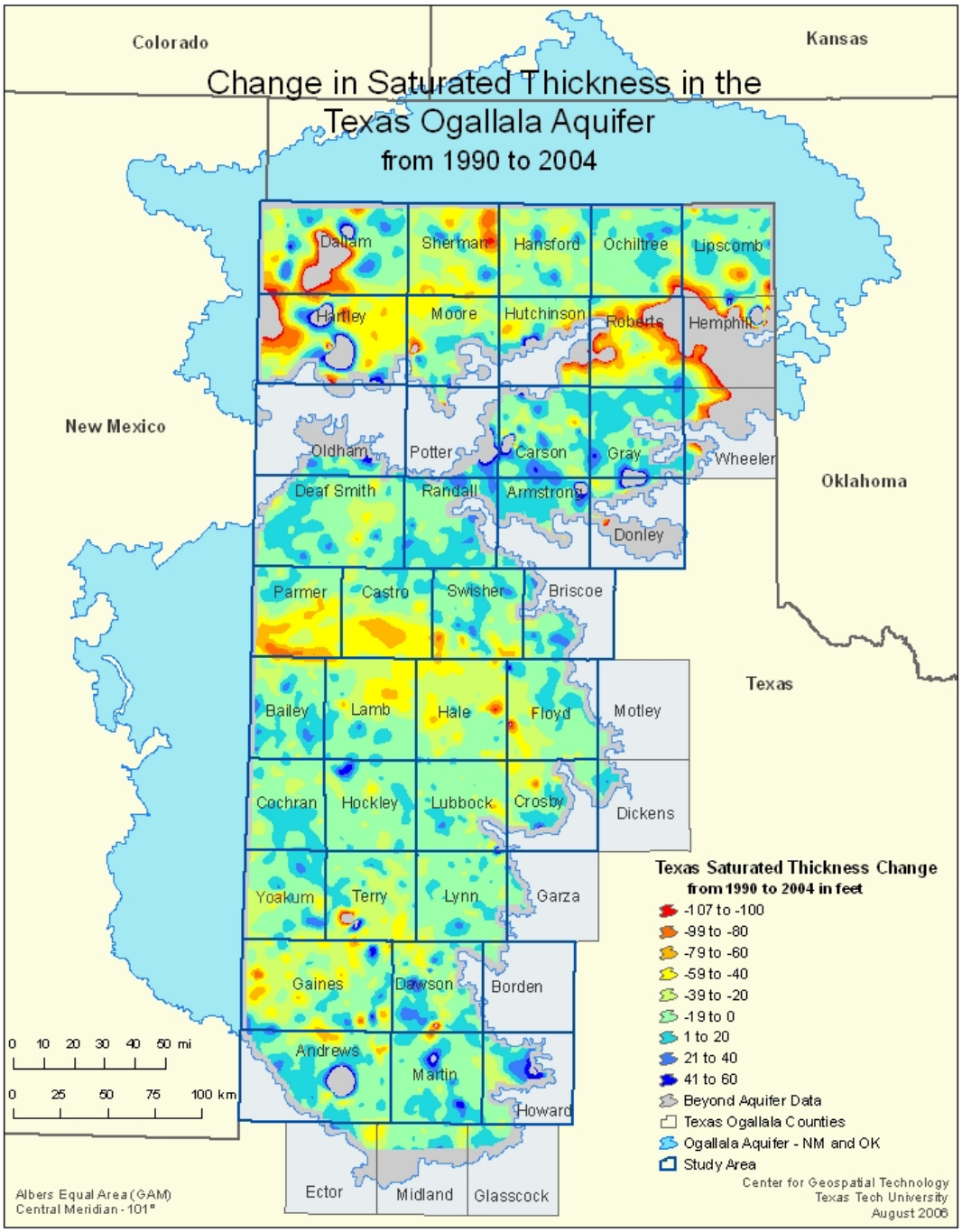

Figure 4.1. Change in Saturated Thickness in the Southern Ogallala Aquifer 1990-2004. Source: Barbato and Mulligan: Texas Tech University Center for Geospatial Technology. gis.ttu.edu/ogallalaatlas/

dynamic optimization model to derive the optimal rate of groundwater depletion from the Ogallala Aquifer that maximized the net present value of returns using Lubbock County, TX, as a study area, and the bio-simulation model (EPIC) to simulate crop growth.

Arabiyat used a dynamic optimization model to evaluate the effects of new irrigation technologies and biotechnology on groundwater use and net present value of agricultural returns for three counties in the Texas High Plains. Her study focused on how these improvements could help sustain irrigated agriculture and the Ogallala Aquifer.

Terrell developed a dynamic linear optimization model for each county in a 19 county study region in the Southern High Plains of Texas in order to evaluate shifts in cropping patterns as the saturated thickness of the Ogallala Aquifer declined to different levels. Economic impacts were evaluated by incorporating her results into an input-output model, IMPLAN.

Johnson's model expanded on both Feng's and Terrell's models, and incorporated the crop simulation software CROPMAN. Output from CROPMAN, a production-risk management simulation model, was used to develop non-linear crop production functions that maximized profit with respect to water use. This information was then used to forecast the net change in the Ogallala Aquifer and the economic impacts under three policy alternative scenarios: a baseline where no change in water extraction takes place, a quota restriction, and the adoption of a production fee of $1 / acre foot of groundwater used. The study focused on a 19 county area in the Southern High Plains of Texas.

Das made several modifications to the hydrologic components and water use-crop production relationships of Johnson's model and evaluated the effects for 23 counties in

the Southern High Plains of Texas. First, the crop production functions were re-formulated to account for differences between irrigated and dryland. Next, rotational effects were added into the model. Specifically, this step was made to prevent peanuts from expanding beyond expectations over the planning horizon. Das' most significant contribution to previous models was the incorporation of a more detailed hydrologic description. Specifically, Das included in the hydrology portion of the optimization model MODFLOW which allows the researcher to simulate the flow of groundwater and changes in saturated thickness of the aquifer over time allowing for more accurate predictions with respect to groundwater availability for future time periods.

Wheeler included additional New Mexico counties for a total of 22 Texas counties and two New Mexico counties and was able to evaluate the efficiency and effectiveness of blanket water conservation policies on the Southern Portion of the Ogallala Aquifer including: 1) compensating producers for decreasing water usage to 0% drawdown over a sixty year planning horizon through a water conservation reserve program, 2) limiting water usage to limit drawdown to 50% relative to the water usage if no policy exists over sixty years, 3) limiting water usage to limit drawdown to 75% relative to the drawdown without a restriction over sixty years, and 4) limiting water usage to an annual extraction quota to achieve 50% drawdown relative to water usage if no policy exists over the sixty year planning horizon.

Model Specification

The objective of the this study's county level optimization models is to maximize net present value of net returns to land, management, groundwater, and irrigation systems over a sixty year planning horizon for a given county as a whole.

The objective function is:

$$\text{Max } NPV = \sum NR_t (1 + r)^{-t} \quad (4.1)$$

where NPV represents the net present value of net returns; r represents the discount rate; and NR_t represents net revenue at time t. NR_t is defined as:

$$NR_t = \sum_i \sum_k \Theta_{ikt} \{[P_{it} * [(Y_{ikt}) [WA_{ikt}, (WP_{ikt})] + (\Omega_{ikt} * t)]] - C_{ikt} (WP_{ikt}, X_t, ST_t)\}, \quad (4.2)$$

where i represents crops grown; k represents irrigation technologies used; Θ_{ikt} represents the percentage of crop i produced using irrigation technology k in time t, P_{it} represents the output price of crop i at time t, WA_{ikt} and WP_{ikt} represents per acre irrigation water applied and water pumped per acre respectively. $Y_{ikt}[\cdot]$ represents the per acre yield production function, Ω_{ikt} represents the increase in yield due to technological advancement, C_{ikt} represents the costs per acre, X_t represents pump lift at time t, ST_t represents the saturated thickness of the aquifer at time t.

The constraints of the model are:

$$ST_{t+1} = ST_t - [(\sum_i \sum_k \Theta_{ikt} * WP_{ikt}) - R]A/s, \quad (4.3)$$

$$X_{t+1} = X_t + [(\sum_i \sum_k \Theta_{ikt} * WP_{ikt}) - R] A/s, \quad (4.4)$$

$$GPC_t = (ST_t/IST)^2 * (4.42*WY/AW), \quad (4.5)$$

$$WT_t = \sum_i \sum_k \Theta_{ikt} * WP_{ikt}, \quad (4.6)$$

$$WT_t \leq GPC_t \quad (4.7)$$

$$PC_{ikt} = \{[EF(X_t + 2.31*PSI)EP]/EFF\} * WP_{ikt}, \quad (4.8)$$

$$C_{ikt} = VC_{ik} + PC_{ikt} + HC_{ikt} + MC_k + DP_k + LC_k \quad (4.9)$$

$$\sum_i \sum_k \Theta_{ikt} \leq 1 \text{ for all t,} \quad (4.10)$$

$$\Theta_{ikt} \geq 0. \quad (4.11)$$

Equations (4.3) and (4.4) represent the two equations of motion included in the model which update the two state variables, saturated thickness and pumping lift, ST_t and X_t, respectively, where R represents the annual recharge rate in feet, A represents the percentage of irrigated acres expressed as the initial number of irrigated acres in the county divided by the area of the county overlying the aquifer, and s represents the specific yield, or the percentage of saturated thickness that will yield water.

Constraints (4.5), (4.6) and (4.7) are the water application and water pumping capacity constraints respectively. In equation (4.5), GPC represents gross pumping capacity, IST represents the initial saturated thickness of the aquifer and WY represents the average initial well yield for the county, AW represents the average acres served per well, and 4.42 is a conversion factor used to calculate GPC. Equation (4.6) represents the total amount of water pumped per acre, WT_t, as the sum of water pumped on each crop. Constraint (4.7) requires WT_t to be less than or equal to GPC.

Equations (4.8) and (4.9) represent the cost functions in the model. In Equation (4.8), PC_{cit} represents the cost of pumping, EF represents the energy use factor for electricity, EP is the price of energy, EFF represents pump efficiency, and 2.31 feet is the height of a column of water that will exert a pressure of 1 pound per square inch. Equation (4.9) expresses the cost of production, C_{ikt} in terms of VC_{ik}, the variable cost of production per acre, $HC_{ikt,}$ the harvest cost per acre, MC_k, the irrigation system

maintenance cost per acre, DP_k, the per acre depreciation of the irrigation system per year, and LC_k, the cost of labor per acre for the irrigation system.

Equation (4.10) limits the sum of all acres of crops i produced by irrigation systems k for time period t to be less than or equal to 1. Equation (4.11) is a non-negativity constraint to assure all decision variables in the model take on positive values. The baseline dynamic optimization model for Lubbock County can be seen in Appendix I.

General Data Collection

Specific data was compiled for each county within the study region. The county specific data included a four year average 2003-2006 of planted acreage of cotton, corn, grain sorghum, wheat, and peanuts; total acreage under sub-surface drip irrigation (SDI), low application spray application (LEPA) and dryland. Operating costs associated with the most commonly used crop production practices were also collected for specific crops, including fertilizer, herbicide, seed, insecticide, fuel, irrigation technology maintenance, irrigation, labor, and harvesting costs. Finally, hydrologic data was collected including the area of each county overlying the aquifer, average recharge, total crop acres per irrigation well, average saturated thickness of the aquifer, initial well yield, and average pump lift.

Specific Data Collection

Hydrologic Data: The amount of annual recharge in the Southern Ogallala is not known, and most estimates are considered controversial at best. For the purposes of this study, a recharge estimate by Stovall (2001) using Texas Water Development Board data

was used. Stovall separated recharge into two categories, primary and secondary. Primary recharge values were available for each square mile in the study area. However, there were fewer values for secondary recharge. Therefore, the recharge value used is the average primary recharge by county plus a weighted secondary county recharge value to account for the differences in data availability between the two recharge estimates.

County saturated thickness levels along with county specific yield was obtained from data collected by Barbato and Mulligan at the Texas Tech Center for Geospatial Technology. Pump lift by county was obtained from the TWDB groundwater database reports and was calculated as the depth from the surface to the water level. Initial acres served per well was calculated from the TWDB Survey of Irrigation (2000) as the number of acres irrigated with groundwater divided by the number of wells in the county. All county hydrologic parameters can be found in Appendix C.

Acreages: General county acreages including area of the county was obtained from the 2000 U.S. Census Bureau and can be seen in Appendix A. National Agricultural Statistics Service (NASS) data was used for harvested acres by crop and system using a 2003-2006 four year average. In order to allocate irrigated acres between SDI and LEPA, county extension agents, local NRCS offices, and county FSA offices were contacted for approximate SDI acres by county. Acres in dryland livestock were unavailable, so each county in the study area was assumed to have 300 acres in dryland livestock in order to initialize the model. Initial acreages by cop and system can be found in Appendix E.

Production Functions: The crop simulation software CROPMAN was used to estimate county production function parameters by crop and system. The most prevalent

soil types along with the weather data from the closest weather stations were used for each county. Yields were obtained from CROPMAN for LEPA (95% efficiency) and SDI (99% efficiency) for varying water application rates. Regressions for each crop and system were then estimated in Microsoft Excel where Y was calculated as the CROPMAN yield minus the actual NASS 2003-2006 average dryland yield, X was water application rate, and X^2 was water application rate squared. The regression was estimated setting the intercept to zero, then adding back the dryland intercept. Since livestock is assumed to be a dryland only activity in the model, only a 178 pound gain per dryland acre using Ww-B. Dahl Bluestem estimated by Dudensing (2005) was used in the models. All county production function parameters can be found in Appendix B.

Technological Coefficients: The increase in technological progress through time in all crops was also estimated. The technological advancement coefficient was estimated for each county by averaging the respective crop and system twenty-six year historical yield data. The respective yield average was then multiplied by 1.67% which is the most recent ERS estimated rate of growth in agricultural output due to technological progress from 1948-2006 (Fugile, MacDonald, and Ball, 2007). By multiplying a county's respective average yield by the ERS estimated growth rate, the technological parameter used in the non-linear models is based on the historic productivity of the crop and system in a county, instead of a blanket rate of technological progress. For detailed data on the technological coefficients used see Appendix F.

Commodity Prices: Prices for wheat, corn, sorghum, and peanuts was collected from NASS 2003-2006. Due to the fact that the price of cotton for the same five year

period was below the marketing loan price, a price equal to the loan price plus coupled government payments ($0.57) was used in place of the NASS price.

Costs of Production: 2007 Texas Crop and Livestock Budgets produced by the Texas Cooperative Extension Service for Districts 1&2 were the primary sources for costs of production. Costs were crop specific, but some modifications had to be made to account for the fact that there are no SDI budgets for Districts 1&2 in Texas. Electricity is the primary power source for this study area; therefore budgets were converted from natural gas to electricity when needed. The electricity price used was $0.09/kwh and was obtained from the Texas Alliance for Water Conservation (Kellsion et al, 2007). For other prices and costs of production used in the model see Appendix D.

CHAPTER V

RESULTS

The primary objective of this study was to analyze and evaluate the impacts of ten and twenty year voluntary incentive based water rights buyouts, and the potential effect of technological progress in agriculture on water conservation for specific counties in the Southern High Plains of Texas overlying the Ogallala Aquifer. Specifically, the objectives were to:

1. Evaluate the effectiveness and efficiency of temporary water rights buyout policies for ten and twenty years; and
2. Evaluate the impacts of postponing the use of underground water resources to be used with improved technologies in the future.

In order to analyze the ten and twenty year water rights buyout policies, baseline scenarios for each county were first developed and evaluated. The baseline scenarios assumed no change from current water policy. The baseline scenarios do, however, incorporate the technological advancement parameter discussed in the Methods and Procedures section in order to account for the technological progress expected to be made over the sixty year planning horizon.

As was extensively discussed in the Literature Review, the discount rate used can have a dramatic impact on the results of net present value calculations. Producers tend to have higher discount rates than society and in turn, prefer to use the water more rapidly. Since the discount rate is not known in reality, both the baseline scenarios and the water rights buyout scenarios were analyzed using 3%, 6%, and 9% discount rates.

Ten and Twenty Year Water Rights Buyouts

Optimal levels of saturated thickness, annual per acre net revenue, pump lift, water applied per cropland acre, cost of pumping, and net present value of net returns (NPV) by county were derived using the non-linear dynamic optimization model for the baseline scenario and for the water rights buyout scenarios. Similar to the baseline scenario, the county level ten and twenty year water rights buyout programs incorporate the technological advancement parameters and the 3 discount rates discussed. The water rights buyout scenarios require that 25% of the irrigated land in a county be transitioned into dryland production for either ten or twenty years. At the end of the ten or twenty year term of the respective buyout, the land may return to irrigated production.

County Results

The results of the study indicate that the nine county study area can be divided into three similar sub-county areas. The results are similar for the three northern counties: Floyd, Hale, and Lamb; the three central counties: Cochran, Hockley, and Lubbock; and the three southern counties: Gaines, Terry, and Yoakum. The counties in the three subgroups are relatively close to one another geographically, show similar beginning and ending levels of saturated thickness, similar NPV estimations, and relatively similar crop mixes. For simplicity, the results will be discussed for one county in each of the three subgroups: Floyd County, Lubbock County, and Terry County.

The initial conditions for the three counties discussed in the results section can be seen below in Table 5.1. Results for the 3% discount rate scenarios for all counties can be found in Appendices G and H.

Floyd County

Floyd County is located in the northeast corner of the nine county study area. The county encompasses 634,880 acres with approximately 92% of the county overlying the aquifer. In the base year, Floyd County had an initial saturated thickness of 76.0 ft and a pump lift of 226.0 ft. Approximately 120,000 acres were irrigated with LEPA, 15,000 irrigated with SDI, and 100,000 acres were in dryland production. The crop mix for the county was predominantly cotton, grain sorghum, and wheat in the base year.

3% Discount Rate Baseline Scenario: Using the 3% discount rate, Figure 5.1 shows the aquifer declines from 76.0 ft to 23.4 ft, or 52.6 ft over the planning horizon. The pump lift shows the expected inverse relationship with saturated thickness increasing from 226.0 ft to 278.6 ft. Figure 5.2 shows that the nominal per acre net return increases from $129.89 to $376.42 by year fifty-five, then slowly begins to decline, falling to $370.17 by year sixty. The increase through year fifty-five is due to the expected technological advancement discussed in the Methods and Procedures section that causes yields to increase throughout the planning horizon. The net return begins to decline after year fifty-five however due to the decreasing water availability causing the amount of water applied per cropland acre to decrease. As the amount of water applied decreases, yields and returns begin to decline.

Table 5.1. Initial Conditions

County	ST	Pump Lift	LEPA Cotton	SDI Cotton	Dry Cotton	LEPA GS	Dry GS	LEPA Wheat	Dry Wheat	Dry Livestock	$/AC Net Return
Floyd	76.0	226.0	81,375	10,000	41,950	27,850	16,925	5,625	39,100	300	129.89
Lubbock	57.0	130.0	144,675	5,000	74,700	11,825	11,325	2,625	4,925	300	164.90
Terry	84.0	94.0	107,675	1,500	100,125	2,925	8,275	7,275	2,025	300	243.96

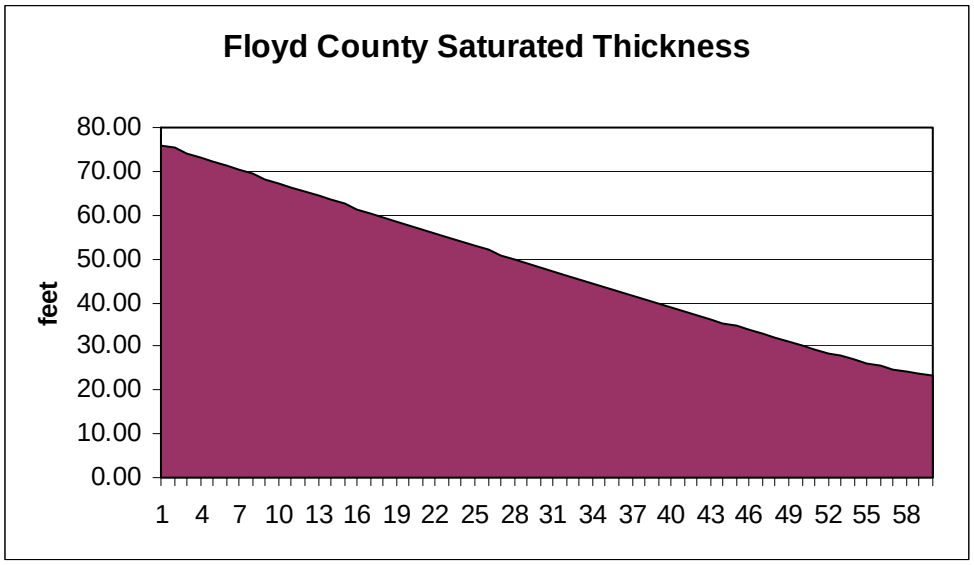

Figure 5.1. Floyd County 3% Baseline Scenario Saturated Thickness.

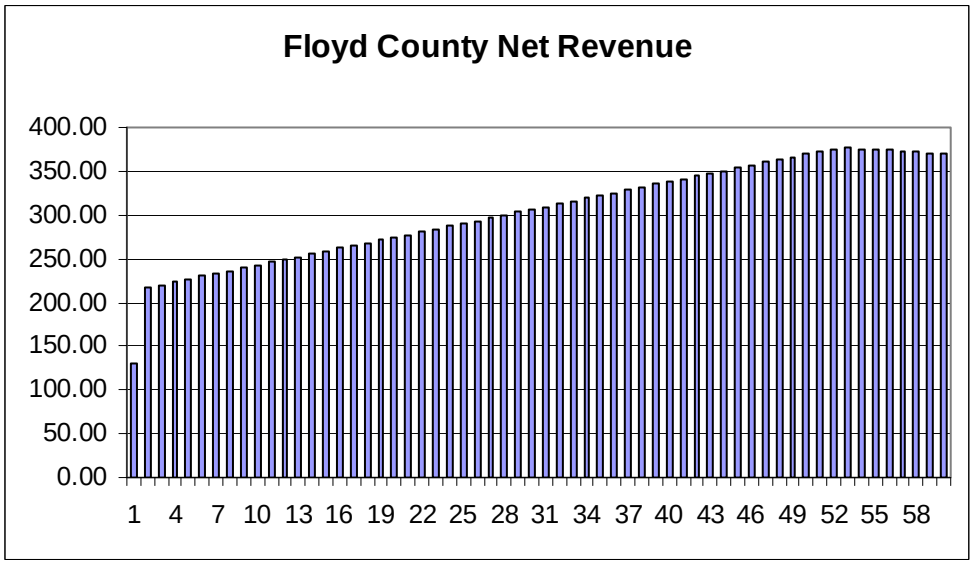

Figure 5.2. Floyd County 3% Baseline Scenario Nominal Net Return.

The cost per acre inch of water pumped increases throughout the planning horizon from $5.48 in year one to approximately $6.58 per acre inch in year sixty. The crop mix for this scenario consists of 57.4% of the county being in irrigated LEPA cotton production and the remaining 42.5% in dryland grain sorghum throughout the sixty year planning horizon. The NPV for the scenario is estimated to be $7,900.50.

6% Discount Rate Baseline Scenario: The baseline scenario using the 6% discount rate shows results similar to the baseline scenario discussed above. Figure 5.3 shows the saturated thickness levels for the 6% baseline scenario. As seen in the figure, the saturated thickness falls from 76.0 ft to 22.54 ft, or 53.6 ft over the sixty year planning horizon. The drawdown is slightly more than the drawdown in the 3% baseline scenario. Similar to the 3% baseline scenario however, the pump lift increases from 226.0 ft to 279.5 ft over sixty years.

Figure 5.4 shows that the nominal per acre net return increases through most of the planning horizon due to technological progress. Specifically, the net return increases from $130.34 in year one to $368.94 in year fifty-two; however, in year fifty-two the aquifer reaches a level at which producers must significantly decrease the amount of water applied per irrigated acre due to the declining water availability. The decrease in applied water thus decreases yields and per acre net return. At the end of the planning horizon the per acre net return has fallen to $361.85. The cost per acre inch of water pumped for the 6% discount rate baseline scenario increases through time from $5.48 to $6.95. The crop mix is almost identical to the 3% discount baseline scenario where

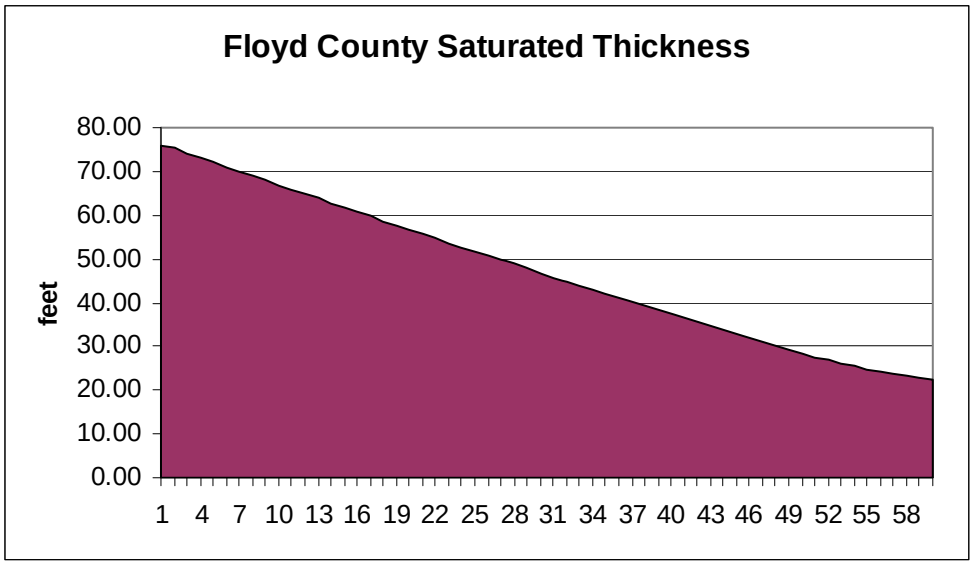

Figure 5.3. Floyd County 6% Baseline Scenario Saturated Thickness.

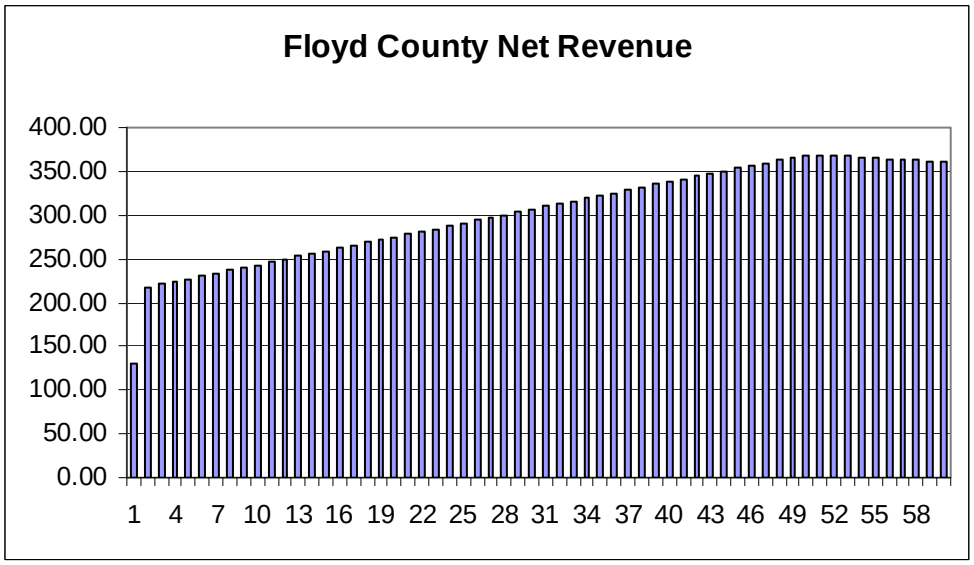

Figure 5.4. Floyd County 6% Baseline Scenario Nominal Net Return.

57.4% of cropland is in irrigated LEPA cotton and the remaining 42.6% of cropland acres are in dryland grain sorghum for the entire term of the planning horizon. Though the aquifer drawdown and the crop mix is similar to the 3% discount rate baseline scenario, the NPV for this scenario is 44.5% less than the 3% discount baseline scenario at $4,386.85.

9% Discount Rate Baseline Scenario: The baseline scenario using the 9% discount rate again shows results similar to the previous scenarios discussed in many aspects. The saturated thickness decline in the 9% scenario can be seen in Figure 5.5 below. The aquifer declines slightly more than the previous scenarios from 76.0 ft to 22.1 ft, or 53.9 ft total. The pump lift increases as expected from 226.0 ft to 275.9 ft.

As seen in the Figure 5.6, the net return increases from $130.41 in year one to $364.63 in year forty-nine due to technological progress. After year forty-nine, per acre net return declines due to decreasing water availability falling to $357.33 in year sixty. Pumping cost per acre inch of water applied was almost identical to the 6% discount rate baseline scenario climbing from $5.48 to $6.60 over the planning horizon. Again the crop mix was similar to both the 3% and 6% discount rate baseline scenarios with 57.4% of cropland acres being in irrigated LEPA cotton and the remaining 42.6% of cropland acres producing dryland grain sorghum through year sixty. The NPV for the scenario is estimated to be $2,909.57. The estimate is 33.7% lower than the 6% baseline scenario and 63.2% less than the 3% baseline scenario.

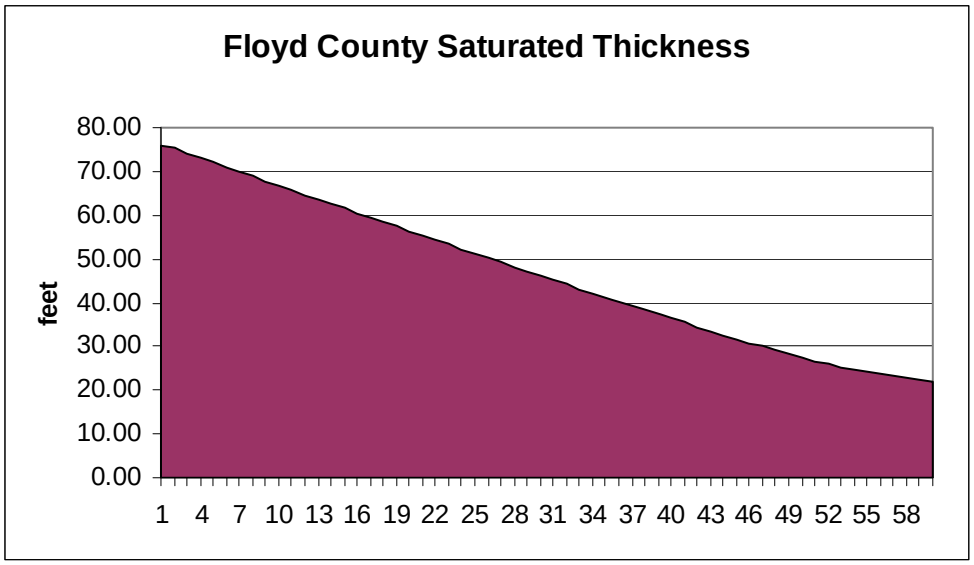

Figure 5.5. Floyd County 9% Baseline Scenario Saturated Thickness.

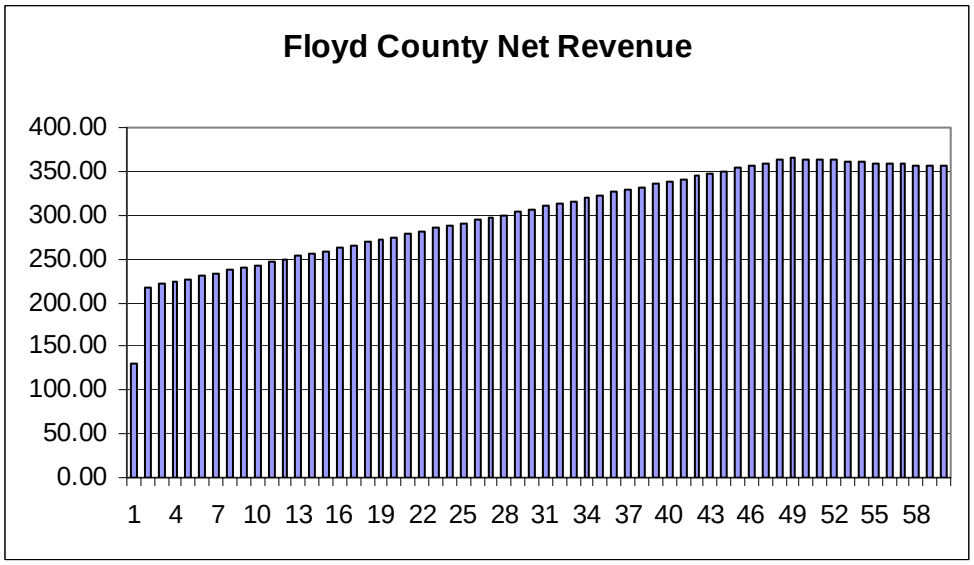

Figure 5.6. Floyd County 9% Baseline Scenario Nominal Net Return.

3% Discount Rate Ten Year Water Rights Buyout: As discussed previously, the policy scenarios evaluated include ten and twenty year water rights buyout policies in addition to the baseline scenarios already discussed for Floyd County. The two policy scenarios were evaluated incorporating 3%, 6%, and 9% discount rates consistent with the aforementioned baseline scenarios. As seen in Figure 5.7 below, the ten year water rights buyout using a 3% discount rate shows a decline in saturated thickness from 76.0 ft in year one to 25.7 ft in year sixty, or a total depletion of 50.4 ft. The figure shows that there is about 4.0 ft of decline during the term of the buyout; however, the rate of depletion increases significantly after the term of the buyout ends and enrolled acres are allowed to return to irrigated production. The decline in saturated thickness over the entire planning horizon for this scenario is 2.3 ft less than that seen in the 3% discount rate baseline policy.

Figure 5.8 shows the nominal per acre net return for this scenario increases gradually during the term of the buyout, then jumps significantly as enrolled acres return to irrigated practices. As seen in the figure, the per acre net return increases from $130.18 in year one to $391.49 in year fifty-seven due to technological progress. After year fifty-seven, the aquifer reaches a level at which irrigators must significantly decrease the amount of water applied per acre causing yields and in turn returns to decrease. At the end of the planning horizon the nominal per acre net return decreases to $389.08. Conversely, the pumping cost per acre inch of water applied continues to increase throughout the planning horizon from $5.48 to $6.53 over sixty years.

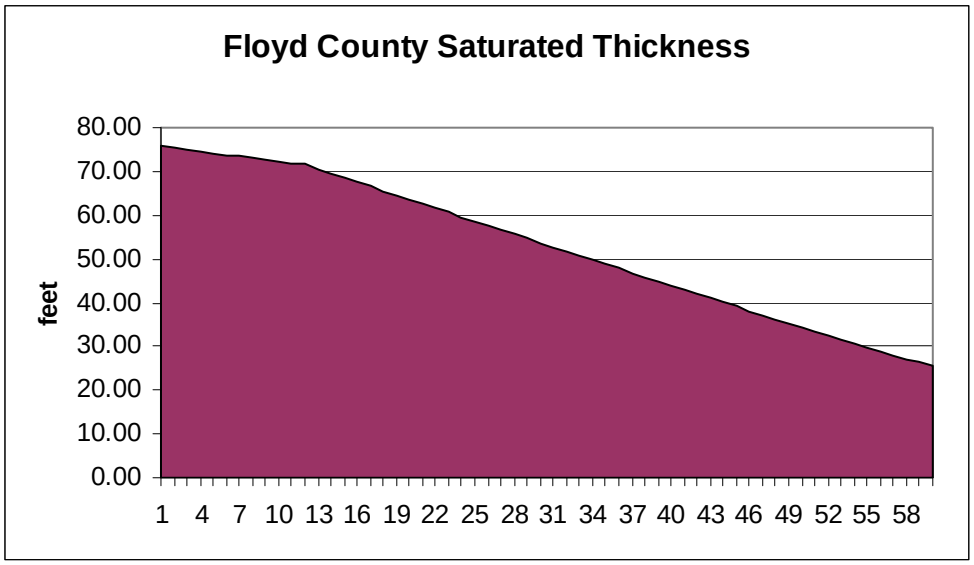

Figure 5.7. Floyd County 3% Ten Year Water Rights Buyout Saturated Thickness.

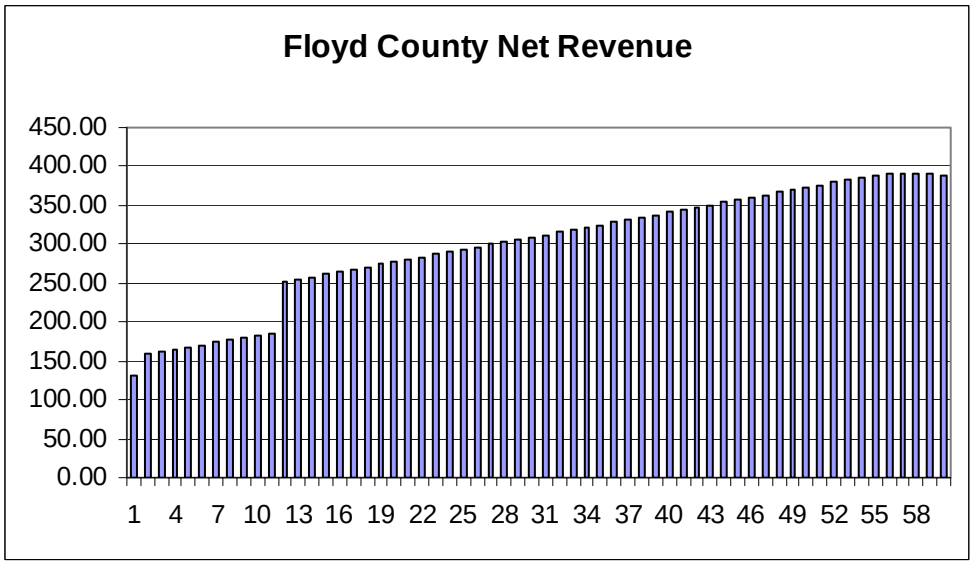

Figure 5.8. Floyd County 3% Ten Year Water Rights Buyout Nominal Net Return.

The crop mix for the ten year water rights buyout is more interesting than the baseline scenarios discussed. During the term of the water rights buyout, 31.9% of Floyd County is in irrigated LEPA cotton production, which is 75% of, or 25% less than the amount of the county irrigated in the base year. Additionally, 68.1% of the county is in dryland grain sorghum production during the term of the water rights buyout. After the buyout has expired and enrolled acres are allowed to return to irrigated production, 57.4% of the county is in irrigated LEPA cotton production, and the remaining 42.6% are in dryland grain sorghum production for the remainder of the planning horizon. Interestingly, the crop mix after the buyout has expired is identical to that in the 3% baseline scenario. The NPV for his scenario is $7,471.45 or 5.4% less than the corresponding 3% discount rate baseline scenario.

6% Discount Rate Ten Year Water Rights Buyout: As seen in Figure 5.9, the saturated thickness declines during the term of the buyout, but much more significant depletion is seen after the buyout has expired. The saturated thickness underlying Floyd County for this scenario shows a decline from 76.0 ft to 25.0 ft, or 51.0 ft over the course of the planning horizon. Therefore, when compared to the 6% discount rate baseline scenario, the ten year water rights buyout policy drawdown is 2.6 ft less. The shape of the saturated thickness curve shows that there is some decline during the term of the water rights buyout policy, but a significant increase in the rate of depletion after the buyout expires and enrolled acres are allowed to be irrigated again. The pump lift

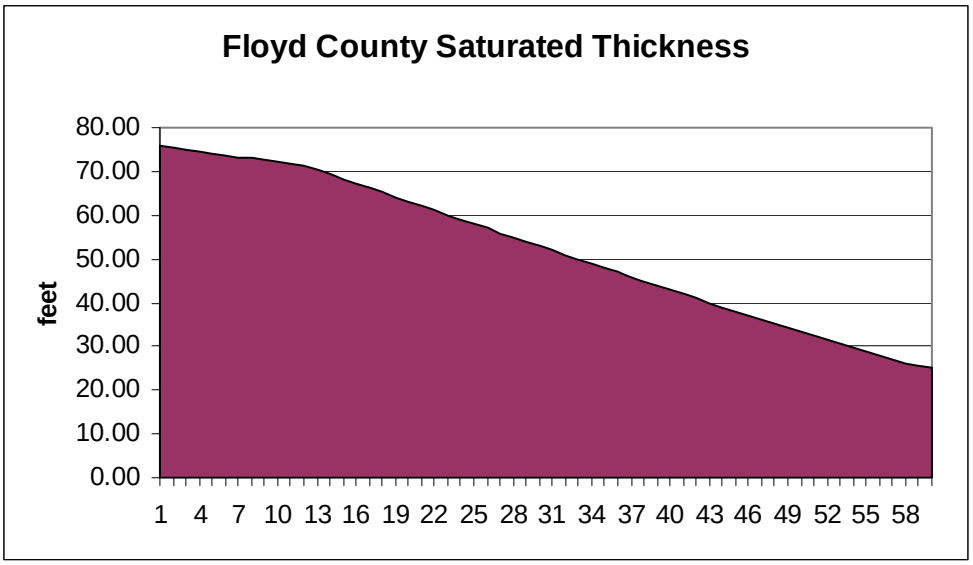

Figure 5.9. Floyd County 6% Ten Year Water Rights Buyout Saturated Thickness.

increases throughout the planning horizon from 226.0 ft in year one to 277.0 ft in year sixty.

Figure 5.10 shows that the per acre nominal net return increases throughout most of the planning horizon due to technological innovations. Similar to the previous scenario discussed, the net return climbs gradually during the term of the buyout, then more significantly as irrigated acres increase after the buyout expires. The net return increases from $130.39 in year one to $387.48 in year fifty-six at which point the water applied per irrigated acre decreases significantly due to decreasing water availability. The decrease causes yields and returns to also decrease. Per acre nominal net return in year sixty drops to $383.89. Pumping cost per acre inch of water applied increases throughout the planning horizon from $5.48 to $6.54.

The crop mix for the scenario shows that during the term of the buyout, 31.9% of the county is in irrigated LEPA cotton production with the remaining 68.1% in dryland grain sorghum production. After the term of the water rights buyout expires, 57.4% of the county is in irrigated LEPA cotton production and the remaining 42.6% are in dryland grain sorghum production similar to the corresponding 6% discount rate baseline scenario. The NPV for this scenario is $3,978.64, or 9.3% less than the 6% discount rate baseline scenario.

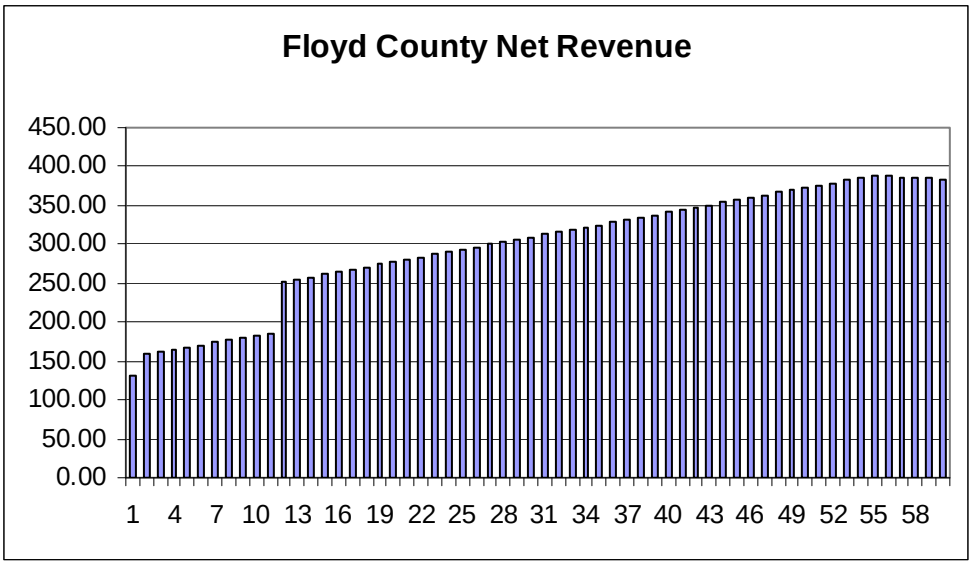

Figure 5.10. Floyd County 6% Ten Year Water Rights Buyout Nominal Net Return.

9% Discount Rate Ten Year Water Rights Buyout: The saturated thickness drawdown incorporating a 9% discount rate for the ten year water rights buyout shows results similar to the 3% and 6% discount rate buyout scenarios previously discussed. The results show a slight drawdown during the term of the buyout, and significant depletion in the years following the buyout as irrigated acres increase. Figure 5.11 shows that the saturated thickness underlying Floyd County declines from 76.0 ft in year one to 24.6 ft at the end of the planning horizon, or a total decline of 51.4 ft. The decline is 2.5 ft less than the corresponding baseline scenario incorporating a 9% discount rate. As expected, the pump lift increases throughout the planning horizon as the saturated thickness falls. Specifically, the pump lift increases from 226.0 ft to 277.4 over sixty years.

The per acre nominal net return trend over the sixty year planning horizon can be seen in Figure 5.12. Again the figure shows that net return climbs during the term of the buyout, but increases at a more rapid rate as enrolled acres are allowed back into irrigated production. The figure shows that the net return increases from $130.43 in year one to a high of $385.00 by year fifty-five. The increase through year fifty-five is due to the expected increases in technology incorporated into the model; however, the drawdown of the aquifer reaches a point after year fifty-five where water applied per irrigated acre decreases causing yields and returns to decrease. At the end of the planning horizon, the nominal per acre net return has fallen to $380.63. Unlike the net return, the cost per acre inch of water pumped for irrigation increases throughout the planning horizon from $5.48 to $6.55.

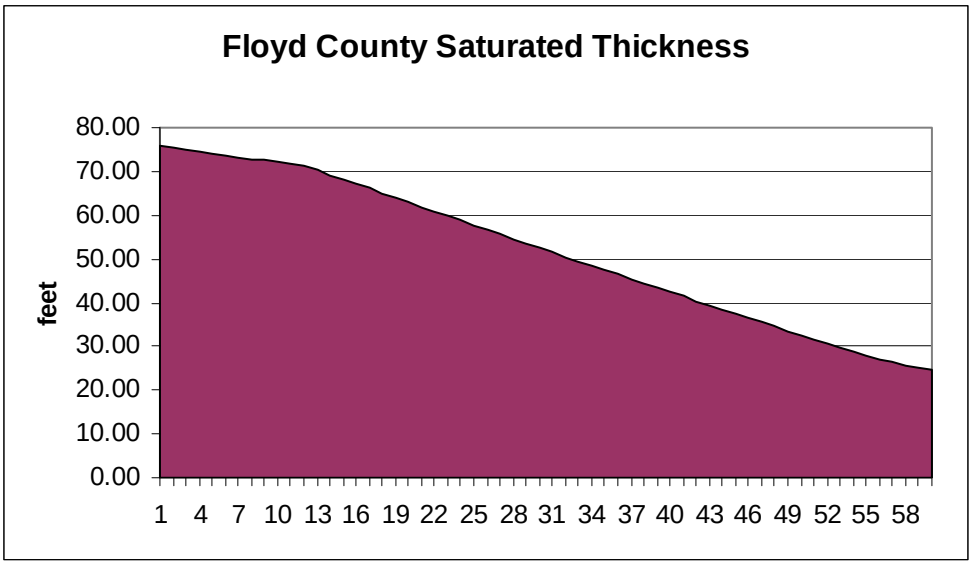

Figure 5.11. Floyd County 9% Ten Year Water Rights Buyout Saturated Thickness.

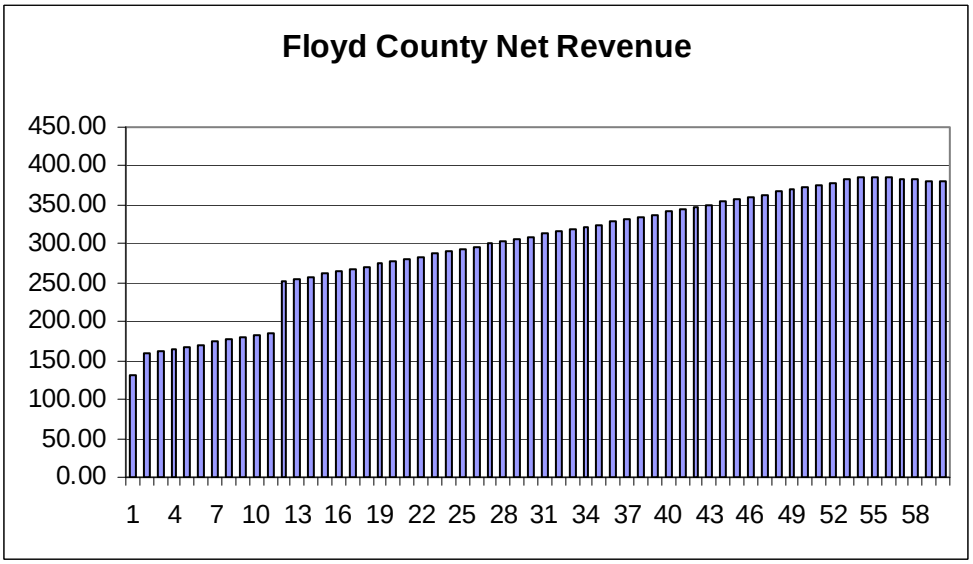

Figure 5.12. Floyd County 9% Ten Year Water Rights Buyout Nominal Net Return.

The crop mix for this scenario is similar to the previous ten year water rights buyout policy scenarios discussed where 31.9% of cropland acres are in irrigated LEPA cotton and 68.1% are in dryland grain sorghum for the term of the water rights buyout. After the buyout has expired, and enrolled acres are allowed to return to irrigated production, the crop mix transitions to 57.4% irrigated LEPA cotton and 42.6% dryland grain sorghum for the remainder of the planning horizon. The NPV for this scenario is $2,541.56 which is 12.7% less than the corresponding baseline scenario using a 9% discount rate.

3% Discount Rate Twenty Year Water Rights Buyout: The saturated thickness drawdown in the twenty year water rights buyout using a 3% discount rate shows a trend similar to that seen in the ten year water rights buyout scenarios where there is slight aquifer drawdown during the term of the buyout and significant drawdown in the years following the policy. The saturated thickness for this scenarios shows a depletion of 47.0 ft from 76.0 ft to 29.0 ft in year sixty (see Figure 5.13). Therefore, when compared to the baseline scenario incorporating a 3% discount rate where no water policy was used, there was a water savings of approximately 5.6 ft of saturated thickness with the twenty year buyout. As expected, the pump lift increases throughout the planning horizon as the saturated thickness declines. The pump lift increases from 226.0 ft in year one to 273.0 ft in year sixty.

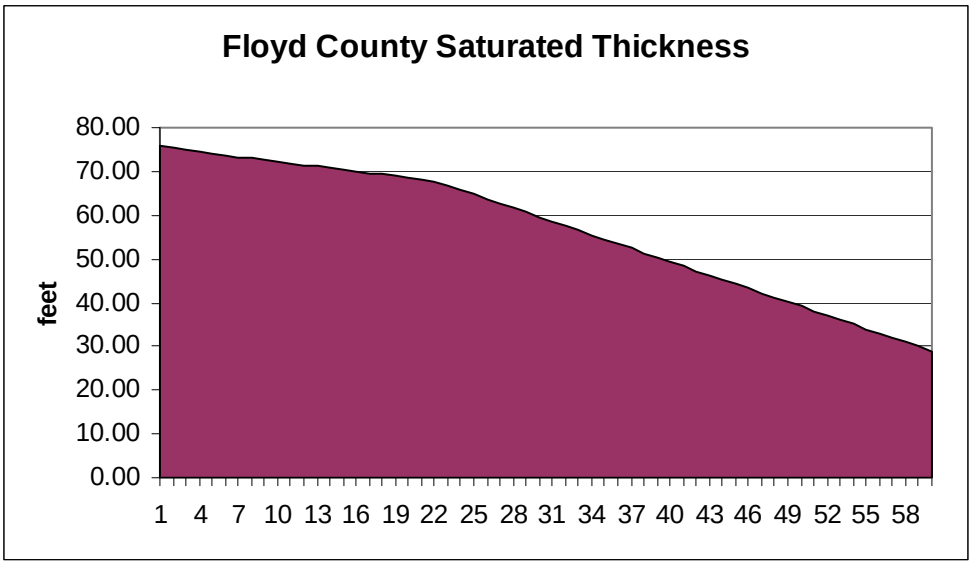

Figure 5.13. Floyd County 3% Twenty Year Water Rights Buyout Saturated Thickness.

Figure 5.14 shows that the per acre nominal net return increases throughout the planning horizon. This result is quite different than that seen in both the baseline scenario and the ten year water rights buyout policies where the returns began to decrease due to decreasing water availability. In this scenario, the net return increases during the twenty year term of the buyout, then jumps to a higher level as enrolled irrigated acres are allowed to return to irrigation practices; however, since more water was saved during the buyout, the aquifer never reaches a point at which water applied per irrigated acre must decrease, thereby decreasing yields and returns. The nominal net return increases from $130.33 in year one to $406.30 in year sixty for this scenario. Because the water remains in the aquifer further into the future, producers are able to take advantage of technological innovations, thereby increasing yields and returns to levels not seen in the previously discussed baseline and ten year water rights buyout policy scenarios.

The cost per acre inch of water pumped also increases throughout the planning horizon from $5.48 in year one to $6.46 in year sixty. The crop mix for the twenty year water rights buyout shows trends similar to those seen in the ten year buyout scenarios. 31.9% of cropland acres are in irrigated LEPA cotton production which is 75% of, or 25% less than the total percentage of cropland acres in irrigated production in the base year. The remaining 68.1% of cropland acres are in dryland grain sorghum for the twenty years of the buyout. After the twenty year water rights buyout has expired, 57.4% of cropland acres are in irrigated LEPA cotton production and 42.6% are in dryalnd grain sorghum production for the remainder of the planning horizon. The NPV for this scenario estimated to be $7,098.92 which is 5.0% less than the ten year water rights

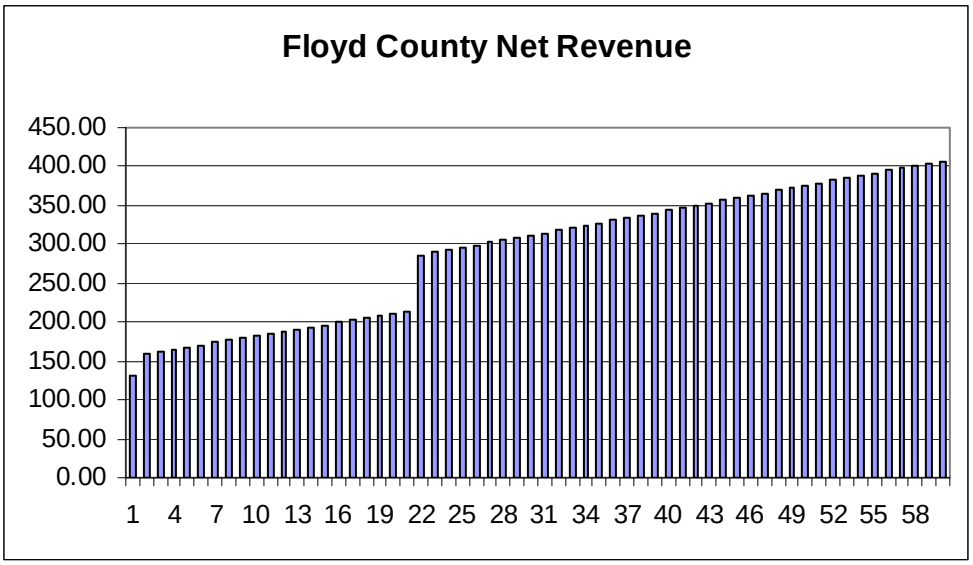

Figure 5.14. Floyd County 3% Twenty Year Water Rights Buyout Nominal Net Return.

buyout incorporating a 3% discount rate and 10.2% less than the baseline scenario incorporating a 3% discount rate and.

6% Discount Rate Twenty Year Water Rights Buyout: Similar to the 3% discount rate twenty year water rights buyout, the saturated thickness for this scenario decreases somewhat during the twenty year term of the buyout, but decreases considerably after the buyout has ended and irrigated acres increase as shown in Figure 5.15. As seen in the figure, the saturated thickness decreases a total of 47.4 ft over the planning horizon from 76.0 ft in year one to 28.6 ft in year sixty. When compared to the 6% discount rate baseline scenario, this policy has a potential water savings of 5.2 ft of saturated thickness. As expected, the pump lift shows an inverse relationship with the declining saturated thickness level increasing from 226.0 ft to 273.4 over sixty years.

Figure 5.16 illustrates that the per acre nominal net return increases during the term of the buyout due to technological progress, and also after the twenty year term as producers increase irrigated acres and are allowed to take advantage of the advances made in irrigation technology during the twenty year buyout. As seen in the figure, the net return increases from $130.42 in year one to $405.15 at the end of the planning horizon. Similar to the 3% discount rate twenty year buyout policy, the per acre net return does not begin to decrease during the planning horizon like the baseline and ten year buyout policies.

As seen in all other scenarios discussed, the cost per acre inch of water pumped increases throughout the sixty years from $5.48 to $6.47. The crop mix includes 31.9%

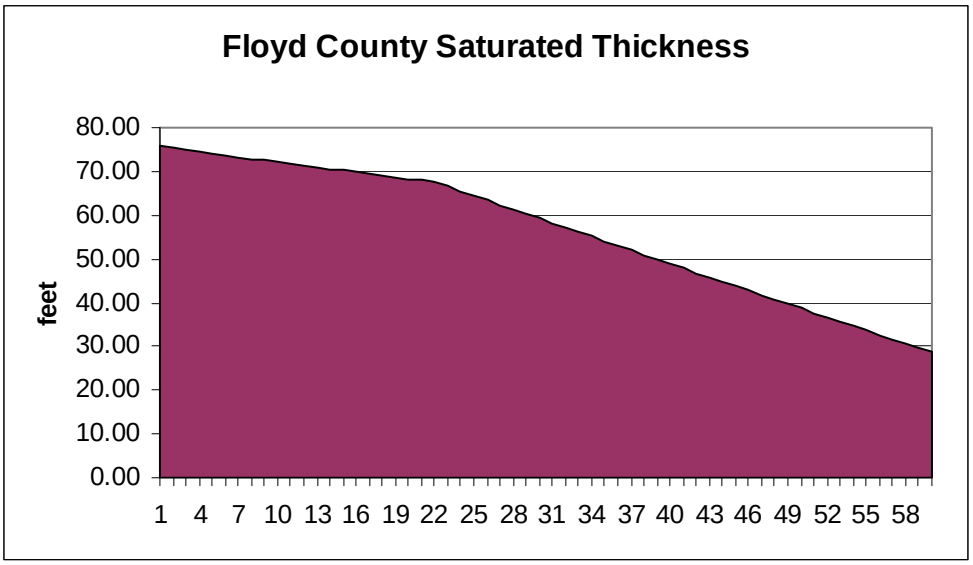

Figure 5.15. Floyd County 6% Twenty Year Water Rights Buyout Saturated Thickness.

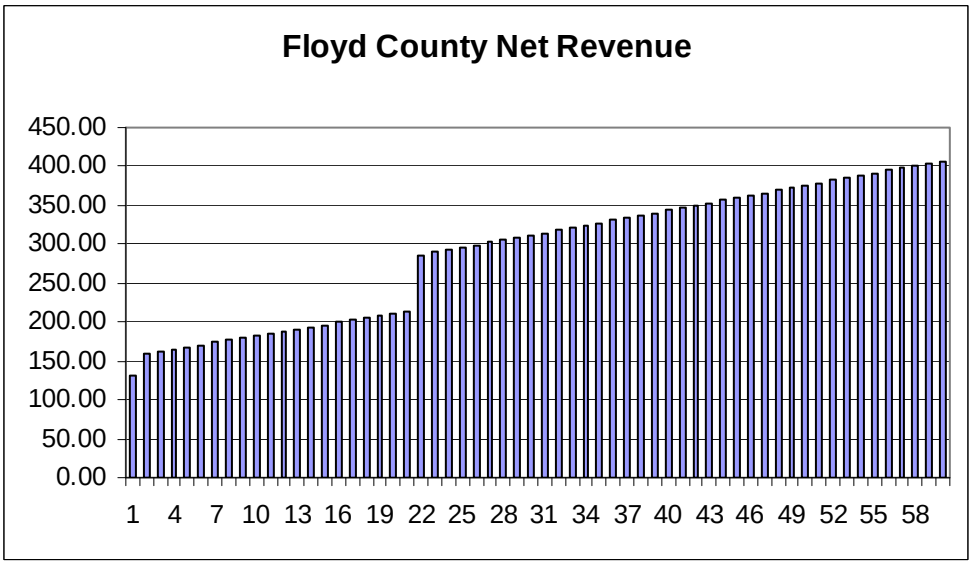

Figure 5.16. Floyd County 6% Twenty Year Water Rights Buyout Nominal Net Return.

of irrigated acres being in irrigated LEPA cotton production and 68.1% in dryland grain sorghum production during the twenty year term of the buyout, and 57.4% in irrigated LEPA cotton and 42.6% in dryland grain sorghum for the remainder of the planning horizon. The NPV for this scenario is $3,724.83 which is 6.4% less than the ten year water rights buyout at a 6% discount rate, and 15.1% less than the corresponding 6% discount rate baseline scenario.

9% Discount Rate Twenty Year Water Rights Buyout: As seen in Figure 5.17, like the previous twenty year buyout policies discussed, the saturated thickness of the aquifer decreases somewhat during the term of the buyout after which the rate of depletion increases dramatically. Specifically, the aquifer declines a total of 47.7 ft from 76.0 ft at the beginning of the planning horizon to 28.4 ft in year sixty. As compared with the 9% discount rate baseline scenario, there was a potential water savings of 6.3 ft with this policy. The pump lift shows an inverse relationship with the declining saturated thickness increasing throughout the sixty years from 226.0 ft to 273.7 ft.

Nominal per acre net return over the planning horizon can be seen in Figure 5.18. The figure shows that per acre net return increases during the term of the buyout, then jumps to a much higher level as irrigated acres increase and producers are able to take advantage of the innovations made in irrigation and other technologies during the term of the buyout. Specifically, the per acre nominal net return increases from $130.44 in year one to $404.3 in year sixty. As expected as the pump lift increases, the cost per acre inch of water pumped increases throughout the sixty years from $5.48 to $6.47.

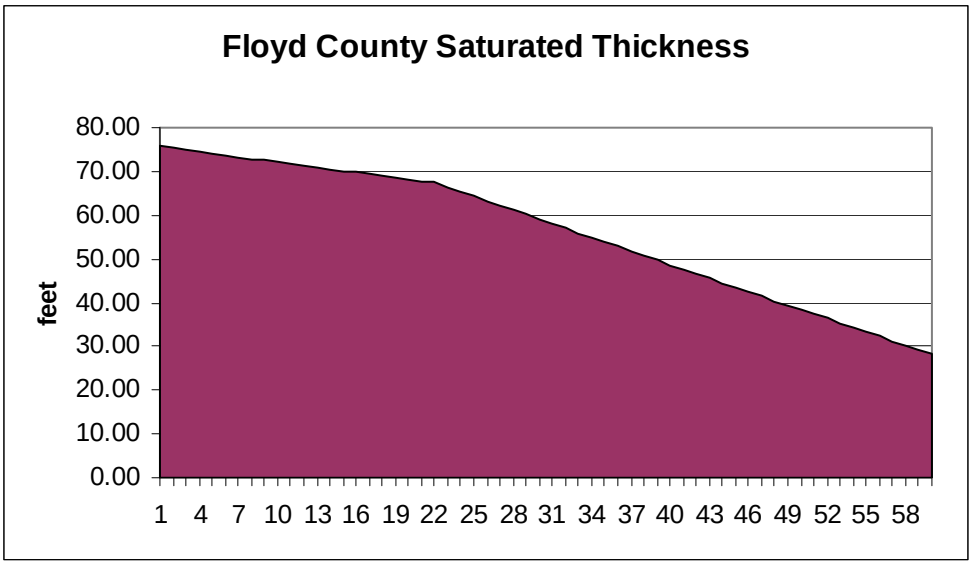

Figure 5.17. Floyd County 9% Twenty Year Water Rights Buyout Saturated Thickness.

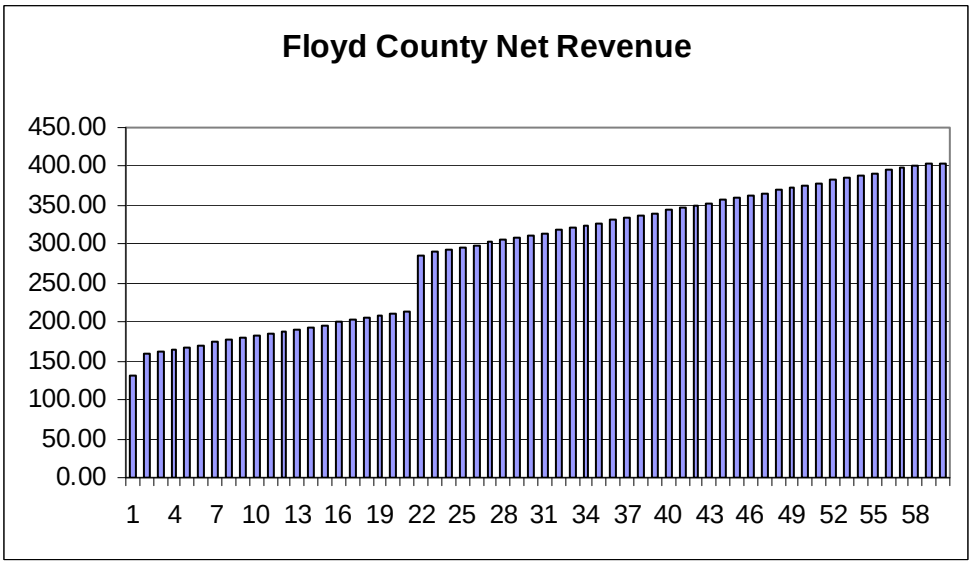

Figure 5.18. Floyd County 9% Twenty Year Water Rights Buyout Nominal Net Return.

The crop mix for this scenario is identical to that in the previous two twenty year water rights buyout policies discussed. 31.9% of total cropland acres are in irrigated LEPA cotton production and 68.1% in dryland grain sorghum production during the twenty year term of the buyout. After the buyout has expired and enrolled acres are allowed to return to irrigated production, 57.4% of total cropland acres are in irrigated LEPA cotton and 42.6% of cropland acres are in dryland grain sorghum for the remainder of the planning horizon. The NPV for this scenario is $2,370.31. The NPV estimate is 6.8% lower than the 9% discount rate ten year water rights buyout and 18.6% less than the 9% discount rate baseline scenario.

Lubbock County

Lubbock County is located towards the middle of the study area. The county encompasses 575,360 acres with 100% overlying the aquifer. In year one, Lubbock County had an initial saturated thickness of 57.0 ft and a pump lift of 130.0 ft. Approximately 160,000 acres were irrigated with LEPA, 5,000 irrigated with SDI, and 95,000 acres were in dryland production. The crop mix for the county was predominantly cotton and grain sorghum in the base year. The baseline GAMS model for Lubbock County can be found in Appendix I.

3% Discount Rate Baseline Scenario: The baseline scenario using the 3% discount rate shows a dramatic decline in the saturated thickness of the aquifer underling Lubbock County. Figure 5.19 shows a drawdown of 45.7 ft declining from 57.0 ft in year one to 11.3 ft at the end of the planning horizon. The pump lift increases significantly from 130.0 ft to 175.4 ft in year sixty.

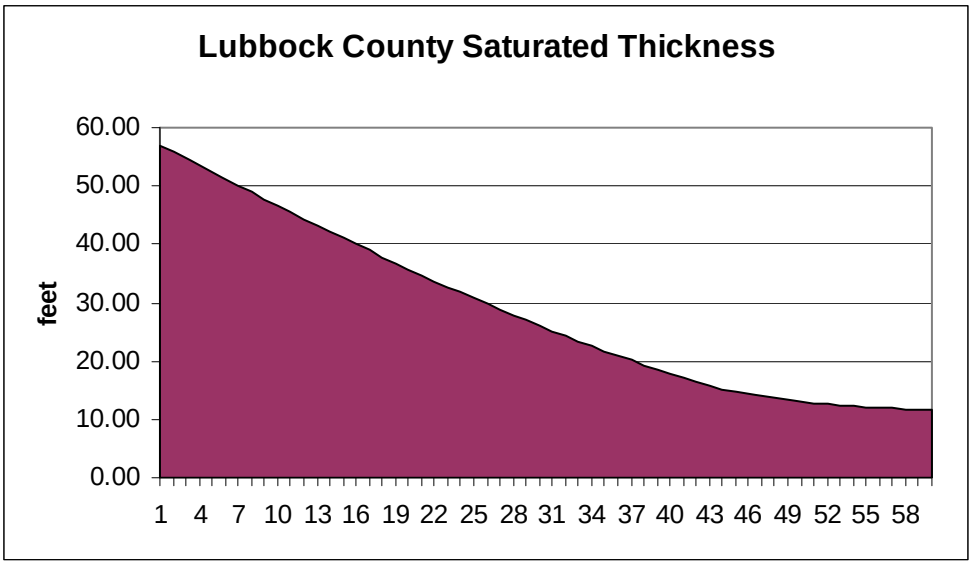

Figure 5.19. Lubbock County 3% Baseline Scenario Saturated Thickness.

Figure 5.20 shows that the per acre nominal net return increases due to technological progress from $164.90 in year one to $294.24 through year forty-one, but then begins to decline. The decline of per acre net return is caused by the aquifer reaching a level at which irrigated acres must transition into dryland acres where yields and net returns are generally less. The net return does begin to recover due to the constant technological progress allowing dryland yields and irrigated yields per acre inch of water applied to continue to increase. The nominal per acre net return at the end of the planning horizon was $293.73. The pumping cost per acre inch increases throughout the planning horizon from approximately $3.49 in year one to $4.43 in year sixty.

The crop mix for Lubbock County transitions into exclusively cotton production after the base year. 63.5% of the county's cropland remains in irrigated LEPA cotton with the remaining 36.5% of cropland acres being in dryland cotton production until year forty-five. In year forty-five, irrigated acres begin to decrease due to the declining aquifer level. At the end of the planning horizon, 44.0% of the county is in irrigated LEPA cotton production and the remaining 56.0% are in dryland cotton. The NPV for this scenario is estimated to be $6,819.45.

6% Discount Rate Baseline Scenario: The saturated thickness of the aquifer underlying Lubbock County for this scenario also shows significant depletion of the aquifer. Figure 5.21 shows the aquifer declines slightly more than the 3% discount rate scenario from 57.0 ft in year one to 11.3 ft , or a total of 45.7 ft at the end of the planning horizon. Additionally the pump lift increases from 130.0 ft at the beginning of the planning horizon to 176.0 ft in year sixty.

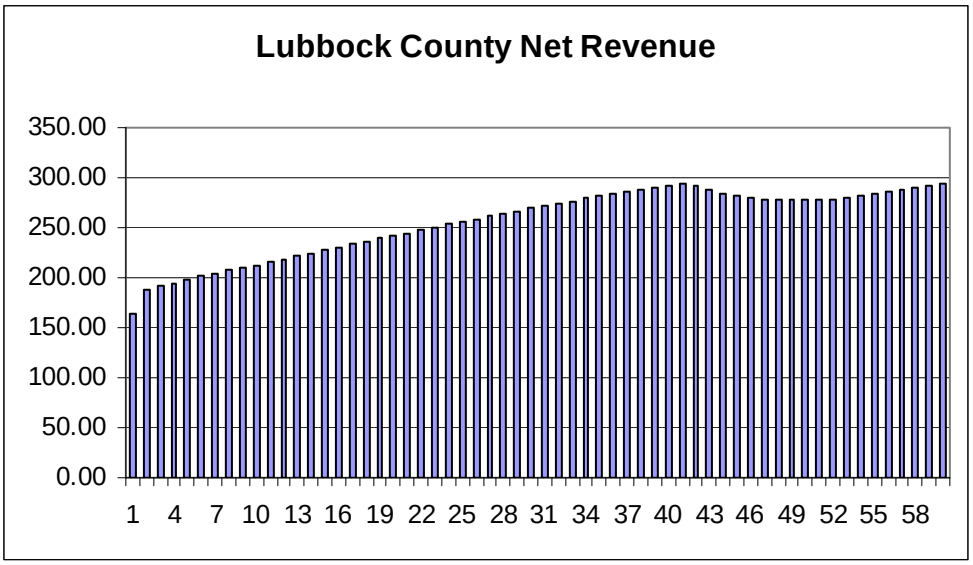

Figure 5.20. Lubbock County 3% Baseline Scenario Nominal Net Return.

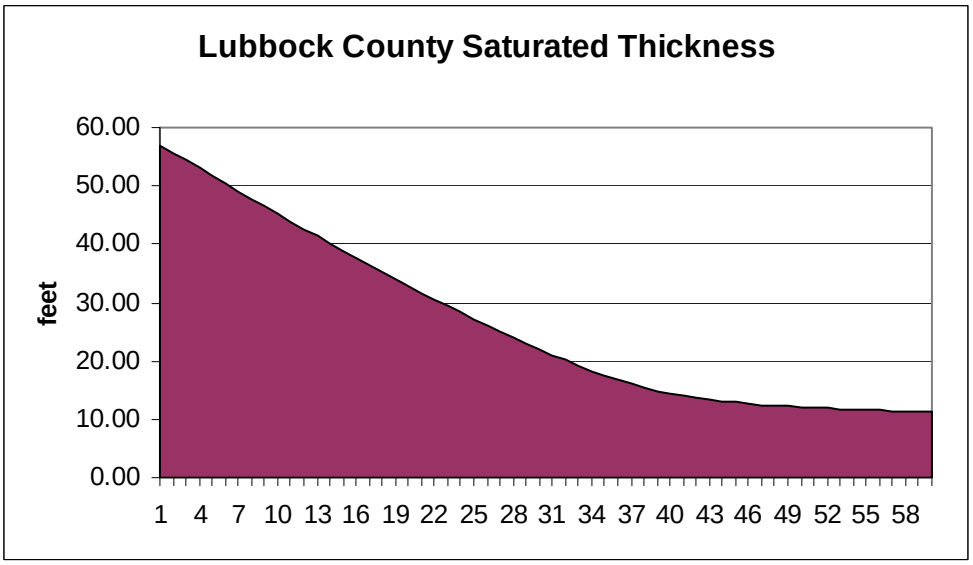

Figure 5.21. Lubbock County 6% Baseline Scenario Saturated Thickness.

As seen in Figure 5.22, the nominal per acre net return increases from $170.40 in year one to $279.47 in year thirty-five due to the increases made in technology. After year thirty-five the net return begins to decline due to the decrease in irrigated acres caused by declining aquifer levels. Per acre net return begins to recover due to the technological innovations allowing dryland yield and irrigated yield per acre inch of water applied to continue to increase. At the end of the planning horizon the nominal per acre net return is $289.75. The pumping cost per acre inch of water applied increases throughout the planning horizon from $3.50 to $4.44.

The crop mix for this scenario is very similar to the 3% baseline scenario for Lubbock County. 63.5% of cropland acres are in irrigated LEPA cotton production with the remaining 36.5% of cropland acres being in dryland cotton production until year thirty-eight. After year thirty-eight declining aquifer levels force some irrigated acres to be converted to dryland acres. At the end of the planning horizon, 41.6% of cropland acres were irrigated LEPA cotton production with the remaining 58.4% of acres being in dryland cotton production. The NPV for this scenario is 43.1% less than the 3% discount rate scenario and is estimated to be $3,881.16.

9% Discount Rate Baseline Scenario: The Lubbock County baseline scenario using the 9% discount rate shows results similar to both the 3% and 6% discount rate scenarios. As seen in Figure 5.23, the saturated thickness in this scenario decreases from 57.0 ft in year one to 11.2 ft at the end of the planning horizon. The total depletion over sixty years is slightly more than both of the previous scenarios at 45.8 ft. The pump lift

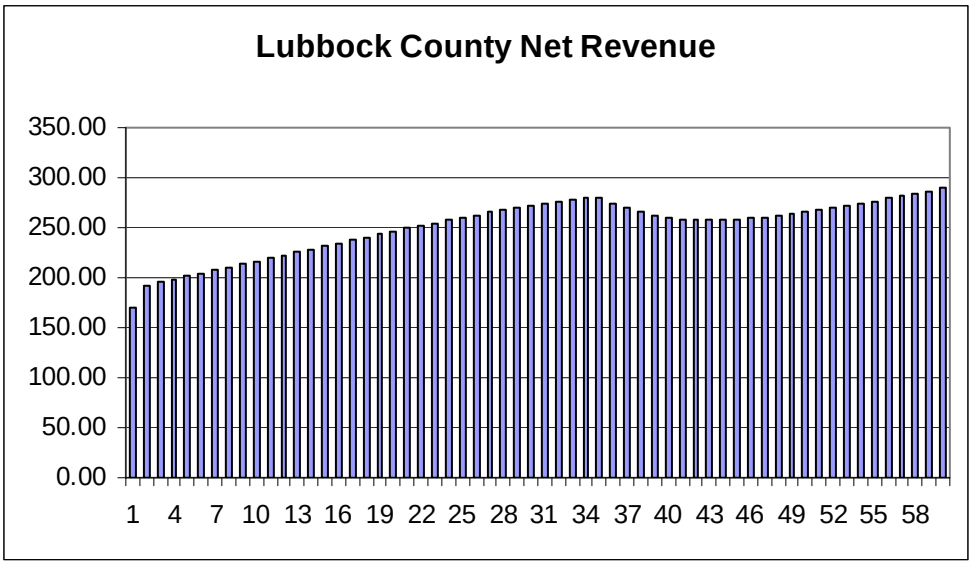

Figure 5.22. Lubbock County 6% Baseline Scenario Nominal Net Return.

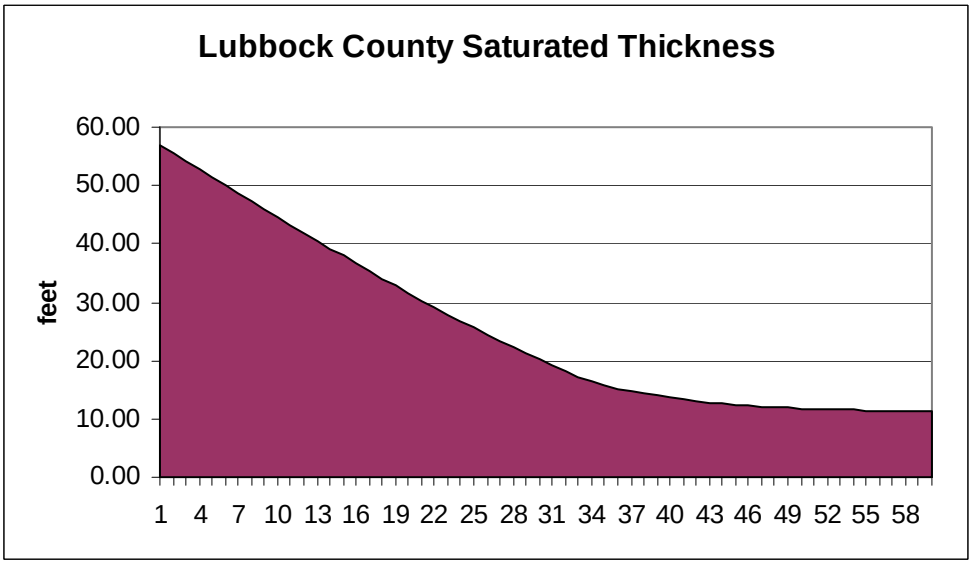

Figure 5.23. Lubbock County 9% Baseline Scenario Saturated Thickness.

increases significantly over the planning horizon for this scenario from 130.0 ft in year one to 175.8 ft at then end of the planning horizon.

The nominal net return seen in Figure 5.24 increases initially from $171.23 in year one to $275.00 in year thirty-two due to technological progress. The net return then begins to decline due to decreasing water availability reaching its minimum in year forty at $249.90. The net return begins to recover, however, due to the constant innovations in technology allowing dryland yields and irrigated yields per acre inch of water applied to continue to increase throughout the planning horizon. At the end of the planning horizon, the per acre net return had recovered to $289.75. The pumping cost per acre inch applied increases similar to the 3% and 6% baseline scenarios from $3.49 in year one to $4.44 in year sixty.

The crop mix is also similar to the previous scenarios discussed for Lubbock County where 63.5% of cropland acres are in irrigated LEPA production and the remaining 36.5 % of cropland acres are dryland production through year thirty-five. After year thirty-five, the percentage of cropland acres in irrigated production begins to decrease due to declining aquifer levels. At the end of the planning horizon, 40.9% of cropland acres are in irrigated LEPA cotton production and the remaining 59.0% are in dryland cotton. The NPV for this scenario is estimated to be $2,624.93 which is 32.4% lower than the 6% discount rate baseline scenario and 61.5% lower than the 3% discount rate baseline scenario.

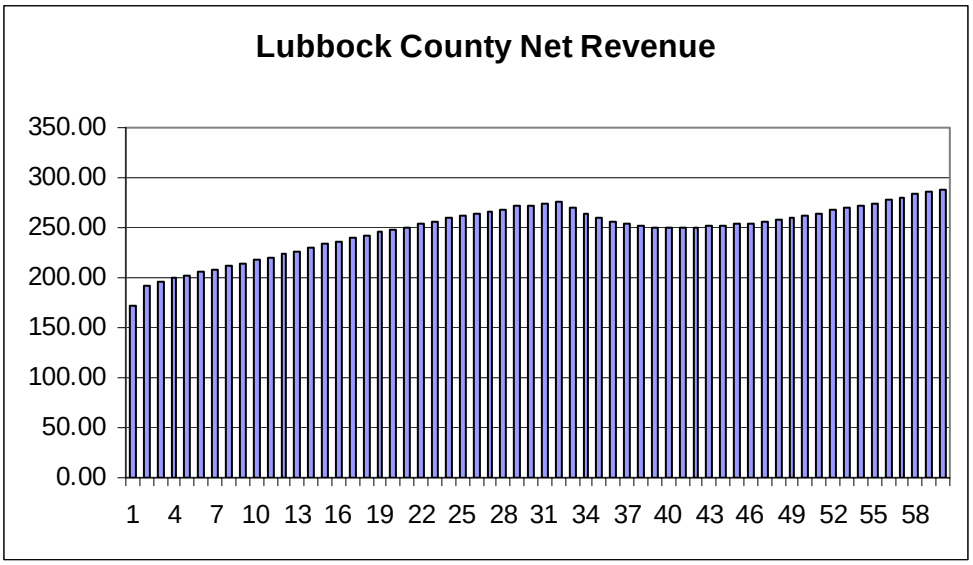

Figure 5.24. Lubbock County 9% Baseline Scenario Nominal Net Return.

3% Discount Rate Ten Year Water Rights Buyout: The ten year water rights buyout policy using a 3% discount rate shows a saturated thickness decline of 45.0 ft falling from a base year saturated thickness of 57.0 ft to 12.0 ft at the end of the planning horizon as shown in Figure 5.25. The rate of decline is less during the term of the buyout policy than in the years after the buyout has expired. The results for this policy scenario are interesting in that, when compared to the 3% discount rate scenario, this policy only saved 0.4 ft of saturated thickness, whereas the same comparison for the Floyd County models show a saving of 4.0 ft of saturated thickness. As expected from the significant drawdown levels, pump lift in this scenario increases throughout the sixty years from 130.0 ft to 175.0 ft.

Figure 5.26 shows the per acre nominal net return increases from $167.45 in year one to $310.39 in year forty-five due to technological advances. At that point, net return begins to decrease due to the significant depletion of the aquifer. The aquifer reaches a point at which irrigated acres must transition into dryland acres where yields and returns are generally less. The per acre net return does begin to recover around year fifty-four due to the constant technological innovations being made in dryland production practices and in irrigation technology. The net return in year sixty is $298.61. Conversely, the pumping cost per acre inch applied increases throughout the planning horizon from $3.49 in year one to $4.42 in year sixty.

The crop mix shows that during the term of the buyout, where 25% of base year irrigated acres are transitioned into dryland production, 43.4% of cropland acres are in irrigated LEPA production with the remaining 56.6% in dryland cotton production. After

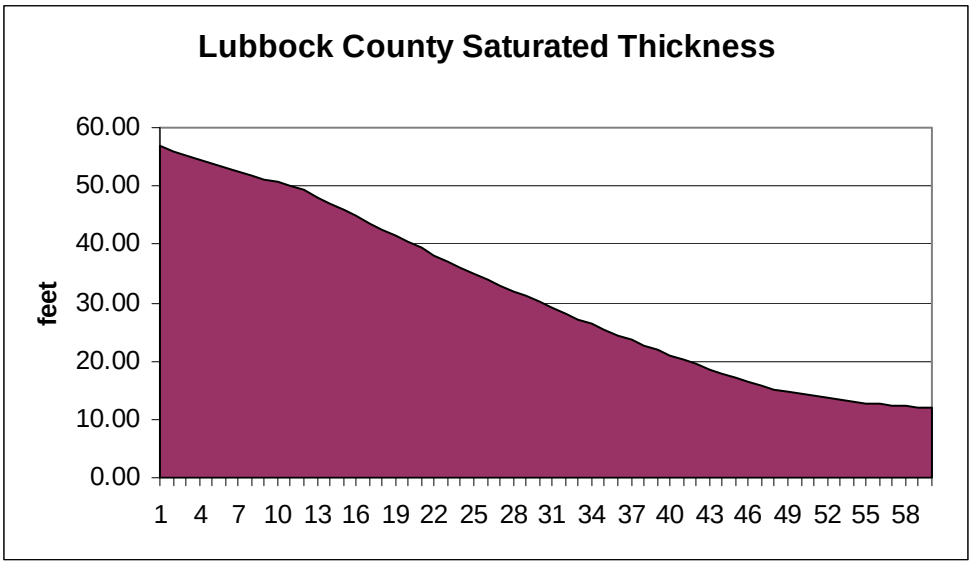

Figure 5.25. Lubbock County 3% Ten Year Water Rights Buyout Saturated Thickness.

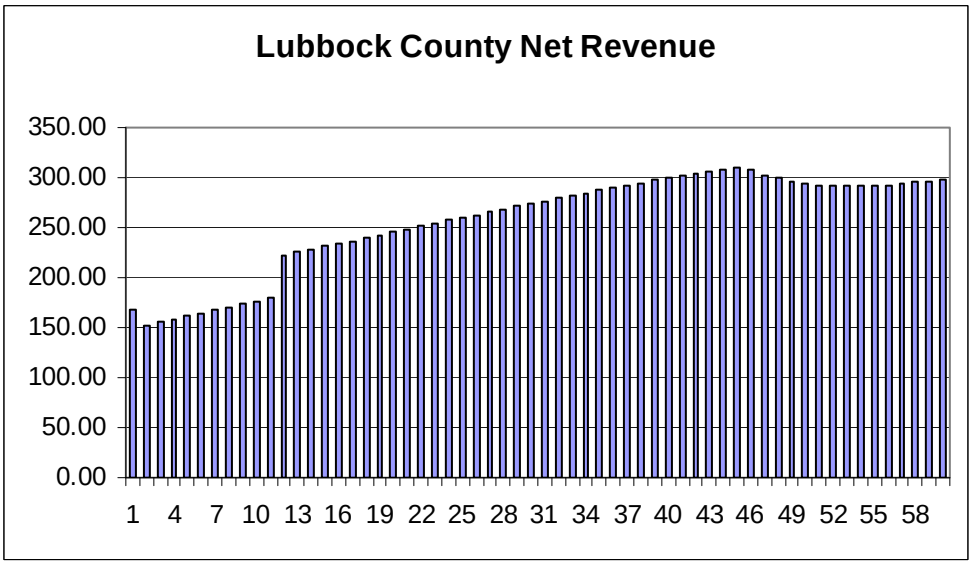

Figure 5.26. Lubbock County 3% Ten Year Water Rights Buyout Nominal Net Return.

the term of the buyout when enrolled acres are allowed to return to irrigated production, 63.5% of cropland acres are in irrigated LEPA cotton and the remaining 36.5% are in dryland cotton. In year forty-nine however, the percentage of irrigated LEPA cotton begins to decrease due to the significant depletion of the aquifer. In year sixty, irrigated LEPA cotton production has fallen to 47.1% and dryland cotton has risen to 52.9%. The NPV estimated for this scenario is $6,641.13 which is 2.6% less than the 3% discount rate baseline scenario

6% Discount Rate Ten Year Water Rights Buyout: This scenario shows similar saturated thickness depletion levels compared to the 3% discount rate ten year scenario. Figure 5.27 shows the saturated thickness depletion rate is less during the term of the buyout, but total depletion is still an astounding 45.5 ft declining from 57.0 ft in year one to a dismal 11.5 ft in year sixty. The water savings with this scenario are even less than those seen in the 3% discount rate ten year buyout scenario. In this scenario, there is a potential water savings of only 0.24 ft of saturated thickness relative to the corresponding 6% discount rate baseline scenario. As expected, pump lift also increases significantly over the planning horizon from 130.0 ft to 175.5 ft.

The nominal per acre net return can be seen in Figure 5.28. The figure shows that net return increases from $170.79 in year one to $295.74 in year thirty-nine due to increases in technology; however, the aquifer reaches a drawdown point at which irrigated acres can no longer be watered and thus must convert to dryland where yields and returns are less. Net returns do however begin to recover towards the end of the planning horizon due to the ever increasing technological progress in water applied per

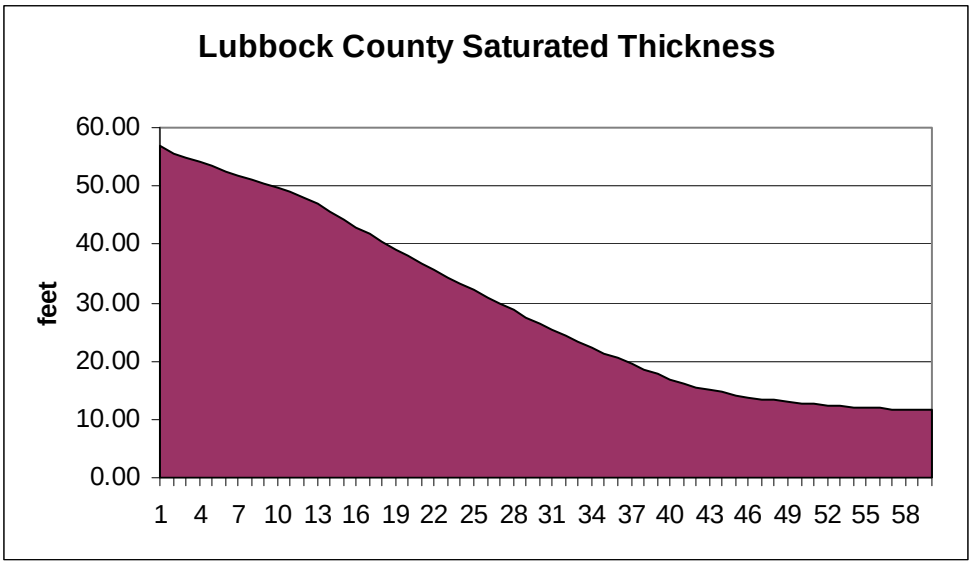

Figure 5.27. Lubbock County 6% Ten Year Water Rights Buyout Saturated Thickness.

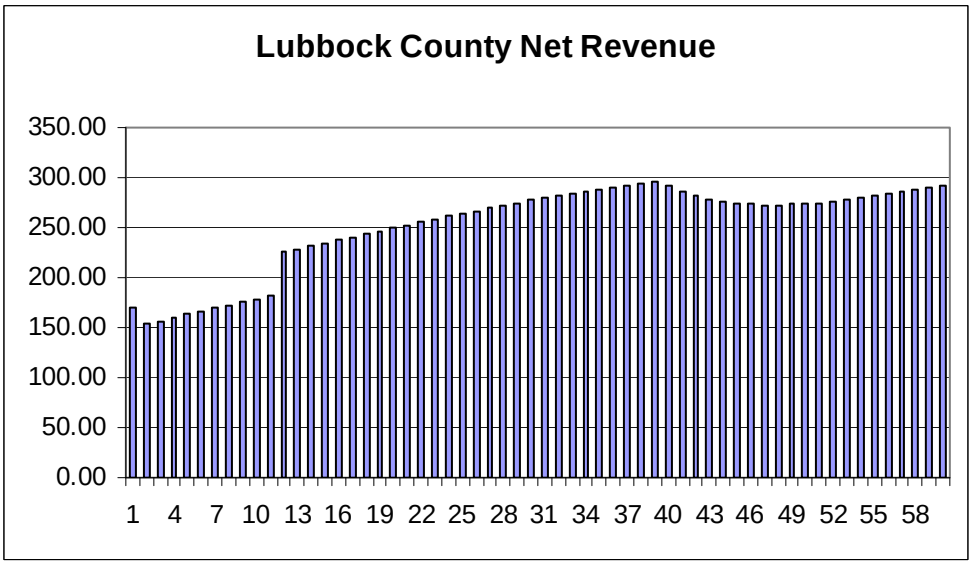

Figure 5.28. Lubbock County 6% Ten Year Water Rights Buyout Nominal Net Return.

irrigated acre and dryland production practices. At the end of the planning horizon, the per acre net return has recovered to $292.61. Unlike the net returns, the pumping cost per acre inch of water applied increases throughout the sixty year planning horizon. Specifically, the cost per acre inch pumped increases from $3.49 to $4.43 over sixty years.

The crop mix for this scenario is similar to that of the previous Lubbock County ten year buyout scenarios. During the term of the buyout, 43.4% of cropland acres are in irrigated LEPA cotton production, with the remaining 56.6% in dryland cotton. After the buyout expires, and enrolled acres transition back into irrigated production, 63.5% of cropland acres are in irrigated LEPA cotton and 36.5% are in dryland cotton. The level of irrigation is not sustainable due to the declining aquifer conditions. Irrigated acres begin to transition back to dryland by year forty-three. At the end of the planning horizon, the percentage of the county in irrigated LEPA cotton has fallen to 43.4% with the remaining 56.6% in dryland cotton. The NPV for this scenario is $3,656.09, or 5.8% less than the 6% discount rate baseline scenario where no change was made to current water policy.

9% Discount Rate Ten Year Water Rights Buyout: This scenario lends similar results to both the 3% and 6% discount rate water rights buyout policies. Figure 5.29 shows the saturated thickness declines 45.6 ft total from 57.0 ft to 11.4 ft over the sixty year planning horizon. The saturated thickness decline for this scenario when compared with the corresponding 9% baseline scenario shows a potential water savings of 0.2 ft. The pump lift increases as expected from 130.0 ft in year one to 175.6 ft in year sixty.

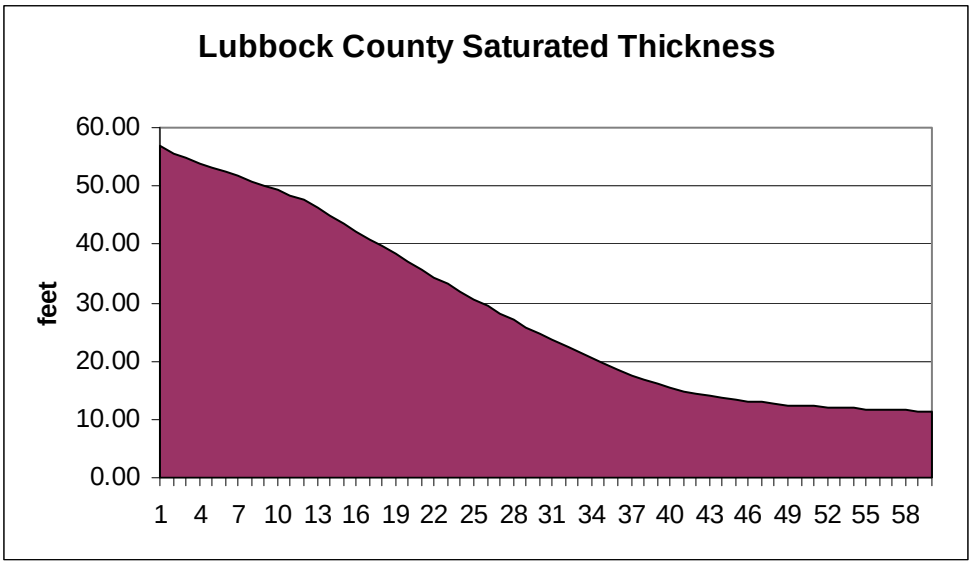

Figure 5.29. Lubbock County 9% Ten Year Water Rights Buyout Saturated Thickness.

Figure 5.30 shows that the nominal net revenue increases from $171.37 in year one to $290.95 in year thirty-six due to the constant innovations being made in technology. After year thirty-six however, a portion of irrigated acres are forced into dryland production due to the declining aquifer conditions causing yields and returns to decrease. In year forty-seven, returns begin to recover due to technological innovations continuing to be made in yield per acre inch of water applied and in dryland practices. At the end of the planning horizon, the per acre net return is $290.92. Unlike net returns, cost per acre inch of water applied increases throughout the planning horizon from $3.49 to $4.44.

The crop mix during the term of the buyout includes 43.4% of cropland acres in irrigated LEPA cotton production and 56.6% of cropland acres in dryland cotton. After the term of the buyout, when enrolled acres are allowed to return to irrigated practices, 63.5% of cropland acres are in irrigated LEPA cotton production and 36.5% are in dryland cotton. As the aquifer continues to be depleted, some irrigated acres must transition into dryland production in later time periods. At the end of the planning horizon, the amount of acres in irrigated LEPA cotton production has fallen to 42.3% of cropland acres and dryland cotton production has increased to 57.7% of total cropland acres. The NPV for this scenario is estimated to be $2,402.43. The estimation is 8.5% less than the corresponding 9% discount rate baseline scenario.

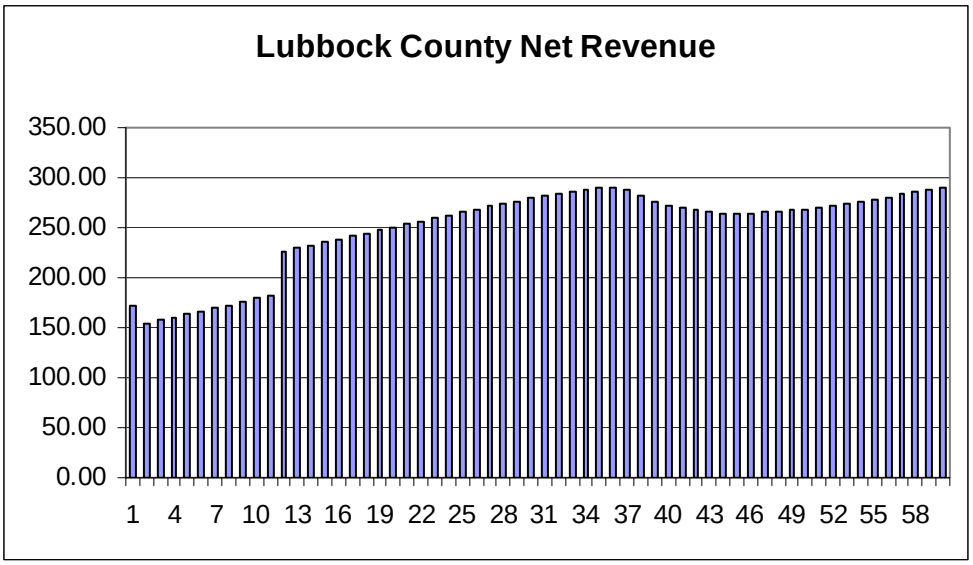

Figure 5.30. Lubbock County 9% Ten Year Water Rights Buyout Nominal Net Return.

3% Discount Rate Twenty Year Water Rights Buyout:

The saturated thickness of the aquifer incorporating a 3% discount rate for the twenty year buyout policy decreases from 57.0 ft in year one to 12.5 ft at the end of the planning horizon, or a total of 44.5 ft as shown in figure 5.31. Similar to the ten year water rights buyout for Lubbock County, there is not a lot of potential water savings. As compared to 3% discount rate baseline scenario, there was only a potential water savings of 0.9 ft. As with all previous scenarios discussed, the pump lift increases throughout the planning horizon from 130.0 ft in year one to 174.5 ft in year sixty.

Figure 5.32 shows the per acre nominal net return for this scenario. As the figure shows, the net return increases initially due to technological progress from $168.15 in year one to $325.03 in year forty-eight; however, the depletion of the aquifer causes net returns to decrease as irrigated acres are forced into dryland production where yields and returns are generally less. However, technology continues to accumulate and net returns begin to recover. At the end of the planning horizon, the net return recovers to $305.34 per acre. The pumping cost per acre inch of water applied increases throughout the sixty years from $3.49 to $4.41.

The crop mix for this scenario indicates that during the term of the buyout 43.4% of cropland acres are in irrigated LEPA cotton production and the remaining 56.6% of cropland acres are in dryland cotton production. After the term of the buyout expires and acres are allowed back into irrigated production, 63.5% of cropland acres are in irrigated LEPA cotton production and 36.5% are in dryland cotton production. In year fifty-four however, aquifer decline forces some irrigated acres into dryland acres. At the end of the

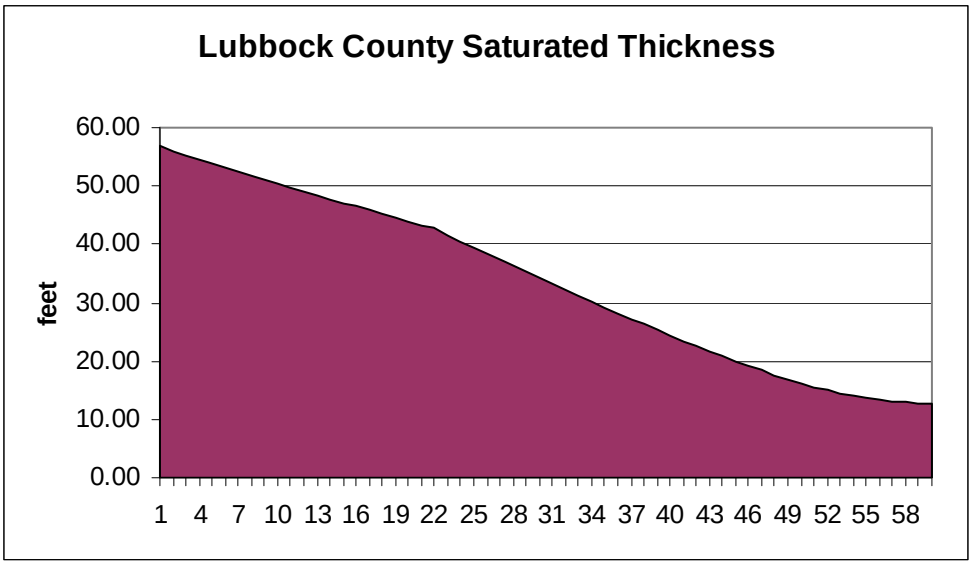

Figure 5.31. Lubbock County 3% Twenty Year Water Rights Buyout Saturated Thickness.

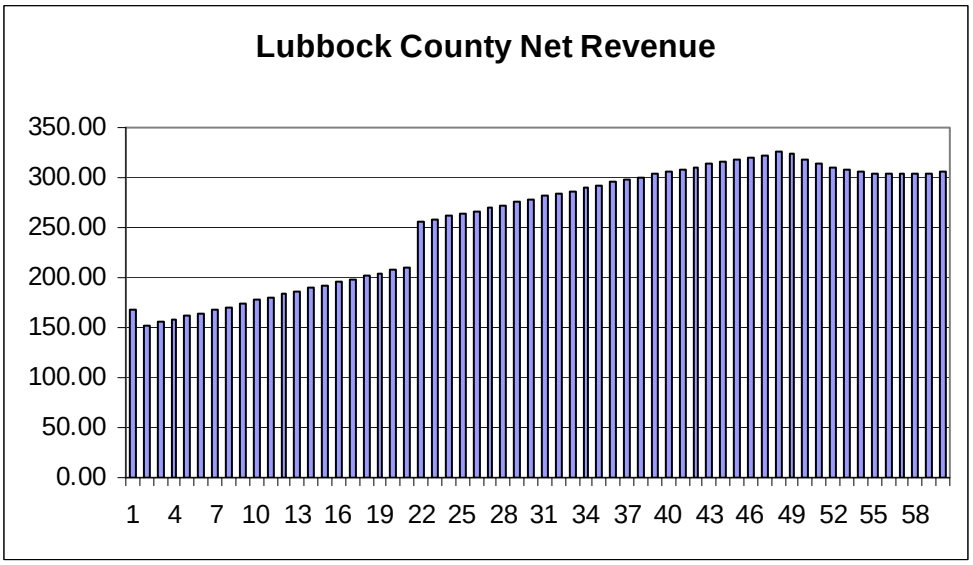

Figure 5.32. Lubbock County 3% Twenty Year Water Rights Buyout Nominal Net Return.

planning horizon, irrigated LEPA cotton acres have fallen to 51.3% of cropland acres and dryland cotton production covers 48.7% of total cropland acres. NPV for the scenario is $6,502.02 which is 2.1% less than the ten year water rights buyout incorporating a 3% discount rate and 4.7% less than the corresponding 3% discount rate baseline scenario.

6% Discount Rate Twenty Year Water Rights Buyout: The saturated thickness depletion for this scenario can be seen in Figure 5.33. The saturated thickness declines from 57.0 ft to 11.9 ft, or 45.1 ft total over the sixty year planning horizon. Compared to the 6% discount rate baseline scenario, there is a potential water savings of only 0.6 ft with this policy scenario. The pump lift increases throughout the sixty years from 130.0 ft to 175.1 ft.

Figure 5.34 shows the per acre nominal net return over the course of the planning horizon. The net return increases due to technology from $171.02 in year one to $310.94 in year in year forty-three. After year forty-three the aquifer reaches a level at which the current level of irrigation is no longer sustainable and some irrigated acres are forced into dryland production where net returns tend to be less. The constant innovations expected in technology allow the net returns to begin to recover. In year sixty, the per acre net return has recovered to $297.02. On the contrary, the pumping cost per acre inch of water applied increases in all sixty years of the planning horizon from $3.49 to $4.43.

The crop mix for this scenario is similar to the previous scenario discussed. During the term of the water rights buyout, 43.4% of cropland acres are in irrigated LEPA cotton production and the remaining 56.6% are in dryland cotton production. After the buyout expires and enrolled acres acre allowed to return to irrigated production,

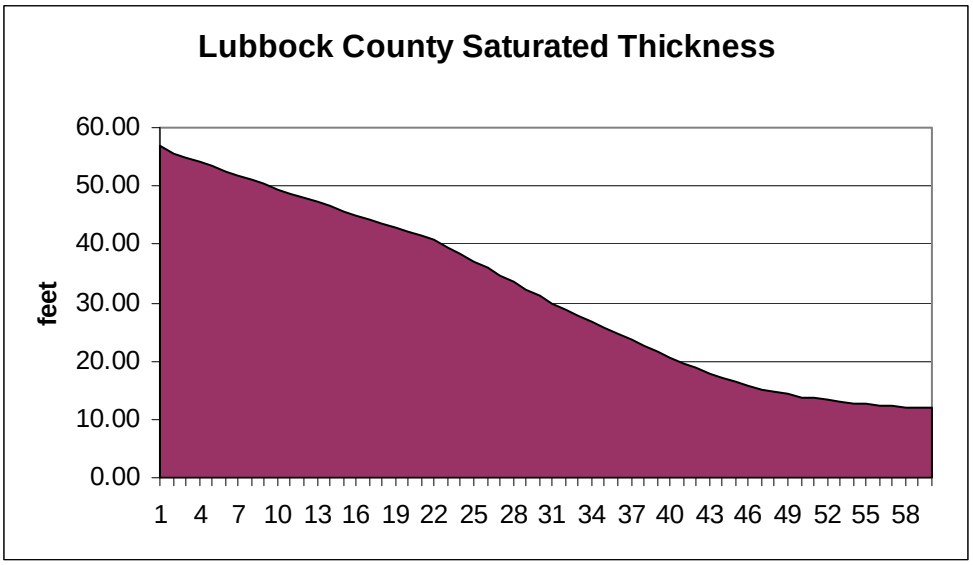

Figure 5.33. Lubbock County 6% Twenty Year Water Rights Buyout Saturated Thickness.

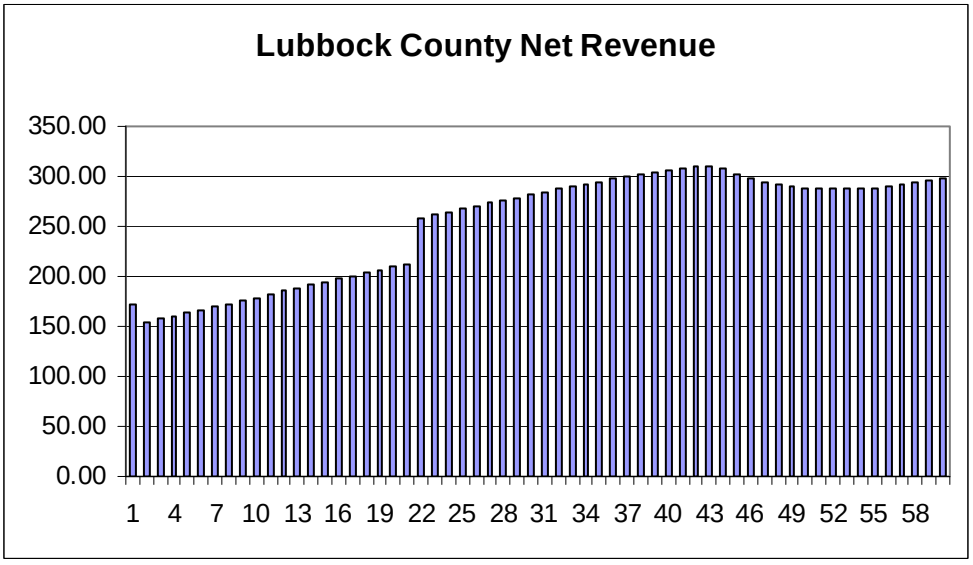

Figure 5.34. Lubbock County 6% Twenty Year Water Rights Buyout Nominal Net Return.

63.5% of cropland acres are in irrigated LEPA cotton production and 36.5% are in dyland cotton production. Due to the significant decline of the aquifer, in year forty-eight some irrigated acres are forced into dryland production. In year sixty, irrigated LEPA cotton production has decreased to 46.1% and dryland cotton production has increased to 53.9% of total cropland acres. The NPV estimation for this scenario is $3,529.82 which is 3.5% less than the ten year water rights buyout incorporating a 6% discount rate and 9.1% less than the 6% discount rate baseline scenario.

9% Discount Rate Twenty Year Water Rights Buyout: The results from this scenario are consistent with the results discussed in both the 3% and 6% discount rate twenty year water rights buyout policies. Figure 5.35 shows the saturated thickness decreases from 57.0 ft to 11.7 ft, or 45.3 ft total by year sixty. When compared to the 9% discount rate baseline scenario, this policy saves a minute 0.5 ft of saturated thickness. As expected, as the saturated thickness decreases the pump lift increases from 130.0 ft to 175.3 ft over the planning horizon.

Figure 5.36 shows the nominal net return increases from $171.44 in year one to $305.94 in year forty because of expected technological innovations included in the model. After year forty, the figure shows a drop in net return due to aquifer depletion forcing some irrigated acres into dryland production where yields and returns are usually less. The net returns recover slightly before year sixty due to the constant accumulation of technology allowing yield per acre inch of water and applied and dryland yield to increase. In year sixty, the nominal net return has recovered and is equal to $294.39.

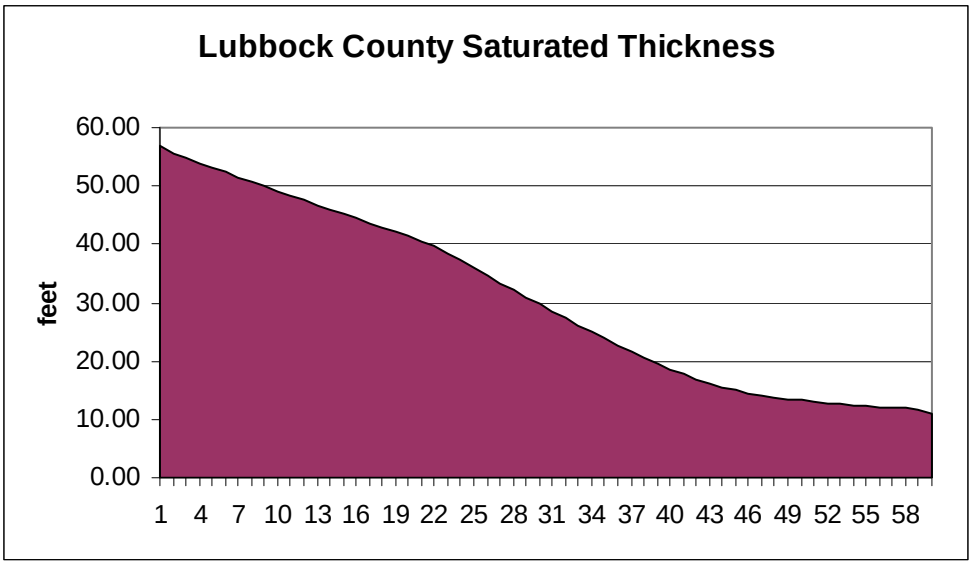

Figure 5.35. Lubbock County 9% Twenty Year Water Rights Buyout Saturated Thickness.

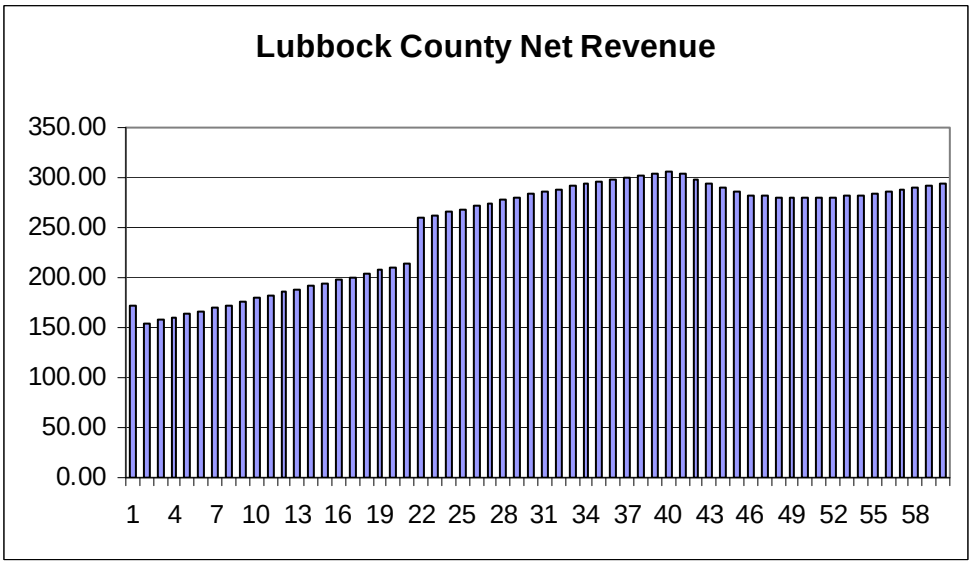

Figure 5.36. Lubbock County 9% Twenty Year Water Rights Buyout Nominal Net Return.

Unlike net returns, the cost per acre inch of water pumped increases throughout the planning horizon from $3.49 to $4.43.

During the term of the water rights buyout, the crop mix consists of 43.4% of total cropland acres in irrigated LEPA cotton production and the remaining 56.5% in dryland cotton. After the term of the buyout when enrolled acres are allowed to return to irrigated production, the crop mix switches to 63.5% of total cropland acres in irrigated LEPA cotton and 36.5% in dryland cotton. Given the declining aquifer level, that percentage of irrigation is not sustainable and irrigated acres begin to decrease by year forty-six. At the end of the planning horizon, irrigated acres have decreased to 44.5% of cropland acres with the remaining 55.5% in dryland cotton production. The NPV estimation for this scenario is $2,306.89 which is 4.0% less than the 9% discount rate ten year water rights buyout and 12.1% less than the 9% discount rate baseline scenario.

Terry County

Terry County is a relatively southern county in the study area. The county is 569,900 acres in size with 100% of the acres in the county overlying the Ogallala Aquifer. At the beginning of the planning horizon, the average saturated thickness of the aquifer underlying Terry County was 84.0 ft with a pump lift of 94.0 ft. Roughly 120,000 acres were in irrigated LEPA, 1,500 are in irrigated SDI, and the remaining 115,000 cropland acres were in dryland production. In the base year, the crop mix was primarily irrigated LEPA and dryland cotton production with a small amount of acres in wheat and grain sorghum.

3% Discount Rate Baseline Scenario: The saturated thickness depletion in Terry County is less than that seen in Lubbock County and in Floyd County. Figure 5.37 shows the saturated thickness falls a total of 37.0 ft from 84.0 ft in year one to 47.0 ft in year sixty. The pump lift increase is also relatively less than the central and northern counties increasing from only 94.0 ft in year one to 131.0 ft at the end of the planning horizon.

The nominal per acre net return is also higher in Terry County than the previous counties discussed and can be seen in Figure 5.38. At the beginning of the planning horizon the net return is $243.96. Unlike Lubbock County and Floyd County, the aquifer does not reach a point in the planning horizon where less water must be applied or irrigated acres must decrease. Due to the technological progress accumulated throughout the planning horizon, the per acre nominal net return increases to a relatively high level of $466.55 in year sixty. The pumping cost per acre inch of water applied increases throughout the planning horizon due to the increasing pump lift. The cost per acre inch of water pumped increases from $2.74 in year one to $3.51 in year sixty. The crop mix in the 3% discount rate baseline scenario is exclusively cotton production. 51.4% of cropland acres remain in irrigated LEPA cotton with the remaining 48.6% of acres in dryland cotton production throughout the planning horizon. The NPV for the scenario is estimated to be $9,599.40.

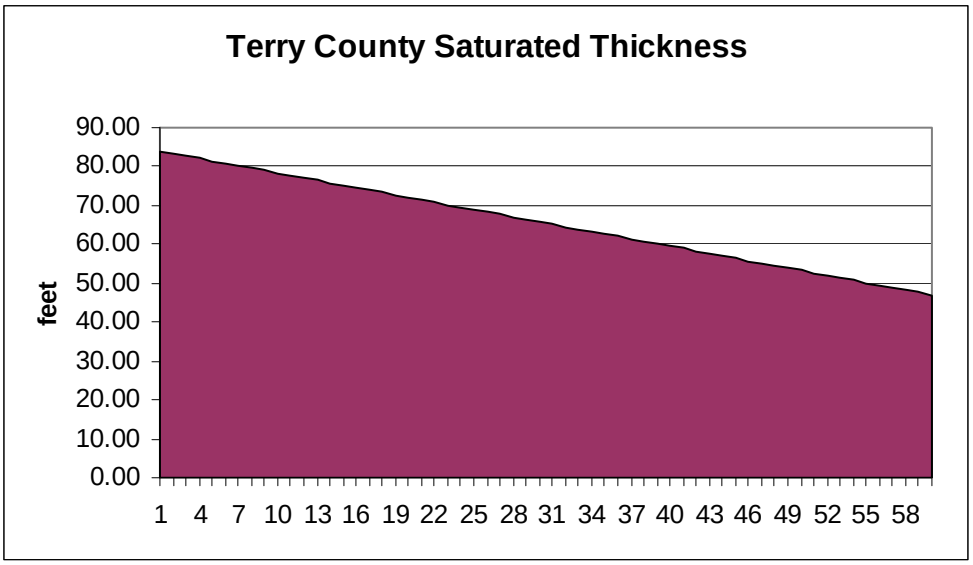

Figure 5.37. Terry County 3% Baseline Scenario Saturated Thickness.

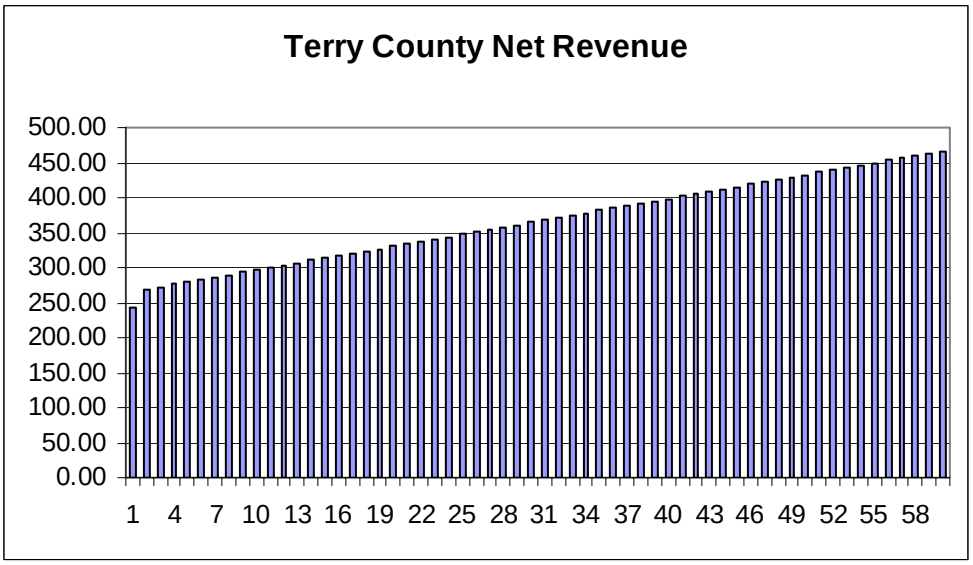

Figure 5.38. Terry County 3% Baseline Scenario Nominal Net Return.

6% Discount Rate Baseline Scenario: The baseline scenario incorporating the 6% discount rate shows a decrease in saturated thickness similar to the 3% discount rate scenario. As seen in figure 5.39, the saturated thickness declines slightly more than the 3% scenario from 84.0 ft to 46.9 ft, or 37.1 ft over sixty years. As expected the pump lift shows the expected inverse relationship with the saturated thickness decline increasing from 94.0 ft to 131.1 ft.

Figure 5.40 shows the nominal net return also increases due to technology throughout the planning horizon from $243.98 to $466.53. Additionally the pumping cost per acre inch of water applied also increases over the sixty years from $2.74 to $3.51. The crop mix is identical to that discussed in the 3% discount rate baseline scenario where 51.4% of cropland acres are in irrigated LEPA cotton production and the remaining 48.6% are in dryland cotton production. The NPV for the 6% discount rate baseline scenario is 43.9% less than the 3% baseline scenario at $5,394.57.

9% Discount Rate Baseline Scenario: The baseline scenario for Terry County incorporating the 9% discount rate again shows results consistent with those seen in previous scenarios. Figure 5.41 shows the saturated thickness decreases from 84.0 ft to 46.8 ft, or a total of 37.2 ft over sixty years. The pump lift increases over the planning horizon from approximately 94.0 ft to 131.2 ft. The nominal per acre net return increases over the sixty years due to the expected innovations in technology. As seen in Figure 5.42, the net return increases from $243.99 in year one to $466.51 in year sixty.

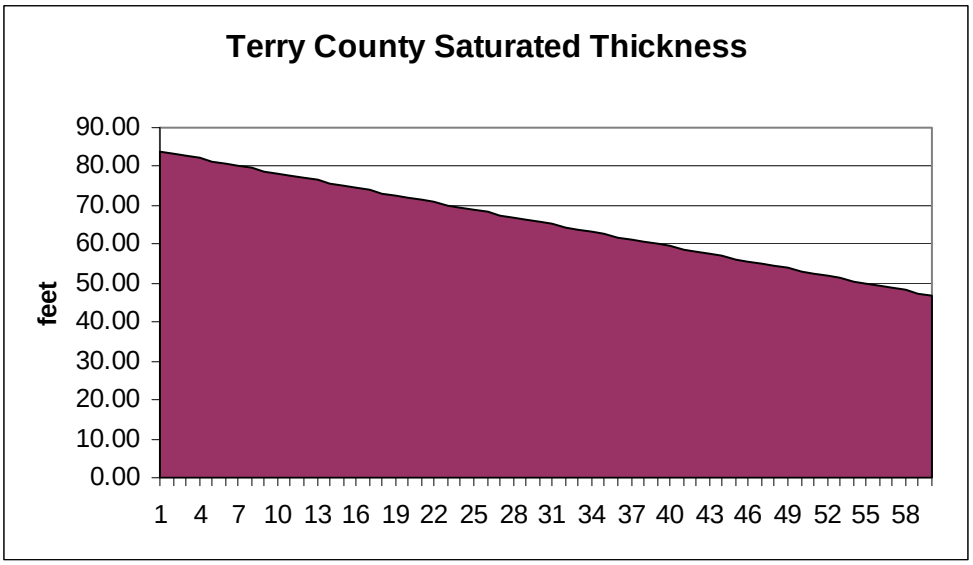

Figure 5.39. Terry County 6% Baseline Scenario Saturated Thickness.

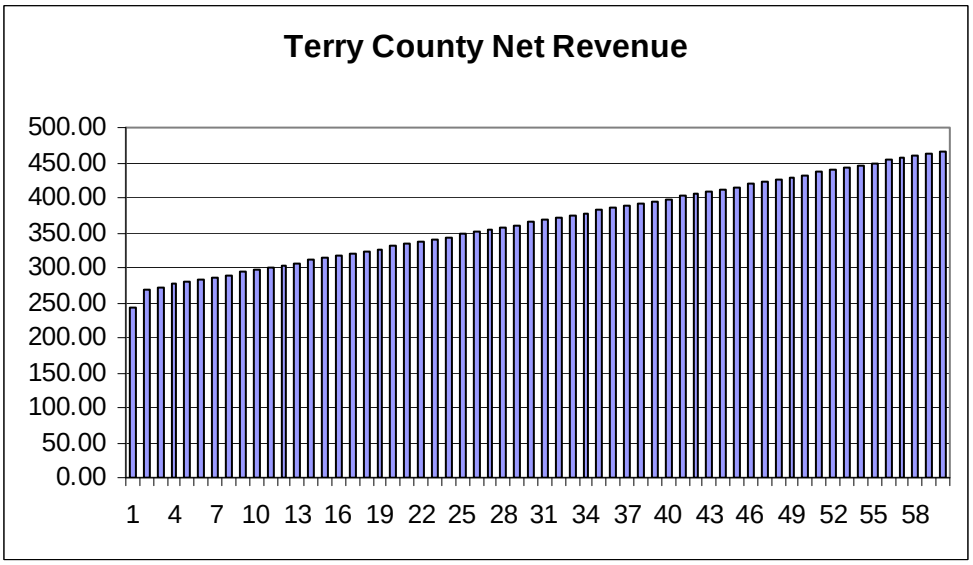

Figure 5.40. Terry County 6% Baseline Scenario Nominal Net Return.

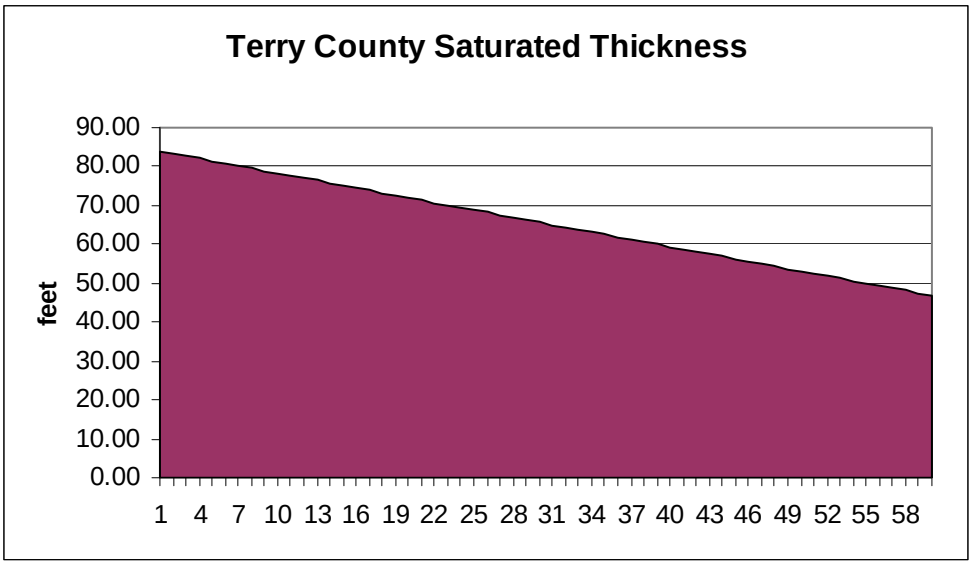

Figure 5.41. Terry County 9% Baseline Scenario Saturated Thickness.

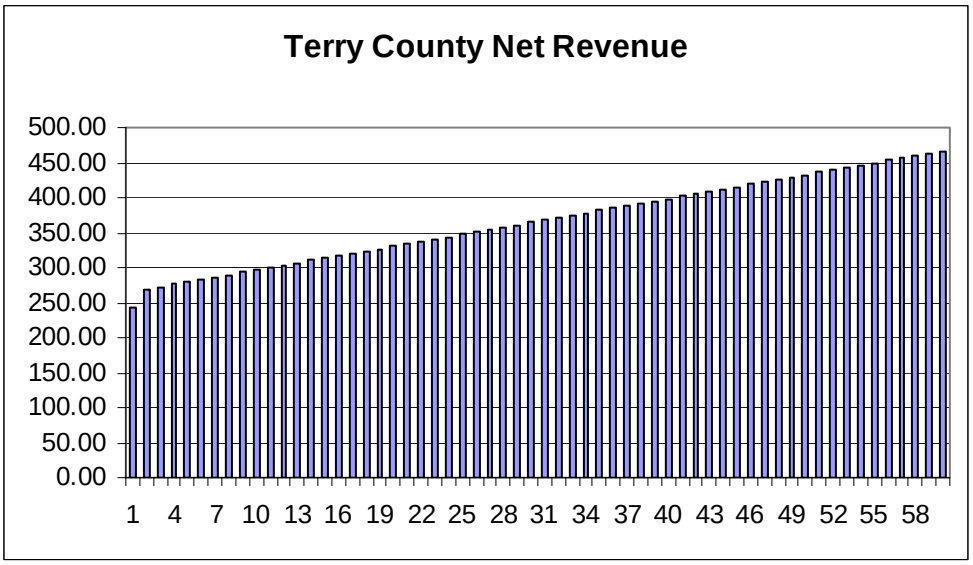

Figure 5.42. Terry County 9% Baseline Scenario Nominal Net Return.

The cost per acre inch of water pumped also increases throughout the planning horizon from $2.74 to $3.51. The crop mix for this scenario is identical to both the 3% and 6% discount rate baseline scenarios for Terry County where 51.4% of cropland in the county remains in irrigated LEPA cotton production while the remaining 48.6% remains is dryland cotton production for every year after the base year. The NPV is $3,620.91 which is 32.9% less than the 6% discount rate baseline scenario and 62.3% less than the 3% discount rate baseline scenario.

3% Discount Rate Ten Year Water Rights Buyout: The saturated thickness for this scenario shows a decline of 34.3 ft from 84.0 ft in year one to 49.7 ft in year sixty as shown in Figure 5.43. When compared with the 3% baseline scenario, there is a potential water savings of 2.7 ft of saturated thickness with this policy. As expected, as the saturated thickness decreases, the pump lift increases from 94.0 ft to 128.3 ft over the planning horizon.

Figure 5.44 shows the nominal per acre net return for this scenario. Unlike Floyd and Lubbock Counties, the net returns in Terry County do not decrease at any point during the planning horizon. The net return for this scenario increases from $243.97 in year one to $467.16 in year sixty due to technological progress. Similar to the net return, the pumping cost per acre inch of water applied also increases throughout the sixty years from $2.74 to $3.45.

The crop mix during the ten year term of the buyout shows 35.2% of cropland acres in irrigated LEPA cotton production with the remaining 64.8% in dryland cotton production. It is important to remember that the 35.2% in LEPA cotton is 25% less than

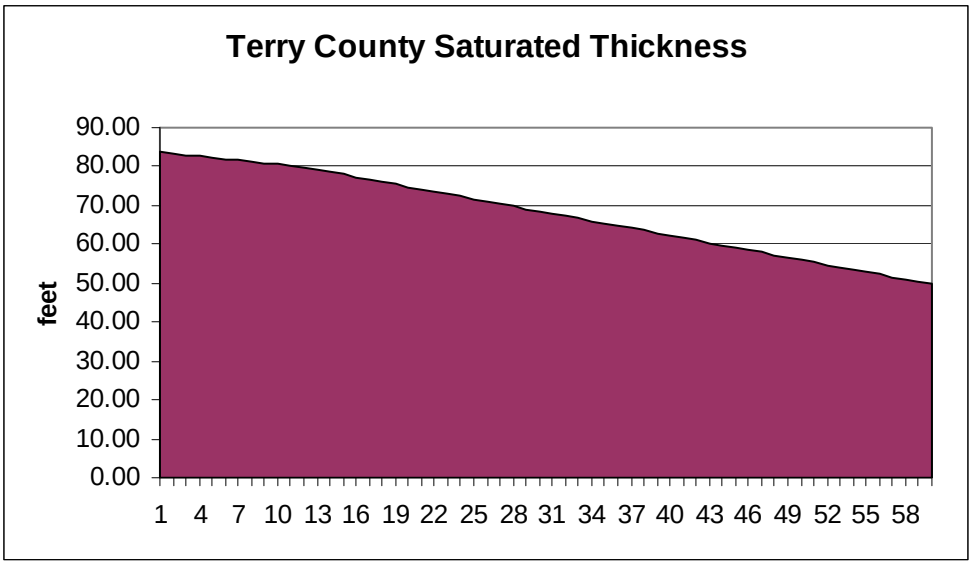

Figure 5.43. Terry County 3% Ten Year Water Rights Buyout Saturated Thickness.

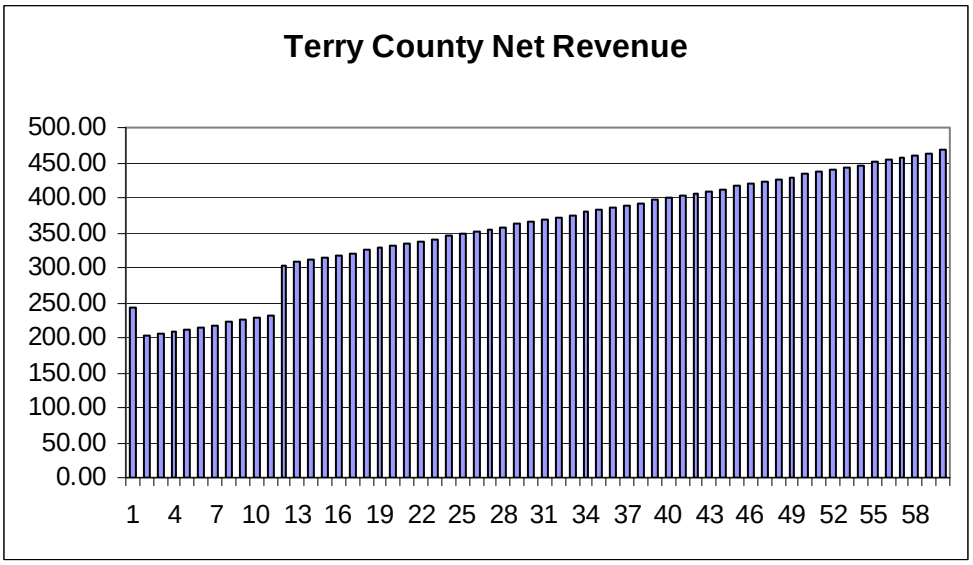

Figure 5.44. Terry County 3% Ten Year Water Rights Buyout Nominal Net Return.

the percentage of the county in irrigated production in the base year. After the term of the buyout expires, and irrigated acres are allowed to return to irrigated production, 51.4% of cropland acres are in irrigated LEPA cotton production and the remaining 48.6% of cropland acres are in dyland cotton production for the remainder of the planning horizon. The NPV estimate for this scenario is $9,033.15, or 5.9% less than the 3% discount rate baseline scenario.

6% Discount Rate Ten Year Water Rights Buyout: This scenario's results are similar to the results discussed in the previous scenario. Figure 5.45 shows the saturated thickness in this scenario declines from 84.0 ft in year one to 49.6 ft after sixty years. The total depletion is 34.4 ft which means there is a potential water savings of 2.8 ft when compared to the 6% discount rate baseline scenario. The pump lift in this scenario increases from 94.0 ft to 128.4 ft as the saturated thickness declines.

The nominal per acre net return can be seen in Figure 5.46 where it increases throughout the planning horizon from $243.99 to $467.14 due to technological progress. Along with the per acre net return, the pumping cost per acre inch of water applied also increases throughout the planning horizon from $2.74 to $3.46. The crop mix for this scenario is identical to that of the previous scenario where 35.2% of cropland acres in irrigated LEPA cotton production with the remaining 64.8% in dryland cotton production during the term of the buyout. After the term of the buyout has expired and enrolled acres are allowed to return to irrigated production, 51.4% of cropland acres are in irrigated LEPA cotton production and the remaining 48.6% are in dyland cotton

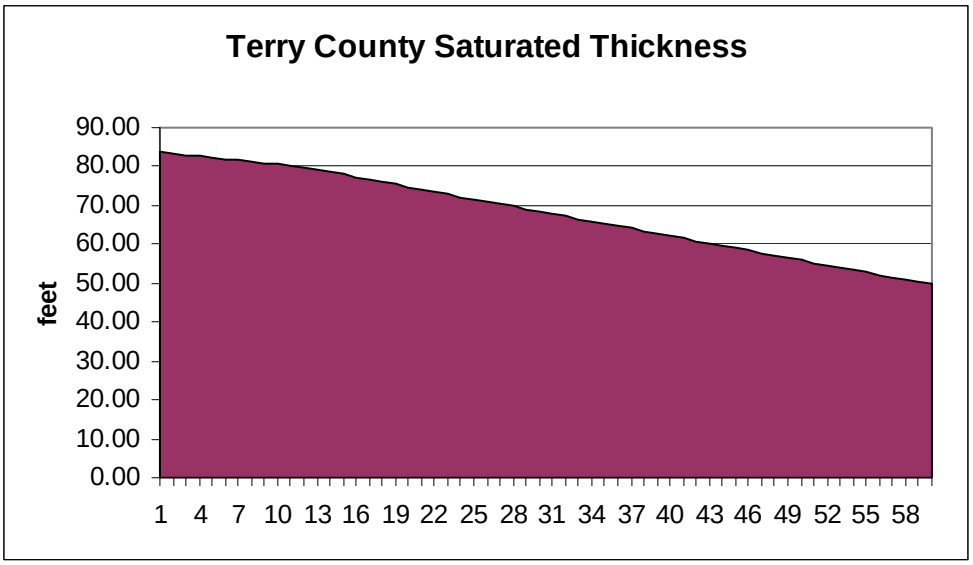

Figure 5.45. Terry County 6% Ten Year Water Rights Buyout Saturated Thickness.

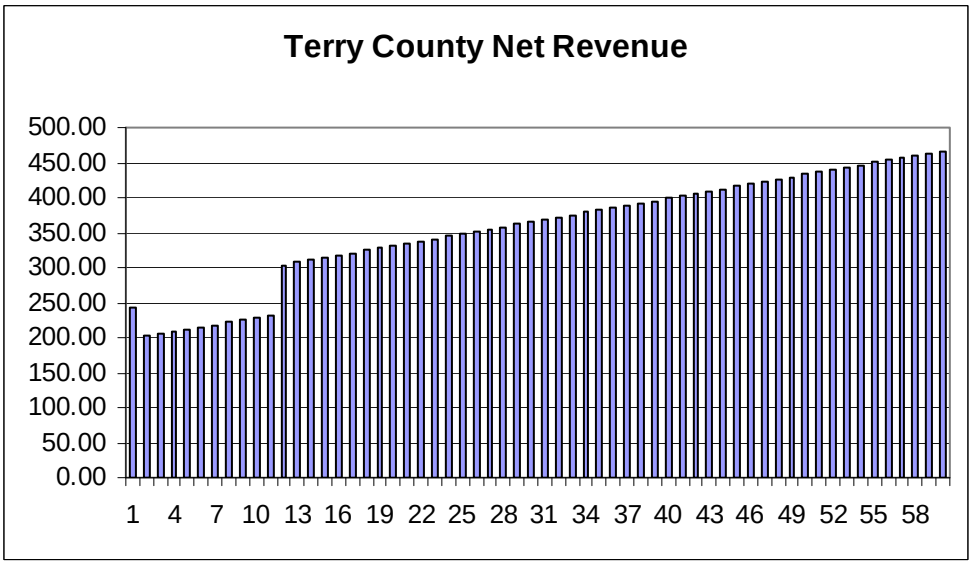

Figure 5.46. Terry County 6% Ten Year Water Rights Buyout Nominal Net Return.

production for the remainder of the sixty years. The NPV for this scenario is $4,901.76, or 9.2% less than the corresponding baseline scenario incorporating a 6% discount rate.

9% Discount Rate Ten Year Water Rights Buyout: The saturated thickness of the aquifer under this scenario shows a decline from 84.0 ft in year one to 49.6 ft at the end of the planning horizon as shown in Figure 5.47. The total depletion is 34.4 ft which means there is a potential water savings of 2.8 ft relative to the 9% discount rate baseline scenario. As expected with a decline in the saturated thickness, the pump lift increases over the planning horizon from 94.0 ft to 128.4 ft.

The nominal per acre net return in this scenario is similar to both of the previous scenarios discussed for the ten year buyout in Terry County in that the returns do not decrease at any point during the planning horizon due to relatively higher levels of saturated thickness and increases in technological innovations. Figure 5.48 shows that the net return increases from $243.99 to $467.13 over the sixty years. The cost per acre inch of water applied also increases throughout the planning horizon from $2.74 to $3.46.

The crop mix in this scenario is also identical to that of both previous scenarios discussed due to the fact the aquifer does not reach a point in the planning horizon where irrigated acres are forced into dryland production. 35.2% of cropland acres are in irrigated LEPA cotton production with the remaining 64.8% in dryland cotton production during the term of the buyout. After the term of the buyout has expired and enrolled acres are allowed to return to irrigated production, 51.4% of cropland acres are in irrigated LEPA cotton production and the remaining acres are in 48.6% are in dyland

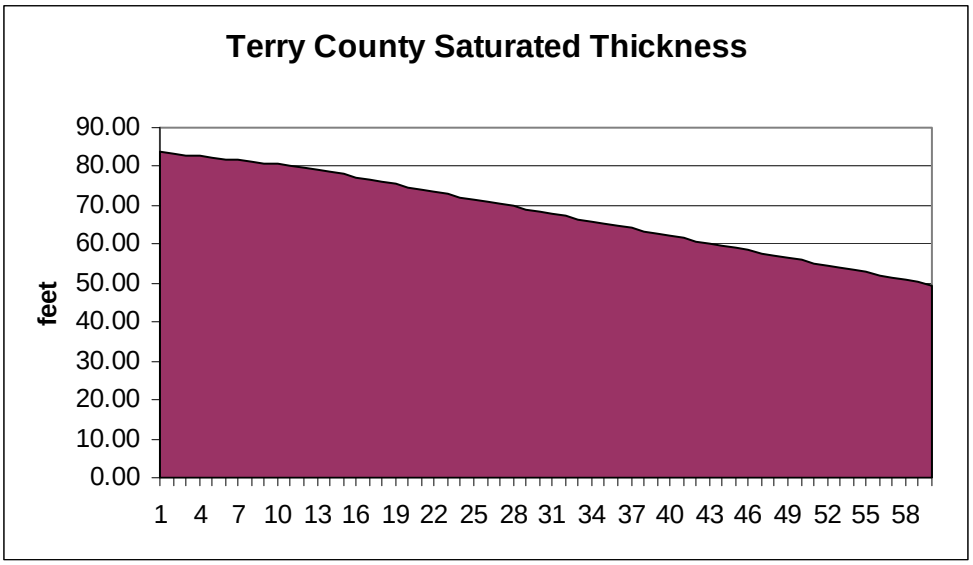

Figure 5.47. Terry County 9% Ten Year Water Rights Buyout Saturated Thickness.

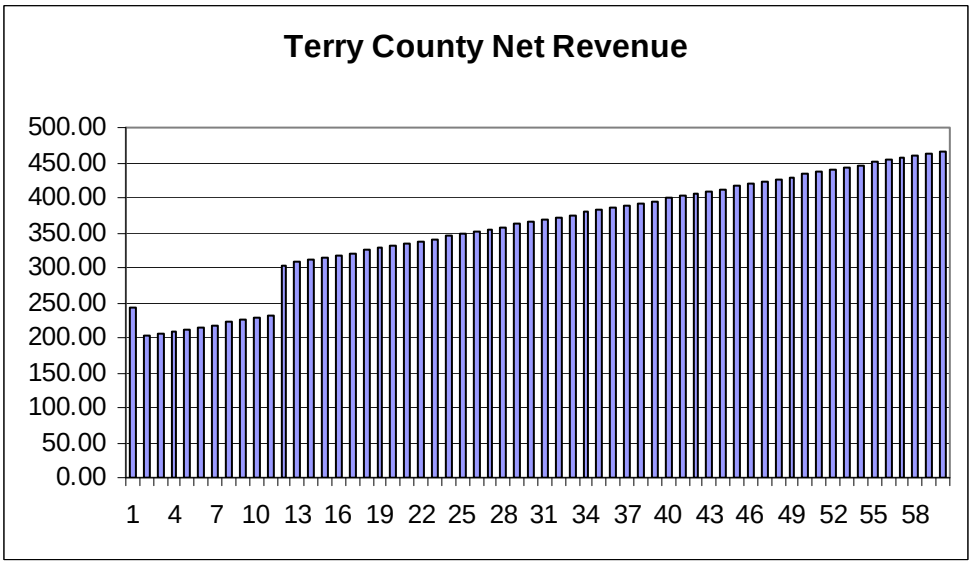

Figure 5.48. Terry County 9% Ten Year Water Rights Buyout Nominal Net Return.

cotton production for the remainder of the sixty years. The NPV for this scenario is $3,189.72 which is 12.0% lower than the 9% baseline scenario NPV.

3% Discount Rate Twenty Year Water Rights Buyout: In this scenario, results are similar to those in the previously discussed ten year water rights buyout scenarios, but at lower levels of saturated thickness depletion and NPV. This scenario, which incorporates a 3% discount rate, shows a saturated thickness drawdown of 31.5 ft from 84.0 ft in year one to 52.5 ft in year sixty as shown in Figure 5.49. When compared to the 3% discount rate baseline scenario, this policy saves approximately 5.5 ft of saturated thickness. As the saturated thickness declines over the sixty year planning horizon, the pump lift increases from 94.0 ft to 125.5 ft.

Figure 5.50 shows the nominal per acre net return for the scenario. The net return increases throughout the planning horizon due to technological progress from $243.97 in year one to $467.77 in year sixty. The pumping cost per acre inch of water applied also increases throughout the sixty year from $2.74 to $3.40. The crop mix for this scenario shows that during the twenty year term of the buyout when 25% of irrigated acres are converted to dryland production, 35.2% of total cropland acres are in irrigated LEPA cotton production and the remaining 64.8% are in dryland cotton production. After the term of the buyout expires and enrolled acres are allowed to return to irrigated production, 51.4% of cropland acres are in irrigated LEPA cotton production and the remaining 48.6% are in dryland cotton production for the remainder of the planning horizon. The NPV for this scenario is $8,589.54 which is 10.6% less than the 3% discount rate baseline scenario and 5.0% less than the 3% discount rate ten year water rights buyout.

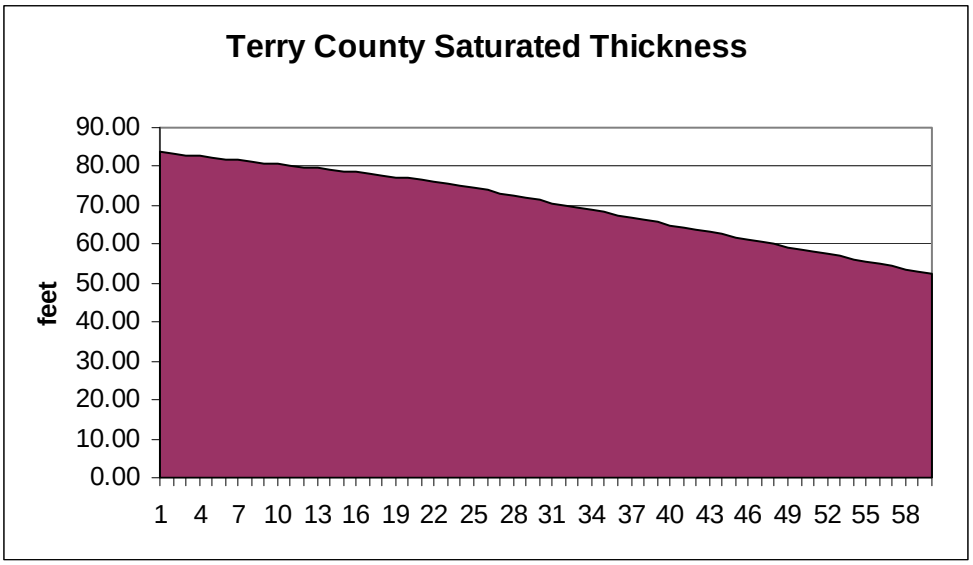

Figure 5.49. Terry County 3% Twenty Year Water Rights Buyout Saturated Thickness.

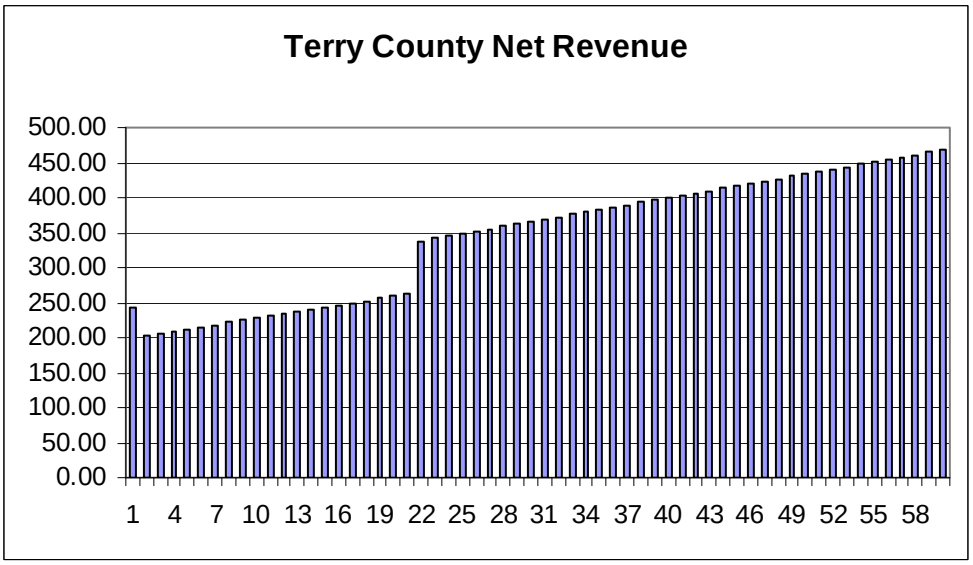

Figure 5.50. Terry County 3% Twenty Year Water Rights Buyout Nominal Net Return.

6% Discount Rate Twenty Year Water Rights Buyout: This scenario shows results similar to the results seen in the previous scenario. Figure 5.51 shows that the saturated thickness of the aquifer under this scenario decreases from 84.0 ft in the first year to 52.4 ft in year sixty. The total decline under this scenario is 31.6 ft or 5.5 ft less drawdown than the 6% discount rate baseline scenario. As expected, the pump lift increases throughout the planning horizon due to the declining saturated thickness. Specifically, the pump lift increases from 94.0 ft to 125.6 ft at the end of the planning horizon.

Figure 5.52 shows the nominal per acre net return over the planning horizon for this scenario. The figure shows that the net return increases from $243.99 to $467.75 due to technological innovations increasing yields. The cost per acre inch also increases from $7.60 to $7.74 throughout the sixty years due to declining saturated thickness levels. The crop mix is identical to that seen in the previous scenario where 35.2% of total cropland acres are in irrigated LEPA cotton production and the remaining 64.8% are in dryland cotton production. After the term of the buyout has expired and enrolled acres return to irrigated production, 51.4% of cropland acres are in irrigated LEPA cotton production and the remaining 48.6% are in dryland cotton production for the remainder of the planning horizon. The NPV for this scenario is $4,612.62. The NPV estimate is 5.9% less than the 6% discount rate ten year water rights buyout and 14.5% less than the 6% discount rate baseline scenario.

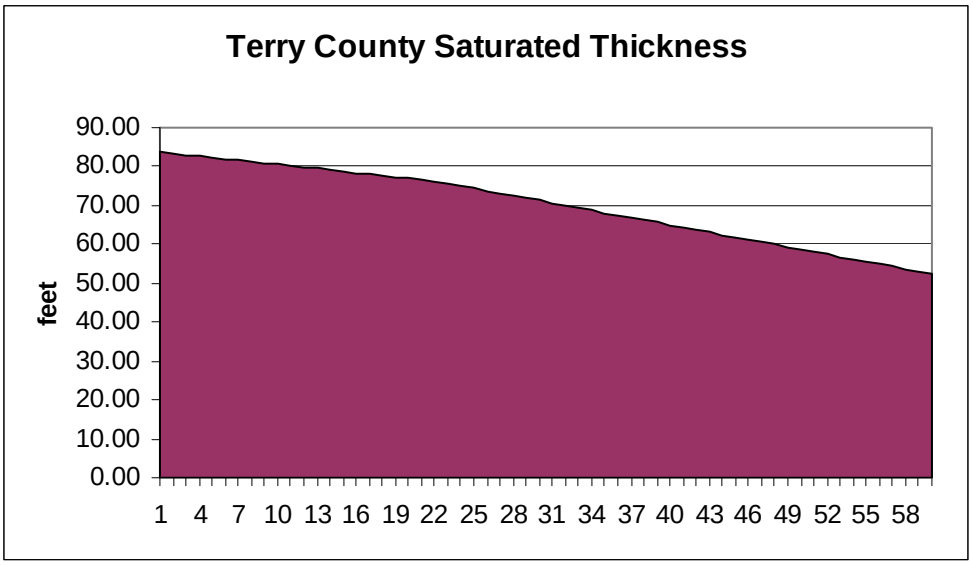

Figure 5.51. Terry County 6% Twenty Year Water Rights Buyout Saturated Thickness.

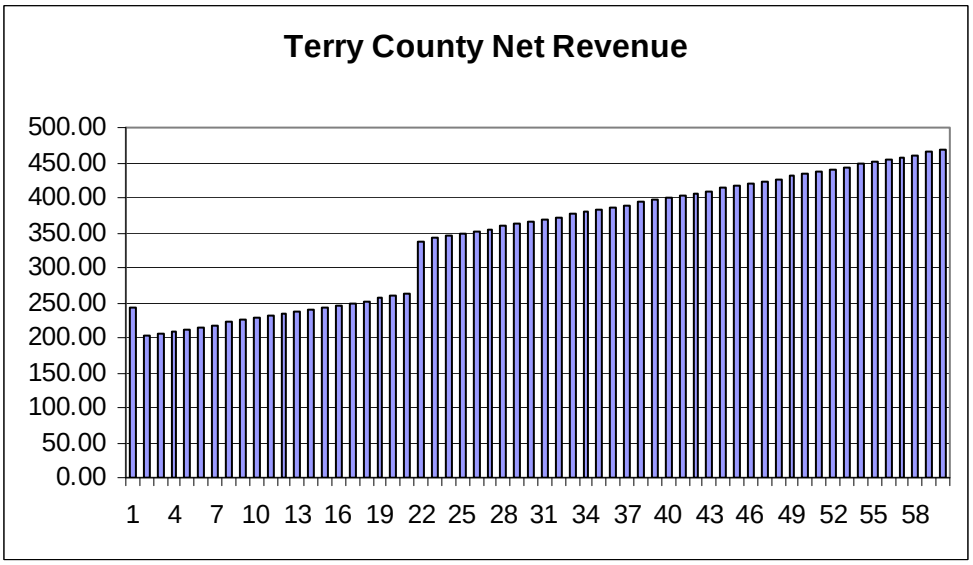

Figure 5.52. Terry County 6% Twenty Year Water Rights Buyout Nominal Net Return.

9% Discount Rate Twenty Year Water Rights Buyout: In this scenario, the saturated thickness of the aquifer falls from 84.0 ft 52.4 ft, or 31.6 ft total over the planning horizon (see Figure 5.53). As the saturated thickness falls, the pump lift increases from 94.0 ft to 125.7 ft over sixty years. The nominal net return increases throughout the planning horizon similar to the previous twenty year buyout policies discussed for Terry County. Specifically, Figure 5.54 shows that the net return increases from $243.99 to $467.74 due to technological progress. As expected, as aquifer drawdown increases, the pumping cost per acre inch increases through time. The cost per acre inch pumped in this scenario increases from $2.74 to $3.40.

The crop mix in this scenario is identical to the two previous twenty year buyout scenarios discussed for this county because the aquifer does not reach a point during the planning horizon where irrigated acres are forced into dryland production. In this scenario, 35.2% of total cropland acres are in irrigated LEPA cotton production and the remaining 64.8% are in dryland cotton production. After the term of the twenty year buyout has expired, and enrolled acres are allowed to return to irrigated production, 51.4% of cropland acres are in irrigated LEPA cotton production and the remaining 48.6% are in dryland cotton production for the remainder of the planning horizon. The NPV estimate for this scenario is $2,998.45. The estimate is 6.0% less than the 9% discount rate ten year water rights buyout and 15.2% less than the 9% discount rate baseline scenario.

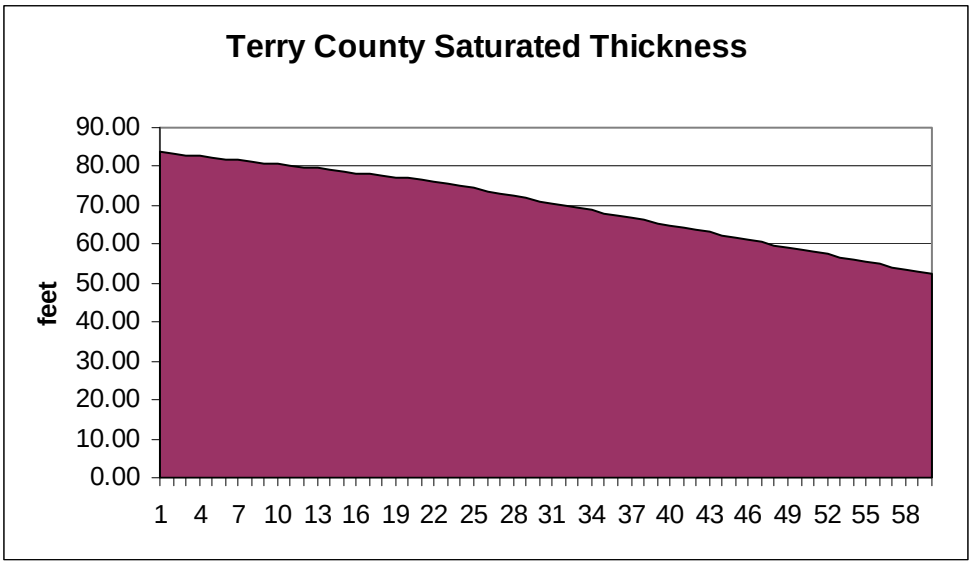

Figure 5.53. Terry County 9% Twenty Year Water Rights Buyout Saturated Thickness.

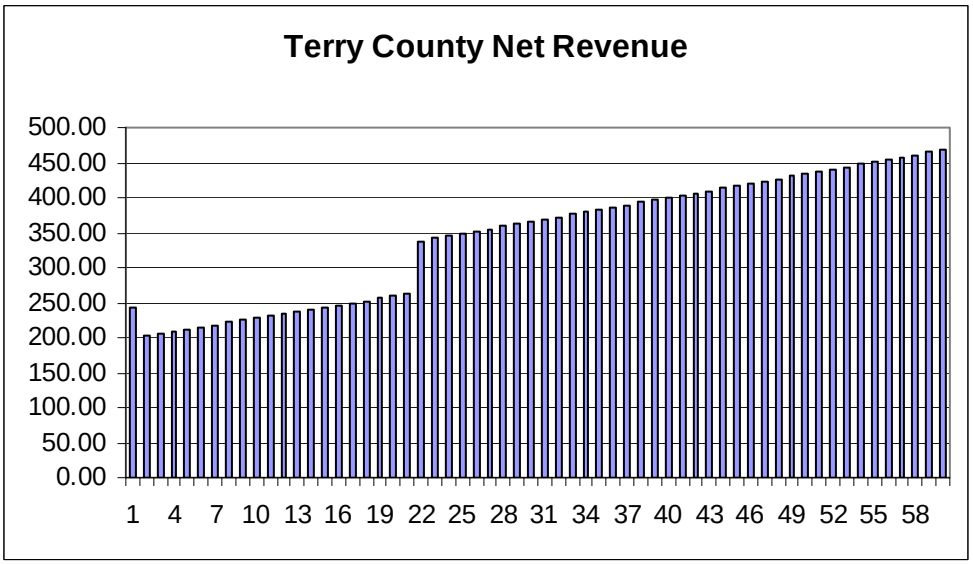

Figure 5.54. Terry County 9% Twenty Year Water Rights Buyout Nominal Net Return.

Comparison of Discount Rates

As discussed previously, the discount rate chosen plays a critical role in the outcome of policy scenarios. The discount rate is never actually known, but in general we know that producers have a higher discount rate than society. In previous studies a blanket discount rate of 3% has been used for analysis because it is thought to be somewhere between society's discount rate and the producer's discount rate. A producer's discount rate is higher than society's discount rate because producers are short-term profit maximizers; therefore they value short-term profit over water being available in the future. Conversely, society's discount is considered much lower because they value water availability for future generations more than short-term profit. It is important to remember however that in the case of the Texas High Plains, due to the Rule of Capture producers have the right to pump all water underlying their land. Due to the Rule of Capture, a policy scenario using an average discount rate of 3% may or may not accurately represent future aquifer and revenue conditions.

Results were discussed above for both the baseline scenarios and the two policy scenarios for Floyd, Lubbock, and Terry Counties incorporating three discount rates (3%, 6%, and 9%) in order to evaluate the role the chosen discount rate has on NPV and aquifer drawdown. The results show that there is a marginal difference in aquifer drawdown for the varying rates of discount used; however, the results show that there is a slightly higher level of water use in the early years of the planning horizon with higher discount rates. In most cases, the difference in drawdown is less than 1.0 ft of saturated thickness between the 3% discount rate and the 9% discount rate.

Figure 5.55 however shows that water used per irrigated acre varies for the three discount rates. The figure shows the per acre inch of water used for the 3%, 6%, and 9% discount rate's baseline scenarios for Lubbock County. It is evident from the figure that the higher the discount rate, the more water used in the early years of the planning horizon. Conversely, the lower the discount rate the less water used in early years. The higher discount rate scenario exhausts the aquifer more quickly causing the lines on the graph to cross around year thirty-five. Around year forty-four the aquifer has reached a point under all three discount rates in which water use is equal. In other words, the lower the discount rate, the less water used initially, but more is used further into the planning horizon. The higher the discount rate, more water is used in early years, but due to the more rapid aquifer decline, less is used comparatively in latter years. As expected however, there is a vast difference in the NPV depending on the discount rate chosen. In general, the 6% discount rate NPV is approximately 40% less than the 3% discount rate NPV, and the 9% discount rate NPV is approximately 30% less than the 6% discount rate NPV and 60% less than the 3% discount rate NPV.

The results show that the evaluation of the policies is affected by the discount rate chosen, but the effect is primarily seen in the NPV and not in the estimated aquifer drawdown. Though the overall goal of the policies is water conservation, the affect on NPV is also extremely important. It is important to remember that the water pumped in these counties is owned by the producers, and the producers will have to be compensated for enrolling acres in a water rights buyout program. Therefore, the NPV tells not only the discounted revenue that will be accumulated over the planning horizon, but the difference between baseline NPV and a water policy scenario NPV gives us a proxy of

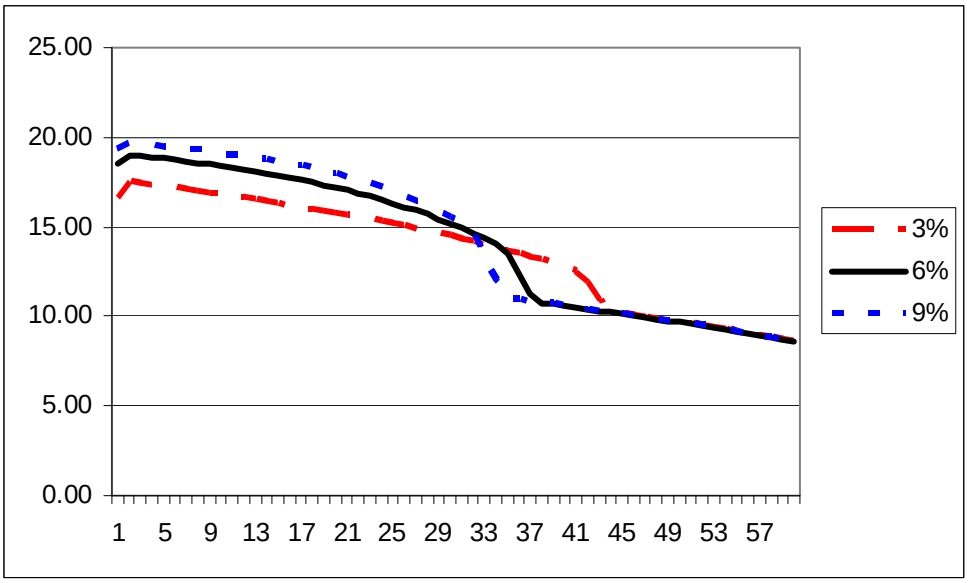

Figure 5.55. Lubbock County Baseline Acre Inches of Water Used Per Irrigated Acre by Year for 3%, 6%, and 9% discount rates.

the level of compensation necessary for producers enroll an acre in a respective buyout program.

In reality, the discount rate will never be truly known; therefore it is important when conducting NPV analyses such as this to estimate scenarios using varying discount rates to give policy makers a probable range of potential water savings and cost of potential water conservation policies. Though the results can seem quite repetitive at times, the more information decision makers have made available to them, the better decisions they can make to conserve water and the maintain the viability of the agriculturally-dependent regional economy.

Effects of Technology

Unlike previous naïve studies forecasting aquifer drawdown and NPV which ignore the effects of technology, this study included a technological advancement parameter in order to incorporate those effects into forecasted results. As previously discussed, the technological advancement coefficient was estimated for each county by averaging the respective crop and system twenty-six year historical yield data. The respective yield average was then multiplied by 1.67% which is the most recent ERS estimated rate of growth in agricultural output from 1948-2006 (Fugile, MacDonald, and Ball, 2007).

The results show that because of the constant accumulation of technology through time, per acre net returns are able to increase through much of the planning horizon in many counties and through the entire scope of the planning horizon in higher saturated thickness counties such as Terry County. The results in Lubbock County show that even

in the face of significant aquifer depletion in latter years in the planning horizon, per acre net returns are able to recover due to the increases in technology in dryland production and in irrigated yield per acre inch of water applied. This differs from similar previous studies without the technological advancement parameter including Wheeler (2005) where per acre net returns fall throughout much of the planning horizon due to declining water availability. The increasing per acre net returns seen throughout the planning horizon in this study also indicate that by enrolling acres in a ten or twenty year water rights buyout program and using the water in later periods when the advancements in technology can be taken advantage of, may not only conserve water during that period, but may allow the water to be used more efficiently at a higher economic value after the buyout has expired.

Comparison of Policies

The two policies evaluated for this study included a ten year water rights buyout policy and a twenty year water rights buyout policy. In the respective policies, 25% of base year irrigated acres were converted into dryland production during the term of the respective buyout. The results show that in general the twenty year water rights buyout policies saved more water for a lower cost per foot of saturated thickness conserved. It is important to point out that nowhere in the model were producers compensated for the reduction in water. Rather the difference in the baseline NPV and the policy NPV is assumed to be a proxy of how much producers may have to be compensated to conserve the water for either ten or twenty year terms.

For the 3% discount rate, the results for Floyd County show that the ten year water rights buyout policy saved a total of 2.3 ft of saturated thickness at a cost of $186.54 per foot. The twenty year water rights buyout policy saved 5.6 ft of saturated thickness at a lower cost of $143.14 per foot conserved. Similarly in Lubbock County for the 3% discount rate, the ten year buyout saved 0.4 ft of saturated thickness at a cost of $445.80 and the twenty year buyout saved 0.9 ft of saturated thickness at a cost of $352.70. Lastly, in the Terry County scenarios using a 3% discount rate, the ten year buyout saved 2.7 ft of saturated thickness at a cost of $209.72 and the twenty year buyout saved 5.5 ft of saturated thickness at a lower cost of $183.61 as shown in Tables 5.2 – 5.4. The results using both the 6% and 9% discount rates show similar results. The results for the 9% discount rate can be seen in Tables 5.5-5.7.

Water conservation is achieved in both policy scenarios; however, the twenty year water rights buyout policy conserves more water at a lower cost per foot of saturated thickness conserved. The overall cost of the policy is more for the twenty year buyout because producers must be compensated for not irrigating for twice as many years when compared to the ten year buyout policy. The best policy depends on the specific conservation needs of the specific county in question. The results indicate that neither of these two policies is restrictive enough to achieve significant water savings for Lubbock County. Conversely, Floyd and Terry Counties could capture significant water savings at a relatively low cost with either policy. The best policy in those counties may be determined by the amount of funds available for a conservation policy or the greater need for more restrictive and costly buyout options in counties such as Lubbock.

Table 5.2. Floyd County 3% Discount Rate Year 60 Conditions

	Baseline	10 Yr Buyout	20 Yr Buyout
ST	23.4	25.7	29.0
Pump Lift	278.6	276.4	273.0
$/AC Net Return	370.17	389.08	406.30
Pump Cost $/AC IN	6.58	6.53	6.46
NPV $	7,900.50	7,471.45	7,098.92
Cost $/Ft Conserved	N/A	186.54	143.14

Table 5.3. Lubbock County 3% Discount Rate Year 60 Conditions

	Baseline	10 Yr Buyout	20 Yr Buyout
ST	11.6	12.0	12.5
Pump Lift	175.4	175.0	174.5
$/AC Net Return	293.73	298.61	305.34
Pump Cost $/AC IN	4.43	4.42	4.41
NPV $	6,819.45	6,641.13	6,502.02
Cost $/Ft Conserved	N/A	445.80	352.70

Table 5.4. Terry County 3% Discount Rate Year 60 Conditions

	Baseline	10 Yr Buyout	20 Yr Buyout
ST	47.0	49.7	52.5
Pump Lift	131.0	128.3	125.5
$/AC Net Return	466.6	467.2	467.77
Pump Cost $/AC IN	3.51	3.45	3.40
NPV $	9,599.40	9,033.15	8,589.54
Cost $/Ft Conserved	N/A	209.72	183.61

Table 5.5. Floyd County 9% Discount Rate Year 60 Conditions

	Baseline	10 Yr Buyout	20 Yr Buyout
ST	22.1	24.6	28.4
Pump Lift	279.9	277.4	273.7
$/AC Net Return	357.33	380.63	404.30
Pump Cost $/AC IN	6.60	6.55	6.47
NPV $	2,909.97	2,541.56	2,370.31
Cost $/Ft Conserved	N/A	148.55	85.52

Table 5.6. Lubbock County 9% Discount Rate Year 60 Conditions

	Baseline	10 Yr Buyout	20 Yr Buyout
ST	11.2	11.4	11.7
Pump Lift	175.8	175.6	175.3
$/AC Net Return	288.70	290.92	294.39
Pump Cost $/AC IN	4.44	4.44	4.43
NPV $	2,624.93	2,402.43	2,306.89
Cost $/Ft Conserved	N/A	1171.05	676.68

Table 5.7. Terry County 9% Discount Rate Year 60 Conditions

	Baseline	10 Yr Buyout	20 Yr Buyout
ST	46.8	49.6	52.5
Pump Lift	131.2	128.4	125.7
$/AC Net Return	466.5	467.13	467.74
Pump Cost $/AC IN	3.51	3.46	3.40
NPV $	3,620.91	3,189.72	2,998.45
Cost $/Ft Conserved	N/A	154.00	108.63

Comparison of Regions

As mentioned previously, the results for the study region can be divided into three sub-groups; the northern sub-group including Floyd, Hale, and Lamb Counties, the central sub-group including Cochran, Hockley, and Lubbock Counties, and the southern sub-group including Gaines, Terry, and Yoakum Counties.

Northern Sub-Group: The northern-sub region including Floyd, Hale, and Lamb Counties shows that in the 3% discount rate baseline scenario, the saturated thickness is depleted from approximately 70.0 ft in year one to approximately 25.0 ft at the end of the planning horizon. On average the water rights buyout policies show that up to 5.0 ft of saturated thickness can be saved allowing water applied per irrigated acre and net returns to remain high further into the future relative to the baseline scenario. The crop-mix for the counties in this sub-group show Hale and Lamb Counties are exclusively in cotton production and Floyd County produces irrigated cotton and dryland grain sorghum throughout the planning horizon.

Central Sub-Group: The results discussed above for select counties show that the greatest depletion of the aquifer is seen in the central sub-group. In the 3% discount rate baseline scenario Cochran, Hockley, and Lubbock Counties show that the saturated thickness in those counties is depleted to 15.0 ft, 9.8 ft, and 11.6 ft respectively. The results for both the ten year and twenty year water rights buyout policies for these counties indicate very little water savings at the end of the planning horizon. In year sixty using the 3% discount rate twenty year water rights buyout, Cochran County saturated thickness is 16.2 ft, Hockley County saturated thickness is 10.7, and Lubbock County saturated thickness is 12.5 ft.

The counties in this sub-group have a relatively low starting saturated thickness and a high percentage of acres are irrigated throughout the planning horizon. Though the water rights buyout policies did conserve some water, these counties' saturated thickness is still depleted to levels that likely warrant a more restrictive water conservation policy than those discussed in this study. The crop mix for the counties in the central sub-region are exclusively cotton producers throughout the planning horizon.

Southern Sub-Group: The southern sub-region including Gaines, Terry, and Yoakum Counties overall have the highest beginning saturated thickness. Yoakum County, which is on the western edge of the aquifer, has the lowest beginning saturated thickness in this group at 57.0 ft and Gaines and Terry Counties have a beginning saturated thickness of close to 80.0 ft. In the baseline scenario incorporating a 3% discount rate, the aquifer is depleted to less than 30.0 ft only in Yoakum County. The twenty year water rights buyout policy incorporating a 3% discount rate shows that 5.0 ft of saturated thickness is saved in both Terry and Yoakum Counties and 12.0 ft of saturated thickness is saved in Gaines County, the southern sub-region's highest water use county.

The crop-mix in the southern sub-region is the most interesting of the three sub-groups. Terry County produces exclusively cotton throughout the planning horizon. Gaines County produces irrigated cotton throughout, dryland livestock through year five, and dryland cotton in years six through sixty. Yoakum County produces irrigated cotton throughout, dryland livestock through year eleven, dryland grain sorghum in years twelve through forty-six, and dryland cotton in years forty-seven through sixty.

CHAPTER VI

SUMMARY & CONCLUSIONS

Summary

The Ogallala Aquifer is a vast resource underlying parts of eight states. The southern portion of the Ogallala Aquifer is considered to be an exhaustible resource due to the relatively low level of recharge compared to the quantities of water pumped annually for the production of agricultural commodities. As the resource continues to be depleted, policy makers in several states including Texas are considering water conservation legislation. Society is likely to benefit more from water conservation policies in certain high water use counties which are rapidly depleting the saturated thickness of the aquifer, rather than a policy for the region as a whole. Thus, nine counties in the Southern sub-region which were identified by Wheeler (2005) as the counties in the region which are expected to drawdown the aquifer to less than 30 ft of saturated thickness over the next sixty years are the focus of this study. These Texas counties include: Cochran, Floyd, Gaines, Hale, Hockley, Lamb, Lubbock, Terry, and Yoakum. These counties accounted for 1,243,800 irrigated cotton acres, 25,800 irrigated grain sorghum acres, and 38,400 irrigated wheat acres in 2006 (National Agricultural Statistics Service, 2006).

The water conservation policies considered in this study include a ten year water rights buyout policy and a twenty year water rights buyout policy. The two policy scenarios require that 25% of a county's irrigated acreage be transitioned into dryland production for the respective term of the buyout. After the term of the buyout has

expired, enrolled acres are allowed to return to irrigated production. The basis for the two policy scenarios is the Conservation Reserve Program (CRP) policy enacted for soil conservation, but with a goal of water conservation.

The models developed for this study were county level non-linear dynamic optimization models. Baseline scenario models where no change is made to current water policy were estimated along with the ten year and twenty year water rights buyout policy scenarios for three discount rates (3%, 6%, and 9%) in order to evaluate the role the chosen discount rate has on the net present value of net returns (NPV) and aquifer drawdown. The models used county average yields, estimated crop production functions, county average hydrologic parameters, and estimated technological advancement parameters to determine the optimal levels of saturated thickness, annual net revenue per acre, pump lift, water applied per cropland acre, cost of pumping, and NPV over a sixty year planning horizon.

The models differ from previous studies conducted on the Ogallala Aquifer due to the technological advancement parameters included. The technological coefficients were estimated for each county by averaging the respective crop and system twenty-six year historical yield data then multiplying the figure by 1.67% which is the most recent ERS estimated rate of growth in agricultural output from 1948-2006 (Fugile, MacDonald, and Ball, 2007).

Policy Implications

The results of the policy scenarios show that though water conservation was captured with both the ten and twenty year water rights buyout policies, the twenty year

water rights buyout policy saved more water for a lower cost per foot of saturated thickness conserved relative to the ten year water rights buyout policy. While the twenty year water rights buyout policy saves more water than the ten year water rights buyout policy, it has a more dramatic decrease in NPV compared to the ten year buyout scenario. Since producers are not directly compensated in the model for the decreased water usage, the difference between a respective policy NPV and the baseline NPV may be used as a proxy for the amount producers would have to be compensated to enroll an acre in the program. Therefore, the smaller NPV estimated in the twenty year buyout causes the projected overall cost of the policy to be more for the twenty year buyout.

In the central region of the study area including Cochran, Hockley and Lubbock Counties even the twenty year water rights buyout is not restrictive enough to conserve significant amounts of water during the sixty year planning horizon. Cochran, Hockley, and Lubbock Counties showed a saturated thickness level in year sixty under the twenty year water rights buyout policy of 16.2 ft, 10.7 ft, and 12.5 ft respectively.

Therefore the results of the study indicate that for counties with relatively high initial saturated thickness levels and relatively low percentage of cropland acres in irrigated production, both the ten and twenty year water rights buyout policies conserve significant saturated thickness in the aquifer. The twenty year water rights buyout conserves more water than the ten year buyout at a lower cost per foot of saturated thickness. When comparing the total cost of the policies based on the decrease in NPV from the baseline, the twenty year water rights buyout policy is more expensive than the ten year buyout policy. In the counties with the most significant depletion, neither of the two policies evaluated in this study are restrictive enough to achieve significant

conservation. Policies that further limit water use will likely be necessary to keep those counties from reaching economic depletion within sixty years.

Conclusions

Though there have been studies surrounding the possible depletion of the Ogallala Aquifer since the 1960's, it seems as though now is the time when policy makers and producers alike are beginning to understand and realize the reality of impending depletion and what it would mean for agriculture, regional economies, and society as a whole. This study examined two voluntary incentive based policies which could feasibly be implemented under current Texas water law. The study shows that the longer term twenty-year water rights buyout is likely a more efficient and effective water conservation tool than the ten year water rights buyout for the Southern High Plains of Texas, but it will not be sufficient for all counties facing depletion.

Overall the regional results indicate that the policy scenarios discussed achieve their goal of water conservation in all but the central sub-region. The central sub-region has a relatively low level of saturated thickness in the base year likely due to the vast amount of irrigation development seen in those counties over the last fifty years. The relatively low level of saturated thickness combined with the high percentage of the counties currently being irrigated causes aquifer depletion to be high in those counties compared to the northern and southern counties. It is possible that the counties in the central sub-region will require a more restrictive conservation policy than the northern and southern sub-region counties will warrant.

In most counties the twenty year water rights buyout policy conserved enough water during the term of the buyout to allow irrigated practices to continue further into the future than in the baseline with no policy and in the ten year buyout policy. The twenty year water rights buyout policy allowed the water to remain in the aquifer twice as long allowing technological progress to accumulate and the water to be used more efficiently in the future. The most appropriate policy will depend on the specific conservation needs of the county in question. Neither of two policy scenarios evaluated is likely restrictive enough to achieve significant water savings for the central counties showing the most significant drawdown. Conversely, counties with higher initial saturated thickness levels such as Floyd and Terry Counties could capture significant water savings at a relatively low cost with either policy.

Limitations

The biggest limitation of the study is likely the fact that the model uses county average hydrologic data including saturated thickness, pump lift, gross pumping capacity, specific yield, and acres served per irrigation well. Averaging saturated thickness for example across a county may lead to the assumption that none of the county has adequate water for irrigation, when a portion of the country actually is relatively heavily irrigated. Some counties lying on the outer edges of the aquifer such as Yoakum County have little to no irrigation in certain areas of the county and significant irrigation in others. For the purposes of this study however it was unfeasible obtain more precise hydrologic characteristics.

Production functions were for each county estimated using data from the crop simulation software CROPMAN which was based on only one weather station in the county and the most predominant soil type in a county. Actual county average crop yields were also used for dryland crops, but in many counties yields can vary greatly from one area of a county to another. There was also some difficulty in finding certain data for sub-surface drip irrigation (SDI). NASS only separates acres into dryland or irrigated and no other data on the exact amount of SDI in counties was available. Therefore, county extension agents and other county officials were relied upon for many county SDI acreage estimations which may or may not be accurate.

Additionally Texas Agricultural Extension Service cost of production budgets do not exist for SDI in the Southern High Plains of Texas. Therefore, the sprinkler irrigated budgets were used for SDI and LEPA. Finally, costs of production and commodity prices were assumed to remain constant over the sixty year planning horizon which, given the recent dramatic increases in both costs of production and commodity prices may no longer be a justifiable assumption in analyses such as this.

Recommendations for Future Research

The recommendations for future research come directly from the limitations of this study. Averaging hydrologic characteristics of the aquifer and land use characteristics across counties may give us an idea of current and future conditions, but more specific estimations are likely needed. By integrating economic models such as the one used here and more sophisticated hydrologic models researchers may be able to better determine what areas of the aquifer need conservation policies and how the aquifer

and overlying acres will be affected by certain conservation efforts. Target areas for conservation likely do not coincide with governmental boundaries such as counties and states. By gathering more specific hydrologic and land use data, water conservation policies can likely be implemented more effectively and efficiently to conserve the aquifer where it is needed the most.

The assumption that the electricity price from which the pumping cost is determined will remain constant over sixty years when it has increased roughly 33% over the last five years likely needs to be changed. Similar trends are seen in the prices of certain commodities. The dramatic increase in recent years in certain crop prices and costs of production may warrant a growth function for the parameters to be included in future studies. The parameters could be similar to the new technological advancement parameter included in this model where the growth rate through time is based on the historic increase of the respective prices over time.

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APPENDIX A

COUNTY TOTAL LAND AREA AND AREA OVERLYING THE OGALLALA AQUIFER

Table A.1. County Acreages

County	Land Area Acres	Acres Overlying Aquifer
Cochran	496,000	496,000
Floyd	634,880	584,089
Gaines	961,280	961,280
Hale	643,200	643,200
Hockley	581,120	581,120
Lamb	650,240	650,240
Lubbock	575,360	575,360
Terry	569,600	569,600
Yoakum	521,000	521,000

APPENDIX B

COUNTY PRODUCTION FUNCTION PARAMETERS

$$YIELD = B0 + B1WATER - B2WATER^2$$

Table B.1. Cochran County PF

LEPA Yield Response to Applied Water

CROP	B0*	B1**	B2	R^2
Cotton	399	77.7 (5.9)	-1.79 (.18)	0.976
Corn	0	0	0	0
Peanuts	0	302.7 (10.8)	-4.24 (.27)	0.995
Sorghum	2800	404 (16.26)	-6.0 (.49)	0.996
Wheat	16	9.3 (.70)	-0.22 (.03)	0.97

SDI Yield Response to Applied Water

	B0*	B1**	B2	R^2
Cotton	399	79.0 (9.8)	-2.1 (.39)	0.982
Corn	0	0	0	0
Peanuts	0	241 (10.8)	-3.4 (.27)	0.993
Sorghum	2800	499 (12.7)	-9 (.44)	0.998
Wheat	16	9.0 (.95)	-0.23(.04)	0.975

**Standard Errors Appear in Parenthesis Next to Coefficients
*B0 = Actual Dryland Yield

Table B.2. Floyd County PF

LEPA Yield Response to Applied Water

CROP	B0*	B1**	B2	R^2
Cotton	402	93.0 (4.3)	-1.8 (.12)	0.994
Corn	0	0	0	0
Peanuts	0	0	0	0
Sorghum	4400	269 (.35)	-3.0 (1.0)	0.979
Wheat	17	10.0 (.75)	-0.23 (.02)	0.976

SDI Yield Response to Applied Water

	B0*	B1**	B2	R^2
Cotton	402	90.0 (8.1)	-2.2 (.32)	0.987
Corn	0	0	0	0
Peanuts	0	0	0	0
Sorghum	4400	373 (14.6)	-7.0 (5.9)	0.998
Wheat	17	12.6 (1.6)	-045 (.09)	0.97

**Standard Errors Appear in Parenthesis Next to Coefficients
*B0 = Actual Dryland Yield

Table B.3. Gaines County PF

LEPA Yield Response to Applied Water

CROP	B0*	B1**	B2	R^2
Cotton	397	84.0 (13.5)	-3.1 (.64)	0.936
Corn	0	0	0	0
Peanuts	0	235.2 (2.7)	-3.2 (.07)	0.999
Sorghum	2200	368 (40.8)	-7.0 (1.6)	0.979
Wheat	19	7.0 (.57)	-0.2 (.03)	0.992

SDI Yield Response to Applied Water

	B0*	B1**	B2	R^2
Cotton	397	73.0 (12.5)	-2.1 (.59)	0.961
Corn	0	0	0	0
Peanuts	0	206.5 (4.8)	-2.8 (.12)	0.998
Sorghum	2200	434 (15.6)	-9.0 (6.3)	0.997
Wheat	19	6.4 (.33)	-1.6 (.01)	0.994

**Standard Errors Appear in Parenthesis Next to Coefficients
*B0 = Actual Dryland Yield

Table B.4. Hale County PF

LEPA Yield Response to Applied Water

CROP	B0*	B1**	B2	R^2
Cotton	429	92.7 (5.5)	-1.8 (.16)	0.991
Corn	0	0	0	0
Peanuts	0	0	0	0
Sorghum	3400	339.0 (39.1)	-4.0 (1.2)	0.981
Wheat	19	9.67 (.57)	-0.22 (.02)	0.984

SDI Yield Response to Applied Water

	B0*	B1**	B2	R^2
Cotton	429	86.0 (4.5)	-2.1 (.18)	0.995
Corn	0	0	0	0
Peanuts	0	0	0	0
Sorghum	3400	567.0 (13.8)	-9.0 (.4)	0.998
Wheat	19	10.1 (1.24)	-0.28 (.05)	0.962

**Standard Errors Appear in Parenthesis Next to Coefficients
*B0 = Actual Dryland Yield

Table B.5. Hockley County PF

LEPA Yield Response to Applied Water

CROP	B0*	B1**	B2	R^2
Cotton	401	92.0 (7.8)	-2.4 (.31)	0.986
Corn	0	0	0	0
Peanuts	0	319.1 (36.1)	-4.6 (.23)	0.998
Sorghum	3500	319 (36.1)	-4.0 (1.1)	0.98
Wheat	21	9.38 (.56)	-0.25 (.02)	0.991

SDI Yield Response to Applied Water

	B0*	B1**	B2	R^2
Cotton	401	85.0 (8.1)	-1.9 (.32)	0.988
Corn	0	0	0	0
Peanuts	0	202.0 (16.4)	-2.2 (.28)	0.972
Sorghum	3500	418.0 (14.0)	-7.0 (.48)	0.998
Wheat	21	10.5 (.86)	-0.34 (.04)	0.99

**Standard Errors Appear in Parenthesis Next to Coefficients
*B0 = Actual Dryland Yield

Table B.6. Lamb County PF

LEPA Yield Response to Applied Water

CROP	B0*	B1**	B2	R^2
Cotton	492	67.0 (5.6)	-1.8 (.19)	0.971
Corn	0	0	0	0
Peanuts	0	0	0	0
Sorghum	4100	320.0 (38.8)	-4.6 (1.3)	0.976
Wheat	22	3.0 (.64)	-0.05 (.02)	0.966

SDI Yield Response to Applied Water

	B0*	B1**	B2	R^2
Cotton	492	71.0 (6.7)	-1.7 (.32)	0.991
Corn	0	0	0	0
Peanuts	0	0	0	0
Sorghum	4100	250.0 (25.6)	-3.6 (.8)	0.99
Wheat	22	3.17 (.53)	-0.05 (.02)	0.989

**Standard Errors Appear in Parenthesis Next to Coefficients
*B0 = Actual Dryland Yield

Table B.7. Lubbock County PF

LEPA Yield Response to Applied Water

CROP	B0*	B1**	B2	R^2
Cotton	443	78.2 (3.8	-1.7 (.11)	0.992
Corn	0	0	0	0
Peanuts	0	0	0	0
Sorghum	3400	308.0 (33.2)	-4.0 (1.0)	0.981
Wheat	19	8.63 (.47	-0.19 (.01)	0.987

SDI Yield Response to Applied Water

	B0*	B1**	B2	R^2
Cotton	443	77.3 (6.1)	-2.1 (.29)	0.995
Corn	0	0	0	0
Peanuts	0	0	0	0
Sorghum	3400	427.0 (14.4)	-8.0 (.5)	0.998
Wheat	19	11.4 (1.1)	-0.37 (.06)	0.985

**Standard Errors Appear in Parenthesis Next to Coefficients
*B0 = Actual Dryland Yield

Table B.8. Terry County PF

LEPA Yield Response to Applied Water

CROP	B0*	B1**	B2	R^2
Cotton	419	159.2 (44.3)	-5.1 (2.1)	0.88
Corn	0	0	0	0
Peanuts	0	275.2 (10.1)	-4.1 (.27)	0.997
Sorghum	2800	415.0 (31.2)	-8.0 (1.2)	0.99
Wheat	22	10.6 (.78)	-0.34 (.04)	0.991

SDI Yield Response to Applied Water

	B0*	B1**	B2	R^2
Cotton	419	92.0 (18.4)	-2.6 (.87)	0.952
Corn	0	0	0	0
Peanuts	0	236.0 (12.8)	-3.2 (.38)	0.993
Sorghum	2800	496.0 (18.6)	-11.0(.7)	0.997
Wheat	22	9.8 (.83)	-0.32 (.04)	0.989

**Standard Errors Appear in Parenthesis Next to Coefficients
*B0 = Actual Dryland Yield

Table B.9. Yoakum County PF

LEPA Yield Response to Applied Water

CROP	B0*	B1**	B2	R^2
Cotton	316	96.1 (15.8)	-2.7 (.63)	0.938
Corn	0	0	0	0
Peanuts	0	302.8 (7.1)	-4.8 (.21)	0.999
Sorghum	3200	382.0 (34.7)	-6.0 (1.2)	0.985
Wheat	21	8.2 (1.4)	-0.23 (.08)	0.968

SDI Yield Response to Applied Water

	B0*	B1**	B2	R^2
Cotton	316	97.5 (20.8)	-2.6 (.99)	0.952
Corn	0	0	0	0
Peanuts	0	259.0 (6.4)	-4.1 (.19)	0.998
Sorghum	3200	462.0 (6.6)	-9.0 (.2)	0.999
Wheat	21	8.2 (.67)	-0.22 (.003)	0.983

**Standard Errors Appear in Parenthesis Next to Coefficients

*B0 = Actual Dryland Yield

APPENDIX C

COUNTY HYDROLOGIC PARAMETERS

Table C.1. County Hydrologic Parameters

County	Recharge in/ac	Pump Lift	Saturated Thickness	Well Yield	Acres Per Well	Specific Yield
	Primary + Secondary	Feet	Feet	GPM		
Cochran	3.2703	143	35	200	43	0.150
Floyd	3.7007	226	76	800	47	0.154
Gaines	2.8199	106	80	800	31	0.159
Hale	6.0132	218	72	750	56	0.157
Hockley	2.6634	127	40	300	25	0.149
Lamb	4.049	170	66	600	47	0.156
Lubbock	3.3196	130	57	600	29	0.156
Terry	2.2011	94	84	800	49	0.151
Yoakum	2.3621	94	54	500	48	0.154

APPENDIX D

PRICES AND COSTS OF PRODUCTION

BY CROP AND SYSTEM

Table D.1. Commodity Prices and Costs of Production

Units	Units	Cotton lb/ac	Grain Sorghum lb/ac	Peanuts lb/ac	Wheat bu/ac
Harvest Cost	$/unit	0.0653	0.0093	0.0475	0.84
Variable Cost Dryland	$/ac	159	66	n/a	59
Additional Variable Cost for Irrigation	$/ac	98	70	349	52
Commodity Price	$/unit	0.57	0.043	0.19	3.56

APPENDIX E

INITIAL ACREAGES BY CROP AND IRRIGATION SYSTEM

Table E.1. Cochran County AC.

	Initial Acreages		
CROP	LEPA	SDI	Dryland
Cotton	53,425	3,500	40,700
Corn	0	0	0
Peanuts	9,500	0	0
Sorghum	13,425	0	20,850
Wheat	3,100	0	4,825

Table E.2. Floyd County AC.

	Initial Acreages		
CROP	LEPA	Furrow	Dryland
Cotton	51,375	10,000	41,950
Corn	0	0	0
Peanuts	0	0	0
Sorghum	27,850	0	16,925
Wheat	5,625	0	39,100

Table E.3. Gaines County AC.

	Initial Acreages		
CROP	LEPA	Furrow	Dryland
Cotton	158,050	200	64,375
Corn	0	0	0
Peanuts	62,200	0	0
Sorghum	3,550	0	4,900
Wheat	20,025	0	4,625

Table E.4. Hale County AC.

	Initial Acreages		
CROP	LEPA	Furrow	Dryland
Cotton	196,375	10,000	22,875
Corn	0	0	0
Peanuts	0	0	0
Sorghum	34,000	0	6,350
Wheat	17,350	0	11,975

Table E.5. Hockley County AC.

	Initial Acreages		
CROP	LEPA	Furrow	Dryland
Cotton	114,100	5,000	96,500
Corn	0	0	0
Peanuts	6,300	0	0
Sorghum	16,166	0	17,366
Wheat	1,050	0	1,575

Table E.6. Lamb County AC.

	Initial Acreages		
CROP	LEPA	Furrow	Dryland
Cotton	117,350	5,000	33,525
Corn	0	0	0
Peanuts	0	0	0
Sorghum	28,900	0	14,550
Wheat	7,025	0	10,325

Table E.7. Lubbock County AC.

	Initial Acreages		
CROP	LEPA	Furrow	Dryland
Cotton	144,675	5,000	74,700
Corn	0	0	0
Peanuts	0	0	0
Sorghum	11,825	0	11,325
Wheat	2,625	0	4,925

Table E.8. Terry County AC.

	Initial Acreages		
CROP	LEPA	Furrow	Dryland
Cotton	107,675	1,500	100,125
Corn	0	0	0
Peanuts	0	0	0
Sorghum	2,925	0	8,275
Wheat	7,275	0	2,025

Table E.9. Yoakum County AC.

	Initial Acreages		
CROP	LEPA	Furrow	Dryland
Cotton	59,700	500	44,650
Corn	0	0	0
Peanuts	21,033	0	0
Sorghum	1,700	0	12,250
Wheat	6,750	0	2,825

APPENDIX F

TECHNOLOGICAL COEFFICIENTS

Table F.1. County Technological Parameters

County	DRY COTTON (LB)	DRY WHEAT (BU)	DRY GS (LB)	PEANUTS (LB)	IRR GS (LB)	IRR WHEAT (BU)	IRR COTTON (LB)
Cochran	4.41	0.27	49.00	43.00	94.00	0.53	8.17
Floyd	5.05	0.29	64.00	0.00	123.00	0.62	9.12
Gaines	4.70	0.29	45.00	57.00	88.00	0.61	10.33
Hale	5.61	0.32	58.00	47.00	129.00	0.72	10.29
Hockley	4.76	0.28	52.00	51.00	91.00	0.55	8.42
Lamb	5.79	0.31	56.00	38.00	112.00	0.75	9.94
LBK	5.24	0.30	54.00	43.00	94.00	0.56	8.41
Terry	4.74	0.33	49.00	4.00	91.00	0.60	9.17
Yoakum	4.77	0.30	45.00	54.00	91.00	0.67	9.66

APPENDIX G

3% DISCOUNT RATE

GENERAL DATA COUNTY RESULTS

Section 1: Baseline Scenario General Data

Table G.1. Cochran County General Data

Period	Saturated Thickness Feet	Pump Lift Feet	GPC Acre in.	Nominal Net Return ($/Acre)	Average Water Applied Per Cropland Acre (in.)	Nominal Pumping Cost ($/Acre in.)
1	35.00	143.00	20.56	98.50	9.03	3.76
2	34.39	143.61	19.85	136.84	9.10	3.77
3	33.78	144.22	19.15	139.17	9.06	3.79
4	33.17	144.83	18.47	141.49	9.01	3.80
5	32.57	145.43	17.80	143.80	8.96	3.81
6	31.97	146.03	17.15	146.60	8.91	3.82
7	31.38	146.62	16.52	149.47	8.86	3.84
8	30.79	147.21	15.91	152.33	8.81	3.85
9	30.21	147.79	15.31	155.18	8.76	3.86
10	29.63	148.37	14.73	158.00	8.70	3.87
11	29.06	148.94	14.17	160.82	8.65	3.88
12	28.49	149.51	13.63	163.61	8.59	3.90
13	27.93	150.07	13.10	166.39	8.53	3.91
14	27.38	150.62	12.58	169.15	8.47	3.92
15	26.83	151.17	12.08	171.90	8.41	3.93
16	26.29	151.71	11.60	174.62	8.34	3.94
17	25.76	152.24	11.14	177.31	8.28	3.95
18	25.23	152.77	10.69	179.99	8.21	3.96
19	24.72	153.28	10.25	182.63	8.14	3.97
20	24.20	153.80	9.83	185.25	8.07	3.98
21	23.70	154.30	9.43	187.85	8.00	4.00
22	23.20	154.80	9.03	190.41	7.92	4.01
23	22.71	155.29	8.66	192.94	7.84	4.02
24	22.23	155.77	8.30	195.43	7.76	4.03
25	21.76	156.24	7.95	197.89	7.68	4.04
26	21.30	156.70	7.61	200.31	7.60	4.04
27	20.84	157.16	7.29	200.49	7.29	4.05
28	20.42	157.58	7.00	200.53	7.00	4.06
29	20.03	157.97	6.73	200.64	6.73	4.07
30	19.66	158.34	6.49	200.84	6.49	4.08
31	19.33	158.67	6.27	201.15	6.27	4.09
32	19.01	158.99	6.06	201.59	6.06	4.09
33	18.72	159.28	5.88	202.15	5.88	4.10
34	18.44	159.56	5.71	202.87	5.71	4.10
35	18.19	159.81	5.55	203.75	5.55	4.11
36	17.95	160.05	5.40	204.77	5.40	4.11
37	17.72	160.28	5.27	205.92	5.27	4.12
38	17.51	160.49	5.15	207.19	5.15	4.12
39	17.31	160.69	5.03	208.56	5.03	4.13
40	17.13	160.87	4.92	210.04	4.92	4.13
41	16.96	161.04	4.82	211.61	4.82	4.14
42	16.79	161.21	4.73	213.27	4.73	4.14
43	16.64	161.36	4.65	215.01	4.65	4.14
44	16.49	161.51	4.57	216.83	4.57	4.14
45	16.36	161.64	4.49	218.72	4.49	4.15
46	16.23	161.77	4.42	220.67	4.42	4.15
47	16.11	161.89	4.35	222.69	4.35	4.15
48	15.99	162.01	4.29	224.76	4.29	4.15
49	15.89	162.11	4.24	226.90	4.24	4.16
50	15.79	162.21	4.18	229.08	4.18	4.16
51	15.69	162.31	4.13	231.32	4.13	4.16
52	15.60	162.40	4.08	233.61	4.08	4.16
53	15.51	162.49	4.04	235.94	4.04	4.16
54	15.43	162.57	4.00	238.33	4.00	4.17
55	15.36	162.64	3.96	240.75	3.96	4.17
56	15.28	162.72	3.92	243.22	3.92	4.17
57	15.22	162.78	3.89	245.73	3.89	4.17
58	15.15	162.85	3.85	248.28	3.85	4.17
59	15.09	162.91	3.82	250.88	3.82	4.17
60	15.03	162.97	3.79	253.51	3.79	4.17

Net Present Value of Net Returns (NPV)/Acre $5,137.66

Table G.2. Floyd County General Data

Period	Saturated Thickness Feet	Pump Lift Feet	GPC Acre in.	Nominal Net Return ($/Acre)	Average Water Applied Per Cropland Acre (in.)	Nominal Pumping Cost ($/Acre in.)
1	76.00	226.00	75.23	129.89	9.62	5.48
2	75.26	226.74	73.77	217.16	11.69	5.50
3	74.26	227.74	71.83	220.34	11.67	5.52
4	73.26	228.74	69.91	223.53	11.66	5.54
5	72.27	229.73	68.03	226.71	11.64	5.56
6	71.27	230.73	66.17	229.89	11.63	5.58
7	70.28	231.72	64.34	233.08	11.61	5.60
8	69.29	232.71	62.54	236.26	11.59	5.62
9	68.31	233.69	60.77	239.45	11.57	5.64
10	67.32	234.68	59.03	242.63	11.56	5.66
11	66.34	235.66	57.32	245.82	11.54	5.68
12	65.36	236.64	55.64	249.00	11.52	5.70
13	64.38	237.62	53.99	252.19	11.50	5.72
14	63.41	238.59	52.37	255.37	11.48	5.75
15	62.43	239.57	50.77	258.56	11.46	5.77
16	61.46	240.54	49.20	261.74	11.45	5.79
17	60.49	241.51	47.66	264.93	11.43	5.81
18	59.53	242.47	46.15	268.12	11.41	5.83
19	58.56	243.44	44.67	271.30	11.39	5.85
20	57.60	244.40	43.22	274.49	11.37	5.87
21	56.64	245.36	41.79	277.67	11.34	5.89
22	55.69	246.31	40.39	280.86	11.32	5.91
23	54.73	247.27	39.02	284.04	11.30	5.93
24	53.78	248.22	37.68	287.22	11.28	5.94
25	52.84	249.16	36.36	290.41	11.26	5.96
26	51.89	250.11	35.07	293.59	11.23	5.98
27	50.95	251.05	33.81	296.77	11.21	6.00
28	50.01	251.99	32.57	299.95	11.19	6.02
29	49.07	252.93	31.37	303.13	11.16	6.04
30	48.14	253.86	30.18	306.31	11.14	6.06
31	47.21	254.79	29.03	309.49	11.11	6.08
32	46.28	255.72	27.90	312.67	11.09	6.10
33	45.36	256.64	26.80	315.85	11.06	6.12
34	44.44	257.56	25.72	319.02	11.04	6.14
35	43.52	258.48	24.67	322.19	11.01	6.16
36	42.61	259.39	23.64	325.37	10.98	6.18
37	41.69	260.31	22.64	328.54	10.95	6.20
38	40.79	261.21	21.67	331.70	10.92	6.21
39	39.88	262.12	20.72	334.87	10.90	6.23
40	38.98	263.02	19.80	338.03	10.87	6.25
41	38.09	263.91	18.90	341.19	10.83	6.27
42	37.20	264.80	18.02	344.35	10.80	6.29
43	36.31	265.69	17.17	347.51	10.77	6.31
44	35.42	266.58	16.34	350.66	10.74	6.33
45	34.54	267.46	15.54	353.81	10.70	6.34
46	33.67	268.33	14.76	356.95	10.67	6.36
47	32.80	269.20	14.01	360.10	10.64	6.38
48	31.93	270.07	13.28	363.23	10.60	6.40
49	31.07	270.93	12.57	366.37	10.56	6.42
50	30.21	271.79	11.89	369.49	10.53	6.43
51	29.35	272.65	11.22	372.62	10.49	6.45
52	28.50	273.50	10.58	375.73	10.45	6.47
53	27.66	274.34	9.97	376.42	9.97	6.49
54	26.88	275.12	9.41	375.83	9.41	6.50
55	26.16	275.84	8.92	374.90	8.92	6.52
56	25.51	276.49	8.48	373.84	8.48	6.53
57	24.91	277.09	8.08	372.76	8.08	6.54
58	24.37	277.63	7.73	371.76	7.73	6.56
59	23.86	278.14	7.42	370.88	7.42	6.57
60	23.40	278.60	7.13	370.17	7.13	6.58

Net Present Value of Net Returns (NPV)/Acre $7,900.50

Table G.3. Gaines County General Data

Period	Saturated Thickness Feet	Pump Lift Feet	GPC Acre in.	Nominal Net Return ($/Acre)	Average Water Applied Per Cropland Acre (in.)	Nominal Pumping Cost ($/Acre in.)
1	80.00	106.00	114.06	80.04	12.84	2.99
2	78.63	107.37	110.20	106.74	8.99	3.02
3	77.79	108.21	107.86	110.67	8.98	3.04
4	76.95	109.05	105.54	114.60	8.98	3.06
5	76.11	109.89	103.24	118.53	8.98	3.07
6	75.27	110.73	100.98	122.72	8.97	3.09
7	74.43	111.57	98.74	127.02	8.97	3.11
8	73.59	112.41	96.53	131.32	8.96	3.13
9	72.76	113.24	94.34	135.62	8.96	3.14
10	71.92	114.08	92.18	139.92	8.95	3.16
11	71.08	114.92	90.05	144.22	8.95	3.18
12	70.25	115.75	87.94	148.52	8.95	3.19
13	69.41	116.59	85.86	152.82	8.94	3.21
14	68.57	117.43	83.81	157.12	8.94	3.23
15	67.74	118.26	81.78	161.42	8.94	3.25
16	66.91	119.09	79.78	165.72	8.93	3.26
17	66.07	119.93	77.80	170.02	8.93	3.28
18	65.24	120.76	75.85	174.33	8.92	3.30
19	64.41	121.59	73.93	178.63	8.92	3.32
20	63.57	122.43	72.03	182.93	8.92	3.33
21	62.74	123.26	70.16	187.24	8.91	3.35
22	61.91	124.09	68.31	191.54	8.91	3.37
23	61.08	124.92	66.49	195.84	8.91	3.39
24	60.25	125.75	64.69	200.15	8.91	3.40
25	59.42	126.58	62.92	204.45	8.90	3.42
26	58.59	127.41	61.18	208.76	8.90	3.44
27	57.76	128.24	59.46	213.06	8.90	3.45
28	56.93	129.07	57.76	217.37	8.89	3.47
29	56.10	129.90	56.09	221.68	8.89	3.49
30	55.27	130.73	54.45	225.98	8.89	3.51
31	54.44	131.56	52.83	230.29	8.89	3.52
32	53.62	132.38	51.24	234.59	8.88	3.54
33	52.79	133.21	49.67	238.90	8.88	3.56
34	51.96	134.04	48.12	243.21	8.88	3.57
35	51.14	134.86	46.60	247.52	8.88	3.59
36	50.31	135.69	45.11	251.82	8.88	3.61
37	49.48	136.52	43.64	256.13	8.88	3.63
38	48.66	137.34	42.20	260.44	8.87	3.64
39	47.83	138.17	40.78	264.75	8.87	3.66
40	47.01	138.99	39.38	269.05	8.87	3.68
41	46.18	139.82	38.01	273.36	8.87	3.69
42	45.35	140.65	36.66	277.67	8.87	3.71
43	44.53	141.47	35.34	281.98	8.87	3.73
44	43.70	142.30	34.04	286.29	8.87	3.75
45	42.88	143.12	32.77	290.60	8.87	3.76
46	42.05	143.95	31.52	294.91	8.87	3.78
47	41.23	144.77	30.30	299.22	8.87	3.80
48	40.40	145.60	29.10	303.53	8.87	3.81
49	39.58	146.42	27.92	307.83	8.87	3.83
50	38.76	147.24	26.77	312.14	8.87	3.85
51	37.93	148.07	25.64	316.45	8.87	3.87
52	37.11	148.89	24.54	320.76	8.87	3.88
53	36.28	149.72	23.46	325.07	8.87	3.90
54	35.45	150.55	22.40	329.38	8.87	3.92
55	34.63	151.37	21.37	333.69	8.87	3.93
56	33.80	152.20	20.37	338.00	8.87	3.95
57	32.98	153.02	19.38	342.31	8.88	3.97
58	32.15	153.85	18.42	346.62	8.88	3.99
59	31.33	154.67	17.49	350.93	8.88	4.00
60	30.50	155.50	16.58	355.23	8.88	4.02

Net Present Value of Net Returns (NPV)/Acre $5,450.60

Table G.4. Hale County General Data

Period	Saturated Thickness Feet	Pump Lift Feet	GPC Acre in.	Nominal Net Return ($/Acre)	Average Water Applied Per Cropland Acre (in.)	Nominal Pumping Cost ($/Acre in.)
1	72.00	218.00	59.20	202.42	12.56	5.32
2	70.38	219.62	56.56	273.50	14.16	5.35
3	68.42	221.58	53.45	276.45	14.05	5.39
4	66.48	223.52	50.47	279.36	13.93	5.43
5	64.57	225.43	47.60	282.24	13.80	5.47
6	62.68	227.32	44.86	285.09	13.68	5.51
7	60.82	229.18	42.24	287.89	13.55	5.55
8	58.99	231.01	39.74	290.66	13.42	5.59
9	57.19	232.81	37.35	293.37	13.28	5.63
10	55.41	234.59	35.06	296.04	13.14	5.66
11	53.67	236.33	32.89	298.66	13.00	5.70
12	51.96	238.04	30.83	301.22	12.86	5.73
13	50.27	239.73	28.86	303.71	12.71	5.77
14	48.62	241.38	27.00	306.15	12.55	5.80
15	47.00	243.00	25.23	308.51	12.40	5.84
16	45.42	244.58	23.56	310.79	12.24	5.87
17	43.87	246.13	21.98	313.00	12.07	5.90
18	42.36	247.64	20.49	315.12	11.90	5.93
19	40.88	249.12	19.08	317.14	11.73	5.96
20	39.44	250.56	17.76	319.07	11.55	5.99
21	38.03	251.97	16.52	320.89	11.37	6.02
22	36.67	253.33	15.35	322.59	11.18	6.05
23	35.35	254.65	14.27	324.18	10.99	6.08
24	34.06	255.94	13.25	325.63	10.79	6.11
25	32.82	257.18	12.30	326.94	10.59	6.13
26	31.63	258.37	11.42	328.11	10.38	6.16
27	30.48	259.52	10.61	329.11	10.16	6.18
28	29.37	260.63	9.85	328.42	9.85	6.20
29	28.34	261.66	9.17	320.76	9.17	6.22
30	27.44	262.56	8.60	314.50	8.60	6.24
31	26.67	263.33	8.12	309.61	8.12	6.26
32	26.01	263.99	7.72	306.06	7.72	6.27
33	25.43	264.57	7.38	303.61	7.38	6.28
34	24.92	265.08	7.09	302.08	7.09	6.30
35	24.47	265.53	6.84	301.31	6.84	6.30
36	24.08	265.92	6.62	301.19	6.62	6.31
37	23.73	266.27	6.43	301.62	6.43	6.32
38	23.43	266.57	6.27	302.53	6.27	6.33
39	23.16	266.84	6.13	303.84	6.13	6.33
40	22.92	267.08	6.00	305.51	6.00	6.34
41	22.71	267.29	5.89	307.49	5.89	6.34
42	22.52	267.48	5.79	309.75	5.79	6.34
43	22.36	267.64	5.71	312.26	5.71	6.35
44	22.21	267.79	5.63	314.99	5.63	6.35
45	22.07	267.93	5.56	317.92	5.56	6.35
46	21.96	268.04	5.50	321.04	5.50	6.36
47	21.85	268.15	5.45	324.33	5.45	6.36
48	21.76	268.24	5.40	327.77	5.40	6.36
49	21.67	268.33	5.36	331.36	5.36	6.36
50	21.60	268.40	5.33	335.04	5.33	6.36
51	21.53	268.47	5.29	338.80	5.29	6.37
52	21.47	268.53	5.26	342.64	5.26	6.37
53	21.42	268.58	5.24	346.54	5.24	6.37
54	21.37	268.63	5.21	350.50	5.21	6.37
55	21.32	268.68	5.19	354.51	5.19	6.37
56	21.29	268.71	5.17	358.57	5.17	6.37
57	21.25	268.75	5.16	362.68	5.16	6.37
58	21.22	268.78	5.14	366.82	5.14	6.37
59	21.19	268.81	5.13	371.00	5.13	6.37
60	21.17	268.83	5.12	375.21	5.12	6.37

Net Present Value of Net Returns (NPV)/Acre $8,685.60

Table G.5. Hockley County General Data

Period	Saturated Thickness Feet	Pump Lift Feet	GPC Acre in.	Nominal Net Return ($/Acre)	Average Water Applied Per Cropland Acre (in.)	Nominal Pumping Cost ($/Acre in.)
1	40.00	127.00	53.04	132.28	8.05	3.43
2	39.25	127.75	51.08	158.02	8.20	3.44
3	38.49	128.51	49.10	160.78	8.17	3.46
4	37.72	129.28	47.17	163.54	8.14	3.48
5	36.97	130.03	45.30	166.29	8.10	3.49
6	36.21	130.79	43.47	169.03	8.07	3.51
7	35.46	131.54	41.69	171.77	8.03	3.52
8	34.72	132.28	39.96	174.49	7.99	3.54
9	33.98	133.02	38.28	177.21	7.96	3.55
10	33.25	133.75	36.64	179.92	7.92	3.57
11	32.52	134.48	35.05	182.62	7.88	3.58
12	31.79	135.21	33.51	185.30	7.84	3.60
13	31.08	135.92	32.02	187.98	7.80	3.61
14	30.37	136.63	30.57	190.89	7.76	3.63
15	29.66	137.34	29.16	193.83	7.71	3.64
16	28.96	138.04	27.80	196.77	7.67	3.66
17	28.27	138.73	26.49	199.68	7.62	3.67
18	27.58	139.42	25.22	202.59	7.57	3.69
19	26.90	140.10	23.99	205.47	7.52	3.70
20	26.23	140.77	22.80	208.34	7.47	3.71
21	25.56	141.44	21.66	211.19	7.42	3.73
22	24.90	142.10	20.55	214.02	7.37	3.74
23	24.25	142.75	19.49	216.83	7.32	3.76
24	23.60	143.40	18.47	219.62	7.26	3.77
25	22.97	144.03	17.48	222.38	7.20	3.78
26	22.34	144.66	16.54	225.12	7.14	3.79
27	21.71	145.29	15.63	227.82	7.08	3.81
28	21.10	145.90	14.76	230.51	7.02	3.82
29	20.50	146.50	13.93	233.15	6.96	3.83
30	19.90	147.10	13.13	235.77	6.89	3.85
31	19.32	147.68	12.37	238.35	6.82	3.86
32	18.74	148.26	11.64	240.90	6.76	3.87
33	18.17	148.83	10.95	243.41	6.68	3.88
34	17.62	149.38	10.29	245.87	6.61	3.89
35	17.07	149.93	9.66	248.29	6.54	3.90
36	16.53	150.47	9.06	250.66	6.46	3.92
37	16.01	150.99	8.49	252.99	6.38	3.93
38	15.49	151.51	7.96	255.26	6.30	3.94
39	14.99	152.01	7.45	257.47	6.21	3.95
40	14.50	152.50	6.97	259.62	6.12	3.96
41	14.02	152.98	6.51	261.71	6.03	3.97
42	13.55	153.45	6.09	263.73	5.94	3.98
43	13.10	153.90	5.69	263.22	5.69	3.99
44	12.68	154.32	5.33	260.73	5.33	4.00
45	12.31	154.69	5.02	258.65	5.02	4.00
46	11.98	155.02	4.76	257.01	4.76	4.01
47	11.69	155.31	4.53	255.80	4.53	4.02
48	11.43	155.57	4.33	255.00	4.33	4.02
49	11.20	155.80	4.16	254.59	4.16	4.03
50	10.99	156.01	4.01	254.54	4.01	4.03
51	10.81	156.19	3.87	254.84	3.87	4.03
52	10.64	156.36	3.75	255.44	3.75	4.04
53	10.49	156.51	3.65	256.31	3.65	4.04
54	10.35	156.65	3.55	257.42	3.55	4.04
55	10.23	156.77	3.47	258.73	3.47	4.05
56	10.12	156.88	3.39	260.21	3.39	4.05
57	10.02	156.98	3.33	261.84	3.33	4.05
58	9.92	157.08	3.27	263.61	3.27	4.05
59	9.84	157.16	3.21	265.50	3.21	4.05
60	9.77	157.23	3.16	267.49	3.16	4.06

Net Present Value of Net Returns (NPV)/Acre $5,919.15

Table G.6. Lamb County General Data

Period	Saturated Thickness Feet	Pump Lift Feet	GPC Acre in.	Nominal Net Return ($/Acre)	Average Water Applied Per Cropland Acre (in.)	Nominal Pumping Cost ($/Acre in.)
1	66.00	170.00	59.20	199.01	11.94	4.32
2	64.96	171.04	57.35	273.55	13.81	4.34
3	63.68	172.32	55.11	277.16	13.74	4.37
4	62.41	173.59	52.93	280.76	13.67	4.40
5	61.14	174.86	50.80	284.35	13.60	4.42
6	59.89	176.11	48.74	287.92	13.53	4.45
7	58.64	177.36	46.73	291.48	13.46	4.47
8	57.40	178.60	44.78	295.02	13.38	4.50
9	56.18	179.82	42.89	298.54	13.31	4.52
10	54.96	181.04	41.05	302.05	13.23	4.55
11	53.75	182.25	39.27	305.53	13.15	4.58
12	52.56	183.44	37.54	308.99	13.06	4.60
13	51.37	184.63	35.87	312.43	12.98	4.62
14	50.20	185.80	34.25	315.85	12.89	4.65
15	49.04	186.96	32.68	319.23	12.80	4.67
16	47.89	188.11	31.17	322.59	12.71	4.70
17	46.75	189.25	29.70	325.92	12.62	4.72
18	45.63	190.37	28.29	329.22	12.52	4.74
19	44.52	191.48	26.93	332.48	12.42	4.77
20	43.42	192.58	25.62	335.70	12.32	4.79
21	42.33	193.67	24.35	338.89	12.21	4.81
22	41.26	194.74	23.13	342.03	12.11	4.83
23	40.20	195.80	21.96	345.13	12.00	4.86
24	39.16	196.84	20.84	348.18	11.88	4.88
25	38.13	197.87	19.76	351.18	11.77	4.90
26	37.11	198.89	18.72	354.12	11.65	4.92
27	36.12	199.88	17.73	357.01	11.53	4.94
28	35.14	200.86	16.78	359.83	11.40	4.96
29	34.17	201.83	15.87	362.59	11.27	4.98
30	33.22	202.78	15.00	365.28	11.14	5.00
31	32.29	203.71	14.17	367.89	11.01	5.02
32	31.38	204.62	13.38	370.42	10.87	5.04
33	30.49	205.51	12.63	372.87	10.72	5.06
34	29.61	206.39	11.91	375.23	10.57	5.08
35	28.75	207.25	11.24	377.49	10.42	5.09
36	27.92	208.08	10.59	379.65	10.27	5.11
37	27.10	208.90	9.98	379.93	9.98	5.13
38	26.33	209.67	9.42	375.65	9.42	5.14
39	25.62	210.38	8.92	371.80	8.92	5.16
40	24.99	211.01	8.48	368.42	8.48	5.17
41	24.41	211.59	8.09	365.55	8.09	5.18
42	23.88	212.12	7.75	363.17	7.75	5.20
43	23.40	212.60	7.44	361.29	7.44	5.21
44	22.95	213.05	7.16	359.86	7.16	5.21
45	22.55	213.45	6.91	358.87	6.91	5.22
46	22.18	213.82	6.68	358.29	6.68	5.23
47	21.84	214.16	6.48	358.09	6.48	5.24
48	21.52	214.48	6.29	358.24	6.29	5.24
49	21.23	214.77	6.13	358.72	6.13	5.25
50	20.96	215.04	5.97	359.50	5.97	5.26
51	20.71	215.29	5.83	360.55	5.83	5.26
52	20.48	215.52	5.70	361.87	5.70	5.27
53	20.27	215.73	5.58	363.42	5.58	5.27
54	20.08	215.92	5.48	365.18	5.48	5.27
55	19.89	216.11	5.38	367.15	5.38	5.28
56	19.72	216.28	5.29	369.31	5.29	5.28
57	19.57	216.43	5.20	371.63	5.20	5.29
58	19.42	216.58	5.12	374.11	5.12	5.29
59	19.28	216.72	5.05	376.61	5.05	5.29
60	19.16	216.84	4.99	379.11	4.99	5.29

Net Present Value of Net Returns (NPV)/Acre $9,299.86

Table G.7. Lubbock County General Data

Period	Saturated Thickness Feet	Pump Lift Feet	GPC Acre in.	Nominal Net Return ($/Acre)	Average Water Applied Per Cropland Acre (in.)	Nominal Pumping Cost ($/Acre in.)
1	57.00	130.00	91.45	164.90	10.54	3.49
2	55.89	131.11	87.93	188.91	11.09	3.51
3	54.70	132.30	84.23	191.95	11.04	3.54
4	53.52	133.48	80.63	194.97	10.99	3.56
5	52.35	134.65	77.13	197.99	10.94	3.59
6	51.18	135.82	73.73	201.01	10.88	3.61
7	50.02	136.98	70.43	204.01	10.83	3.64
8	48.87	138.13	67.22	207.01	10.78	3.66
9	47.73	139.27	64.12	210.00	10.72	3.68
10	46.59	140.41	61.11	212.98	10.66	3.71
11	45.47	141.53	58.19	215.95	10.61	3.73
12	44.35	142.65	55.37	218.91	10.55	3.75
13	43.25	143.75	52.64	221.85	10.48	3.78
14	42.15	144.85	50.00	224.79	10.42	3.80
15	41.06	145.94	47.45	227.71	10.36	3.82
16	39.98	147.02	45.00	230.62	10.29	3.84
17	38.91	148.09	42.62	233.51	10.22	3.87
18	37.86	149.14	40.34	236.39	10.15	3.89
19	36.81	150.19	38.14	239.25	10.08	3.91
20	35.77	151.23	36.02	242.09	10.01	3.93
21	34.75	152.25	33.99	244.91	9.94	3.95
22	33.73	153.27	32.03	247.71	9.86	3.97
23	32.73	154.27	30.16	250.48	9.78	3.99
24	31.74	155.26	28.36	253.24	9.70	4.01
25	30.77	156.23	26.64	255.96	9.62	4.04
26	29.80	157.20	25.00	258.66	9.53	4.06
27	28.85	158.15	23.42	261.33	9.45	4.07
28	27.91	159.09	21.92	263.97	9.36	4.09
29	26.98	160.02	20.50	266.58	9.27	4.11
30	26.07	160.93	19.13	269.14	9.17	4.13
31	25.18	161.82	17.84	271.68	9.08	4.15
32	24.29	162.71	16.61	274.17	8.98	4.17
33	23.43	163.57	15.45	276.61	8.88	4.19
34	22.58	164.42	14.35	279.01	8.77	4.21
35	21.74	165.26	13.31	281.36	8.66	4.22
36	20.92	166.08	12.32	283.66	8.55	4.24
37	20.12	166.88	11.40	285.91	8.44	4.26
38	19.34	167.66	10.53	288.09	8.32	4.27
39	18.57	168.43	9.71	290.21	8.20	4.29
40	17.82	169.18	8.94	292.26	8.08	4.30
41	17.09	169.91	8.22	294.24	7.95	4.32
42	16.38	170.62	7.56	292.72	7.56	4.33
43	15.73	171.27	6.97	288.09	6.97	4.35
44	15.18	171.82	6.48	284.20	6.48	4.36
45	14.69	172.31	6.08	281.22	6.08	4.37
46	14.27	172.73	5.73	279.17	5.73	4.38
47	13.90	173.10	5.44	277.88	5.44	4.39
48	13.58	173.42	5.19	277.21	5.19	4.39
49	13.29	173.71	4.97	277.05	4.97	4.40
50	13.04	173.96	4.78	277.32	4.78	4.40
51	12.81	174.19	4.62	277.96	4.62	4.41
52	12.61	174.39	4.48	278.91	4.48	4.41
53	12.44	174.56	4.35	280.12	4.35	4.42
54	12.28	174.72	4.24	281.57	4.24	4.42
55	12.14	174.86	4.15	283.22	4.15	4.42
56	12.01	174.99	4.06	285.05	4.06	4.42
57	11.90	175.10	3.98	287.03	3.98	4.43
58	11.79	175.21	3.92	289.14	3.92	4.43
59	11.70	175.30	3.85	291.38	3.85	4.43
60	11.62	175.38	3.80	293.73	3.80	4.43

Net Present Value of Net Returns (NPV)/Acre $6,819.45

Table G.8. Terry County General Data

Period	Saturated Thickness Feet	Pump Lift Feet	GPC Acre in.	Nominal Net Return ($/Acre)	Average Water Applied Per Cropland Acre (in.)	Nominal Pumping Cost ($/Acre in.)
1	84.00	94.00	72.16	243.96	7.55	2.74
2	83.37	94.63	71.09	269.28	7.56	2.76
3	82.74	95.26	70.01	272.68	7.55	2.77
4	82.11	95.89	68.95	276.08	7.55	2.78
5	81.48	96.52	67.90	279.48	7.55	2.80
6	80.85	97.15	66.85	282.88	7.55	2.81
7	80.22	97.78	65.82	286.28	7.55	2.82
8	79.59	98.41	64.79	289.68	7.55	2.83
9	78.96	99.04	63.77	293.08	7.55	2.85
10	78.33	99.67	62.75	296.48	7.55	2.86
11	77.70	100.30	61.75	299.88	7.54	2.87
12	77.07	100.93	60.75	303.28	7.54	2.89
13	76.45	101.55	59.77	306.68	7.54	2.90
14	75.82	102.18	58.79	310.08	7.54	2.91
15	75.19	102.81	57.82	313.48	7.54	2.93
16	74.56	103.44	56.85	316.88	7.54	2.94
17	73.93	104.07	55.90	320.28	7.54	2.95
18	73.30	104.70	54.95	323.68	7.54	2.97
19	72.68	105.32	54.02	327.08	7.53	2.98
20	72.05	105.95	53.09	330.48	7.53	2.99
21	71.42	106.58	52.17	333.88	7.53	3.00
22	70.79	107.21	51.25	337.28	7.53	3.02
23	70.16	107.84	50.35	340.68	7.53	3.03
24	69.54	108.46	49.45	344.09	7.53	3.04
25	68.91	109.09	48.56	347.49	7.53	3.06
26	68.28	109.72	47.68	350.89	7.53	3.07
27	67.66	110.34	46.81	354.29	7.53	3.08
28	67.03	110.97	45.95	357.69	7.53	3.10
29	66.40	111.60	45.09	361.09	7.53	3.11
30	65.77	112.23	44.25	364.49	7.52	3.12
31	65.15	112.85	43.41	367.89	7.52	3.13
32	64.52	113.48	42.58	371.30	7.52	3.15
33	63.90	114.10	41.75	374.70	7.52	3.16
34	63.27	114.73	40.94	378.10	7.52	3.17
35	62.64	115.36	40.13	381.50	7.52	3.19
36	62.02	115.98	39.33	384.90	7.52	3.20
37	61.39	116.61	38.54	388.30	7.52	3.21
38	60.76	117.24	37.76	391.70	7.52	3.23
39	60.14	117.86	36.99	395.11	7.52	3.24
40	59.51	118.49	36.22	398.51	7.52	3.25
41	58.89	119.11	35.46	401.91	7.52	3.26
42	58.26	119.74	34.71	405.31	7.52	3.28
43	57.63	120.37	33.97	408.71	7.52	3.29
44	57.01	120.99	33.24	412.12	7.52	3.30
45	56.38	121.62	32.51	415.52	7.52	3.32
46	55.76	122.24	31.79	418.92	7.52	3.33
47	55.13	122.87	31.09	422.32	7.52	3.34
48	54.51	123.49	30.38	425.72	7.52	3.36
49	53.88	124.12	29.69	429.13	7.52	3.37
50	53.25	124.75	29.00	432.53	7.52	3.38
51	52.63	125.37	28.33	435.93	7.52	3.39
52	52.00	126.00	27.66	439.33	7.52	3.41
53	51.38	126.62	27.00	442.73	7.52	3.42
54	50.75	127.25	26.34	446.14	7.52	3.43
55	50.13	127.87	25.70	449.54	7.52	3.45
56	49.50	128.50	25.06	452.94	7.52	3.46
57	48.87	129.13	24.43	456.34	7.52	3.47
58	48.25	129.75	23.81	459.74	7.52	3.49
59	47.62	130.38	23.19	463.15	7.52	3.50
60	47.00	131.00	22.59	466.55	7.52	3.51

Net Present Value of Net Returns (NPV)/Acre $9,599.40

Table G.9. Yoakum County General Data

Period	Saturated Thickness Feet	Pump Lift Feet	GPC Acre in.	Nominal Net Return ($/Acre)	Average Water Applied Per Cropland Acre (in.)	Nominal Pumping Cost ($/Acre in.)
1	54.00	94.00	46.04	109.68	10.71	2.74
2	53.21	94.79	44.71	146.65	9.17	2.76
3	52.57	95.43	43.64	149.66	9.17	2.77
4	51.94	96.06	42.59	152.66	9.16	2.79
5	51.30	96.70	41.55	155.67	9.15	2.80
6	50.66	97.34	40.52	158.68	9.14	2.81
7	50.02	97.98	39.51	161.68	9.13	2.83
8	49.39	98.61	38.51	164.69	9.12	2.84
9	48.75	99.25	37.53	167.70	9.11	2.85
10	48.12	99.88	36.56	170.70	9.10	2.87
11	47.48	100.52	35.60	173.71	9.09	2.88
12	46.85	101.15	34.66	176.87	9.08	2.89
13	46.22	101.78	33.73	180.15	9.07	2.90
14	45.59	102.41	32.82	183.44	9.06	2.92
15	44.96	103.04	31.92	186.72	9.04	2.93
16	44.33	103.67	31.03	190.00	9.03	2.94
17	43.71	104.29	30.16	193.28	9.02	2.96
18	43.08	104.92	29.30	196.56	9.01	2.97
19	42.45	105.55	28.46	199.84	9.00	2.98
20	41.83	106.17	27.63	203.12	8.99	3.00
21	41.21	106.79	26.81	206.40	8.97	3.01
22	40.59	107.41	26.01	209.68	8.96	3.02
23	39.97	108.03	25.22	212.96	8.95	3.03
24	39.35	108.65	24.45	216.23	8.93	3.05
25	38.73	109.27	23.68	219.51	8.92	3.06
26	38.11	109.89	22.94	222.79	8.91	3.07
27	37.50	110.50	22.20	226.06	8.89	3.09
28	36.88	111.12	21.48	229.33	8.88	3.10
29	36.27	111.73	20.77	232.61	8.86	3.11
30	35.66	112.34	20.08	235.88	8.85	3.12
31	35.05	112.95	19.40	239.15	8.83	3.14
32	34.44	113.56	18.73	242.42	8.82	3.15
33	33.84	114.16	18.08	245.69	8.80	3.16
34	33.23	114.77	17.43	248.96	8.79	3.17
35	32.63	115.37	16.81	252.23	8.77	3.19
36	32.02	115.98	16.19	255.49	8.75	3.20
37	31.42	116.58	15.59	258.75	8.73	3.21
38	30.82	117.18	15.00	262.02	8.72	3.22
39	30.23	117.77	14.43	265.28	8.70	3.24
40	29.63	118.37	13.86	268.53	8.68	3.25
41	29.04	118.96	13.31	271.79	8.66	3.26
42	28.45	119.55	12.78	275.04	8.64	3.27
43	27.86	120.14	12.25	278.29	8.62	3.29
44	27.27	120.73	11.74	281.54	8.60	3.30
45	26.68	121.32	11.24	284.79	8.58	3.31
46	26.10	121.90	10.75	288.03	8.55	3.32
47	25.52	122.48	10.28	291.49	8.53	3.33
48	24.94	123.06	9.82	295.10	8.51	3.35
49	24.36	123.64	9.37	298.70	8.49	3.36
50	23.78	124.22	8.93	302.31	8.46	3.37
51	23.21	124.79	8.51	305.90	8.44	3.38
52	22.64	125.36	8.09	307.89	8.09	3.39
53	22.10	125.90	7.71	309.07	7.71	3.41
54	21.60	126.40	7.36	309.91	7.36	3.42
55	21.13	126.87	7.05	310.51	7.05	3.43
56	20.69	127.31	6.76	310.98	6.76	3.43
57	20.27	127.73	6.49	311.38	6.49	3.44
58	19.89	128.11	6.24	311.76	6.24	3.45
59	19.52	128.48	6.02	312.16	6.02	3.46
60	19.18	128.82	5.81	312.60	5.81	3.47

Net Present Value of Net Returns (NPV)/Acre $5,946.16

Section 2: 10 Year Buyout General Data

Table G.10. Cochran County 10 Year Buyout General Data

Period	Saturated Thickness Feet	Pump Lift Feet	GPC Acre in.	Nominal Net Return ($/Acre)	Average Water Applied Per Cropland Acre (in.)	Nominal Pumping Cost ($/Acre in.)
1	35.00	143.00	20.56	102.74	9.57	3.76
2	34.34	143.66	19.79	95.91	4.84	3.77
3	34.17	143.83	19.60	97.63	4.82	3.78
4	34.01	143.99	19.41	99.34	4.80	3.78
5	33.85	144.15	19.23	101.04	4.78	3.78
6	33.69	144.31	19.05	103.59	4.76	3.79
7	33.53	144.47	18.87	106.26	4.74	3.79
8	33.38	144.62	18.70	108.92	4.72	3.79
9	33.23	144.77	18.53	111.57	4.69	3.80
10	33.08	144.92	18.36	114.22	4.67	3.80
11	32.93	145.07	18.20	116.87	4.65	3.80
12	32.79	145.21	18.04	167.14	8.99	3.81
13	32.18	145.82	17.38	170.03	8.95	3.82
14	31.59	146.41	16.75	172.91	8.90	3.83
15	31.00	147.00	16.12	175.78	8.85	3.84
16	30.41	147.59	15.52	178.63	8.79	3.86
17	29.83	148.17	14.93	181.47	8.74	3.87
18	29.25	148.75	14.36	184.30	8.69	3.88
19	28.69	149.31	13.81	187.11	8.63	3.89
20	28.12	149.88	13.27	189.90	8.57	3.90
21	27.56	150.44	12.75	192.67	8.51	3.91
22	27.01	150.99	12.25	195.43	8.45	3.93
23	26.47	151.53	11.76	198.16	8.39	3.94
24	25.93	152.07	11.28	200.87	8.32	3.95
25	25.40	152.60	10.83	203.57	8.26	3.96
26	24.88	153.12	10.38	206.23	8.19	3.97
27	24.36	153.64	9.96	208.87	8.12	3.98
28	23.85	154.15	9.55	211.48	8.05	3.99
29	23.35	154.65	9.15	214.07	7.97	4.00
30	22.85	155.15	8.76	216.62	7.90	4.01
31	22.37	155.63	8.40	219.14	7.82	4.02
32	21.89	156.11	8.04	221.62	7.74	4.03
33	21.42	156.58	7.70	224.07	7.65	4.04
34	20.96	157.04	7.37	224.54	7.37	4.05
35	20.53	157.47	7.07	224.57	7.07	4.06
36	20.13	157.87	6.80	224.66	6.80	4.07
37	19.76	158.24	6.55	224.83	6.55	4.08
38	19.41	158.59	6.32	225.12	6.32	4.08
39	19.09	158.91	6.12	225.52	6.12	4.09
40	18.79	159.21	5.93	226.04	5.93	4.10
41	18.51	159.49	5.75	226.70	5.75	4.10
42	18.25	159.75	5.59	227.48	5.59	4.11
43	18.01	159.99	5.44	228.39	5.44	4.11
44	17.78	160.22	5.30	229.42	5.30	4.12
45	17.57	160.43	5.18	230.57	5.18	4.12
46	17.36	160.64	5.06	231.84	5.06	4.13
47	17.18	160.82	4.95	233.22	4.95	4.13
48	17.00	161.00	4.85	234.71	4.85	4.13
49	16.83	161.17	4.76	236.29	4.76	4.14
50	16.68	161.32	4.67	237.97	4.67	4.14
51	16.53	161.47	4.59	239.74	4.59	4.14
52	16.39	161.61	4.51	241.59	4.51	4.15
53	16.26	161.74	4.44	243.52	4.44	4.15
54	16.14	161.86	4.37	245.51	4.37	4.15
55	16.02	161.98	4.31	247.58	4.31	4.15
56	15.91	162.09	4.25	249.71	4.25	4.16
57	15.81	162.19	4.20	251.91	4.20	4.16
58	15.71	162.29	4.14	254.17	4.14	4.16
59	15.62	162.38	4.10	256.48	4.10	4.16
60	15.54	162.46	4.05	258.86	4.05	4.16

Net Present Value of Net Returns (NPV)/Acre $4,953.88

Table G.11. Floyd County 10 Year Buyout General Data

Period	Saturated Thickness Feet	Pump Lift Feet	GPC Acre in.	Nominal Net Return ($/Acre)	Average Water Applied Per Cropland Acre (in.)	Nominal Pumping Cost ($/Acre in.)
1	76.00	226.00	75.23	130.18	9.78	5.48
2	75.24	226.76	73.74	159.35	6.61	5.50
3	74.88	227.12	73.02	162.21	6.60	5.51
4	74.51	227.49	72.32	165.07	6.60	5.51
5	74.15	227.85	71.62	167.92	6.59	5.52
6	73.79	228.21	70.92	170.78	6.59	5.53
7	73.43	228.57	70.23	173.64	6.58	5.54
8	73.07	228.93	69.54	176.50	6.57	5.54
9	72.71	229.29	68.86	179.36	6.57	5.55
10	72.35	229.65	68.18	182.21	6.56	5.56
11	71.99	230.01	67.51	185.07	6.56	5.57
12	71.63	230.37	66.84	251.72	11.79	5.57
13	70.62	231.38	64.96	254.91	11.78	5.60
14	69.61	232.39	63.12	258.10	11.77	5.62
15	68.60	233.40	61.30	261.29	11.75	5.64
16	67.60	234.40	59.52	264.48	11.74	5.66
17	66.59	235.41	57.76	267.67	11.73	5.68
18	65.59	236.41	56.03	270.86	11.72	5.70
19	64.58	237.42	54.33	274.06	11.71	5.72
20	63.58	238.42	52.66	277.25	11.69	5.74
21	62.58	239.42	51.01	280.44	11.68	5.76
22	61.58	240.42	49.40	283.64	11.67	5.78
23	60.59	241.41	47.81	286.83	11.65	5.80
24	59.59	242.41	46.26	290.03	11.64	5.82
25	58.60	243.40	44.73	293.23	11.63	5.84
26	57.61	244.39	43.23	296.42	11.62	5.87
27	56.62	245.38	41.76	299.62	11.60	5.89
28	55.63	246.37	40.31	302.82	11.59	5.91
29	54.64	247.36	38.89	306.02	11.57	5.93
30	53.66	248.34	37.50	309.22	11.56	5.95
31	52.68	249.32	36.14	312.42	11.55	5.97
32	51.69	250.31	34.81	315.62	11.53	5.99
33	50.72	251.28	33.50	318.82	11.52	6.01
34	49.74	252.26	32.22	322.02	11.50	6.03
35	48.76	253.24	30.97	325.22	11.49	6.05
36	47.79	254.21	29.74	328.43	11.48	6.07
37	46.81	255.19	28.55	331.63	11.46	6.09
38	45.84	256.16	27.38	334.83	11.45	6.11
39	44.88	257.12	26.23	338.04	11.43	6.13
40	43.91	258.09	25.11	341.24	11.42	6.15
41	42.94	259.06	24.02	344.45	11.40	6.17
42	41.98	260.02	22.96	347.65	11.38	6.19
43	41.02	260.98	21.92	350.86	11.37	6.21
44	40.06	261.94	20.90	354.06	11.35	6.23
45	39.10	262.90	19.92	357.27	11.34	6.25
46	38.15	263.85	18.96	360.47	11.32	6.27
47	37.20	264.80	18.02	363.68	11.30	6.29
48	36.25	265.75	17.11	366.89	11.29	6.31
49	35.30	266.70	16.23	370.09	11.27	6.33
50	34.35	267.65	15.37	373.30	11.25	6.35
51	33.41	268.59	14.54	376.51	11.23	6.37
52	32.46	269.54	13.73	379.71	11.21	6.39
53	31.52	270.48	12.94	382.92	11.20	6.41
54	30.59	271.41	12.19	386.13	11.18	6.43
55	29.65	272.35	11.45	389.33	11.16	6.45
56	28.72	273.28	10.74	391.30	10.74	6.47
57	27.84	274.16	10.09	391.49	10.09	6.48
58	27.04	274.96	9.52	391.00	9.52	6.50
59	26.31	275.69	9.02	390.13	9.02	6.52
60	25.65	276.35	8.57	389.08	8.57	6.53

Net Present Value of Net Returns (NPV)/Acre $7,471.45

Table G.12. Gaines County 10 Year Buyout General Data

Period	Saturated Thickness Feet	Pump Lift Feet	GPC Acre in.	Nominal Net Return ($/Acre)	Average Water Applied Per Cropland Acre (in.)	Nominal Pumping Cost ($/Acre in.)
1	80.00	106.00	114.06	78.70	12.91	2.99
2	78.62	107.38	110.17	78.18	4.39	3.02
3	78.41	107.59	109.58	80.61	4.39	3.03
4	78.20	107.80	108.98	83.04	4.38	3.03
5	77.98	108.02	108.39	85.48	4.38	3.03
6	77.77	108.23	107.79	88.58	4.38	3.04
7	77.56	108.44	107.20	91.97	4.38	3.04
8	77.34	108.66	106.62	95.36	4.38	3.05
9	77.13	108.87	106.03	98.75	4.38	3.05
10	76.92	109.08	105.45	102.14	4.37	3.06
11	76.71	109.29	104.87	105.53	4.37	3.06
12	76.50	109.50	104.29	150.21	8.99	3.06
13	75.65	110.35	102.01	154.51	8.99	3.08
14	74.81	111.19	99.75	158.81	8.98	3.10
15	73.97	112.03	97.52	163.11	8.98	3.12
16	73.13	112.87	95.32	167.41	8.98	3.13
17	72.29	113.71	93.14	171.71	8.97	3.15
18	71.45	114.55	90.99	176.01	8.97	3.17
19	70.61	115.39	88.87	180.31	8.96	3.19
20	69.78	116.22	86.77	184.61	8.96	3.20
21	68.94	117.06	84.70	188.91	8.96	3.22
22	68.10	117.90	82.66	193.21	8.95	3.24
23	67.26	118.74	80.64	197.51	8.95	3.26
24	66.43	119.57	78.64	201.81	8.95	3.27
25	65.59	120.41	76.68	206.11	8.95	3.29
26	64.76	121.24	74.73	210.42	8.94	3.31
27	63.92	122.08	72.82	214.72	8.94	3.33
28	63.09	122.91	70.93	219.02	8.94	3.34
29	62.25	123.75	69.07	223.32	8.93	3.36
30	61.42	124.58	67.23	227.63	8.93	3.38
31	60.58	125.42	65.41	231.93	8.93	3.40
32	59.75	126.25	63.63	236.24	8.93	3.41
33	58.92	127.08	61.86	240.54	8.93	3.43
34	58.08	127.92	60.13	244.84	8.92	3.45
35	57.25	128.75	58.42	249.15	8.92	3.46
36	56.42	129.58	56.73	253.45	8.92	3.48
37	55.59	130.41	55.07	257.76	8.92	3.50
38	54.75	131.25	53.43	262.06	8.92	3.52
39	53.92	132.08	51.82	266.37	8.92	3.53
40	53.09	132.91	50.24	270.67	8.91	3.55
41	52.26	133.74	48.67	274.98	8.91	3.57
42	51.43	134.57	47.14	279.29	8.91	3.59
43	50.60	135.40	45.63	283.59	8.91	3.60
44	49.77	136.23	44.14	287.90	8.91	3.62
45	48.94	137.06	42.68	292.20	8.91	3.64
46	48.10	137.90	41.24	296.51	8.91	3.65
47	47.27	138.73	39.83	300.82	8.91	3.67
48	46.44	139.56	38.44	305.12	8.91	3.69
49	45.61	140.39	37.08	309.43	8.91	3.71
50	44.78	141.22	35.74	313.74	8.91	3.72
51	43.95	142.05	34.43	318.04	8.91	3.74
52	43.12	142.88	33.14	322.35	8.91	3.76
53	42.29	143.71	31.87	326.66	8.91	3.78
54	41.46	144.54	30.63	330.97	8.91	3.79
55	40.63	145.37	29.42	335.27	8.91	3.81
56	39.80	146.20	28.23	339.58	8.92	3.83
57	38.96	147.04	27.06	343.88	8.92	3.84
58	38.13	147.87	25.92	348.19	8.92	3.86
59	37.30	148.70	24.80	352.50	8.92	3.88
60	36.47	149.53	23.70	356.80	8.92	3.90

Net Present Value of Net Returns (NPV)/Acre $5,191.33

Table G.13. Hale County 10 Year Buyout General Data

Period	Saturated Thickness Feet	Pump Lift Feet	GPC Acre in.	Nominal Net Return ($/Acre)	Average Water Applied Per Cropland Acre (in.)	Nominal Pumping Cost ($/Acre in.)
1	73.00	219.00	59.20	208.66	13.38	5.34
2	71.42	220.58	56.66	193.81	9.06	5.37
3	70.77	221.23	55.63	197.31	9.00	5.38
4	70.13	221.87	54.63	200.79	8.95	5.40
5	69.50	222.50	53.65	204.25	8.90	5.41
6	68.88	223.12	52.70	207.70	8.84	5.42
7	68.27	223.73	51.77	211.13	8.78	5.44
8	67.68	224.32	50.88	214.54	8.72	5.45
9	67.09	224.91	50.00	217.92	8.66	5.46
10	66.52	225.48	49.16	221.29	8.60	5.47
11	65.97	226.03	48.34	224.63	8.54	5.48
12	65.43	226.57	47.55	318.88	14.12	5.50
13	63.69	228.31	45.06	321.98	14.01	5.53
14	61.97	230.03	42.66	325.05	13.89	5.57
15	60.28	231.72	40.37	328.08	13.78	5.60
16	58.62	233.38	38.17	331.08	13.66	5.64
17	56.98	235.02	36.06	334.05	13.53	5.67
18	55.36	236.64	34.05	336.97	13.41	5.70
19	53.78	238.22	32.12	339.84	13.28	5.74
20	52.22	239.78	30.29	342.67	13.14	5.77
21	50.69	241.31	28.54	345.45	13.01	5.80
22	49.19	242.81	26.88	348.17	12.87	5.83
23	47.72	244.28	25.29	350.83	12.72	5.86
24	46.28	245.72	23.79	353.43	12.57	5.89
25	44.87	247.13	22.37	355.96	12.42	5.92
26	43.50	248.50	21.01	358.42	12.27	5.95
27	42.15	249.85	19.74	360.80	12.11	5.98
28	40.84	251.16	18.53	363.09	11.95	6.01
29	39.57	252.43	17.39	365.30	11.78	6.03
30	38.33	253.67	16.32	367.41	11.61	6.06
31	37.13	254.87	15.32	369.42	11.43	6.08
32	35.97	256.03	14.37	371.31	11.25	6.11
33	34.85	257.15	13.49	373.09	11.06	6.13
34	33.77	258.23	12.67	374.75	10.87	6.15
35	32.72	259.28	11.90	376.26	10.67	6.17
36	31.73	260.27	11.18	377.64	10.47	6.20
37	30.77	261.23	10.52	378.86	10.26	6.22
38	29.86	262.14	9.90	377.50	9.90	6.23
39	29.02	262.98	9.36	372.52	9.36	6.25
40	28.31	263.69	8.90	368.69	8.90	6.27
41	27.69	264.31	8.51	365.88	8.51	6.28
42	27.15	264.85	8.19	364.00	8.19	6.29
43	26.68	265.32	7.91	362.94	7.91	6.30
44	26.28	265.72	7.67	362.59	7.67	6.31
45	25.92	266.08	7.46	362.88	7.46	6.32
46	25.61	266.39	7.29	363.71	7.29	6.32
47	25.34	266.66	7.13	365.03	7.13	6.33
48	25.10	266.90	7.00	366.77	7.00	6.33
49	24.89	267.11	6.88	368.88	6.88	6.34
50	24.70	267.30	6.78	371.32	6.78	6.34
51	24.54	267.46	6.69	374.04	6.69	6.34
52	24.39	267.61	6.61	377.01	6.61	6.35
53	24.26	267.74	6.54	380.20	6.54	6.35
54	24.15	267.85	6.48	383.58	6.48	6.35
55	24.05	267.95	6.43	387.14	6.43	6.35
56	23.96	268.04	6.38	390.84	6.38	6.36
57	23.88	268.12	6.34	394.68	6.34	6.36
58	23.81	268.19	6.30	398.63	6.30	6.36
59	23.75	268.25	6.27	402.69	6.27	6.36
60	23.70	268.30	6.24	406.84	6.24	6.36

Net Present Value of Net Returns (NPV)/Acre $8,750.77

Table G.14. Hockley County 10 Year Buyout General Data

Period	Saturated Thickness Feet	Pump Lift Feet	GPC Acre in.	Nominal Net Return ($/Acre)	Average Water Applied Per Cropland Acre (in.)	Nominal Pumping Cost ($/Acre in.)
1	40.00	127.00	53.04	126.05	8.08	3.43
2	39.25	127.75	51.07	120.26	5.26	3.44
3	38.89	128.11	50.14	122.74	5.24	3.45
4	38.53	128.47	49.22	125.21	5.22	3.46
5	38.18	128.82	48.32	127.68	5.21	3.47
6	37.83	129.17	47.43	130.15	5.19	3.47
7	37.48	129.52	46.56	132.62	5.17	3.48
8	37.13	129.87	45.70	135.08	5.15	3.49
9	36.78	130.22	44.86	137.53	5.13	3.49
10	36.44	130.56	44.02	139.98	5.11	3.50
11	36.10	130.90	43.21	142.43	5.09	3.51
12	35.77	131.23	42.41	187.78	8.10	3.52
13	35.01	131.99	40.64	190.53	8.06	3.53
14	34.27	132.73	38.92	193.51	8.03	3.55
15	33.52	133.48	37.25	196.53	7.99	3.56
16	32.78	134.22	35.63	199.54	7.95	3.58
17	32.05	134.95	34.05	202.55	7.92	3.59
18	31.32	135.68	32.52	205.54	7.88	3.61
19	30.60	136.40	31.04	208.53	7.84	3.62
20	29.88	137.12	29.60	211.50	7.79	3.64
21	29.17	137.83	28.21	214.46	7.75	3.65
22	28.47	138.53	26.86	217.41	7.71	3.67
23	27.77	139.23	25.56	220.35	7.66	3.68
24	27.07	139.93	24.30	223.27	7.62	3.70
25	26.39	140.61	23.08	226.17	7.57	3.71
26	25.71	141.29	21.91	229.06	7.52	3.72
27	25.03	141.97	20.78	231.93	7.47	3.74
28	24.37	142.63	19.68	234.78	7.42	3.75
29	23.71	143.29	18.63	237.62	7.37	3.77
30	23.06	143.94	17.62	240.43	7.31	3.78
31	22.41	144.59	16.65	243.22	7.26	3.79
32	21.78	145.22	15.72	245.98	7.20	3.81
33	21.15	145.85	14.82	248.72	7.14	3.82
34	20.53	146.47	13.97	251.44	7.08	3.83
35	19.91	147.09	13.14	254.12	7.02	3.85
36	19.31	147.69	12.36	256.78	6.96	3.86
37	18.71	148.29	11.61	259.40	6.89	3.87
38	18.13	148.87	10.89	261.98	6.82	3.88
39	17.55	149.45	10.21	264.53	6.76	3.89
40	16.98	150.02	9.56	267.05	6.68	3.91
41	16.43	150.57	8.94	269.52	6.61	3.92
42	15.88	151.12	8.36	271.94	6.54	3.93
43	15.34	151.66	7.80	274.32	6.46	3.94
44	14.82	152.18	7.28	276.65	6.38	3.95
45	14.30	152.70	6.78	278.93	6.30	3.96
46	13.80	153.20	6.31	281.15	6.21	3.97
47	13.31	153.69	5.87	279.68	5.87	3.98
48	12.86	154.14	5.48	277.02	5.48	3.99
49	12.47	154.53	5.16	274.75	5.16	4.00
50	12.13	154.87	4.87	272.91	4.87	4.01
51	11.82	155.18	4.63	271.50	4.63	4.01
52	11.55	155.45	4.42	270.52	4.42	4.02
53	11.30	155.70	4.24	269.94	4.24	4.02
54	11.09	155.91	4.07	269.72	4.07	4.03
55	10.89	156.11	3.93	269.84	3.93	4.03
56	10.71	156.29	3.81	270.27	3.81	4.04
57	10.56	156.44	3.69	270.92	3.69	4.04
58	10.41	156.59	3.59	271.82	3.59	4.04
59	10.28	156.72	3.51	272.94	3.51	4.05
60	10.17	156.83	3.43	274.25	3.43	4.05

Net Present Value of Net Returns (NPV)/Acre $5,705.19

Table G.15. Lamb County 10 Year Buyout General Data

Period	Saturated Thickness Feet	Pump Lift Feet	GPC Acre in.	Nominal Net Return ($/Acre)	Average Water Applied Per Cropland Acre (in.)	Nominal Pumping Cost ($/Acre in.)
1	66.00	170.00	59.20	200.89	12.28	4.32
2	64.92	171.08	57.27	186.46	8.25	4.34
3	64.37	171.63	56.31	189.99	8.21	4.35
4	63.83	172.17	55.36	193.52	8.18	4.37
5	63.29	172.71	54.43	197.04	8.15	4.38
6	62.75	173.25	53.51	200.55	8.11	4.39
7	62.22	173.78	52.61	204.05	8.08	4.40
8	61.69	174.31	51.72	207.54	8.04	4.41
9	61.17	174.83	50.85	211.03	8.01	4.42
10	60.66	175.34	50.00	214.50	7.97	4.43
11	60.14	175.86	49.16	217.96	7.93	4.44
12	59.64	176.36	48.33	315.67	13.62	4.45
13	58.38	177.62	46.32	319.25	13.55	4.48
14	57.13	178.87	44.36	322.82	13.47	4.51
15	55.89	180.11	42.46	326.37	13.40	4.53
16	54.67	181.33	40.61	329.91	13.32	4.56
17	53.45	182.55	38.82	333.43	13.24	4.58
18	52.24	183.76	37.09	336.92	13.16	4.61
19	51.04	184.96	35.40	340.40	13.08	4.63
20	49.85	186.15	33.78	343.85	13.00	4.66
21	48.68	187.32	32.20	347.28	12.91	4.68
22	47.51	188.49	30.68	350.69	12.82	4.70
23	46.36	189.64	29.21	354.06	12.73	4.73
24	45.22	190.78	27.79	357.41	12.64	4.75
25	44.09	191.91	26.42	360.72	12.55	4.78
26	42.98	193.02	25.10	364.01	12.45	4.80
27	41.87	194.13	23.83	367.25	12.35	4.82
28	40.78	195.22	22.60	370.46	12.25	4.84
29	39.71	196.29	21.43	373.63	12.14	4.87
30	38.65	197.35	20.30	376.75	12.03	4.89
31	37.60	198.40	19.21	379.83	11.92	4.91
32	36.56	199.44	18.17	382.86	11.81	4.93
33	35.55	200.45	17.17	385.83	11.69	4.95
34	34.54	201.46	16.22	388.75	11.57	4.97
35	33.56	202.44	15.30	391.61	11.44	4.99
36	32.59	203.41	14.43	394.41	11.32	5.01
37	31.63	204.37	13.60	397.14	11.19	5.03
38	30.70	205.30	12.80	399.79	11.05	5.05
39	29.78	206.22	12.05	402.37	10.92	5.07
40	28.88	207.12	11.33	404.87	10.77	5.09
41	27.99	208.01	10.65	407.27	10.63	5.11
42	27.13	208.87	10.00	402.97	10.00	5.13
43	26.35	209.65	9.44	398.68	9.44	5.14
44	25.65	210.35	8.94	394.81	8.94	5.16
45	25.01	210.99	8.50	391.42	8.50	5.17
46	24.42	211.58	8.11	388.53	8.11	5.18
47	23.89	212.11	7.76	386.14	7.76	5.20
48	23.41	212.59	7.45	384.23	7.45	5.21
49	22.97	213.03	7.17	382.79	7.17	5.21
50	22.56	213.44	6.92	381.79	6.92	5.22
51	22.19	213.81	6.69	381.19	6.69	5.23
52	21.85	214.15	6.49	380.98	6.49	5.24
53	21.53	214.47	6.30	381.12	6.30	5.24
54	21.24	214.76	6.13	381.59	6.13	5.25
55	20.97	215.03	5.98	382.36	5.98	5.26
56	20.72	215.28	5.84	383.41	5.84	5.26
57	20.49	215.51	5.71	384.71	5.71	5.27
58	20.28	215.72	5.59	386.26	5.59	5.27
59	20.08	215.92	5.48	388.02	5.48	5.27
60	19.90	216.10	5.38	389.98	5.38	5.28

Net Present Value of Net Returns (NPV)/Acre $8,829.76

Table G.16. Lubbock County 10 Year Buyout General Data

Period	Saturated Thickness Feet	Pump Lift Feet	GPC Acre in.	Nominal Net Return ($/Acre)	Average Water Applied Per Cropland Acre (in.)	Nominal Pumping Cost ($/Acre in.)
1	57.00	130.00	91.45	167.45	10.78	3.49
2	55.86	131.14	87.82	151.94	7.73	3.51
3	55.18	131.82	85.71	155.00	7.70	3.53
4	54.51	132.49	83.64	158.06	7.67	3.54
5	53.85	133.15	81.61	161.11	7.64	3.56
6	53.18	133.82	79.61	164.15	7.61	3.57
7	52.53	134.47	77.66	167.19	7.57	3.58
8	51.88	135.12	75.74	170.23	7.54	3.60
9	51.23	135.77	73.87	173.25	7.51	3.61
10	50.59	136.41	72.03	176.28	7.47	3.62
11	49.95	137.05	70.23	179.29	7.44	3.64
12	49.32	137.68	68.46	222.06	10.83	3.65
13	48.17	138.83	65.31	225.06	10.77	3.67
14	47.03	139.97	62.25	228.05	10.72	3.70
15	45.89	141.11	59.29	231.03	10.66	3.72
16	44.77	142.23	56.42	234.00	10.60	3.74
17	43.66	143.34	53.64	236.96	10.54	3.77
18	42.55	144.45	50.96	239.91	10.48	3.79
19	41.45	145.55	48.36	242.85	10.42	3.81
20	40.36	146.64	45.86	245.77	10.35	3.84
21	39.29	147.71	43.44	248.68	10.29	3.86
22	38.22	148.78	41.11	251.58	10.22	3.88
23	37.16	149.84	38.87	254.45	10.15	3.90
24	36.12	150.88	36.71	257.31	10.08	3.92
25	35.08	151.92	34.64	260.16	10.01	3.95
26	34.06	152.94	32.64	262.98	9.93	3.97
27	33.04	153.96	30.73	265.78	9.86	3.99
28	32.04	154.96	28.90	268.56	9.78	4.01
29	31.05	155.95	27.14	271.32	9.70	4.03
30	30.07	156.93	25.46	274.04	9.62	4.05
31	29.11	157.89	23.85	276.75	9.53	4.07
32	28.16	158.84	22.32	279.42	9.44	4.09
33	27.22	159.78	20.85	282.06	9.36	4.11
34	26.30	160.70	19.46	284.67	9.26	4.13
35	25.38	161.62	18.14	287.24	9.17	4.15
36	24.49	162.51	16.88	289.77	9.07	4.17
37	23.61	163.39	15.69	292.27	8.98	4.18
38	22.74	164.26	14.55	294.72	8.87	4.20
39	21.89	165.11	13.49	297.12	8.77	4.22
40	21.05	165.95	12.48	299.48	8.66	4.24
41	20.24	166.76	11.53	301.78	8.55	4.25
42	19.43	167.57	10.63	304.03	8.44	4.27
43	18.65	168.35	9.79	306.21	8.32	4.29
44	17.88	169.12	9.00	308.34	8.20	4.30
45	17.14	169.86	8.26	310.39	8.08	4.32
46	16.41	170.59	7.58	307.64	7.58	4.33
47	15.75	171.25	6.99	302.99	6.99	4.35
48	15.19	171.81	6.50	299.07	6.50	4.36
49	14.71	172.29	6.09	295.92	6.09	4.37
50	14.28	172.72	5.74	293.65	5.74	4.38
51	13.91	173.09	5.45	292.18	5.45	4.39
52	13.59	173.41	5.19	291.35	5.19	4.39
53	13.30	173.70	4.98	291.07	4.98	4.40
54	13.04	173.96	4.79	291.24	4.79	4.40
55	12.82	174.18	4.63	291.78	4.63	4.41
56	12.62	174.38	4.48	292.66	4.48	4.41
57	12.44	174.56	4.36	293.81	4.36	4.42
58	12.28	174.72	4.25	295.21	4.25	4.42
59	12.14	174.86	4.15	296.82	4.15	4.42
60	12.01	174.99	4.06	298.61	4.06	4.42

Net Present Value of Net Returns (NPV)/Acre $6,641.13

Table G.17. Terry County 10 Year Buyout General Data

Period	Saturated Thickness Feet	Pump Lift Feet	GPC Acre in.	Nominal Net Return ($/Acre)	Average Water Applied Per Cropland Acre (in.)	Nominal Pumping Cost ($/Acre in.)
1	84.00	94.00	72.16	243.97	7.56	2.74
2	83.37	94.63	71.08	202.69	5.19	2.76
3	83.02	94.98	70.49	205.81	5.19	2.76
4	82.67	95.33	69.89	208.94	5.19	2.77
5	82.32	95.68	69.30	212.07	5.18	2.78
6	81.96	96.04	68.71	215.19	5.18	2.79
7	81.61	96.39	68.12	218.32	5.18	2.79
8	81.26	96.74	67.54	221.44	5.18	2.80
9	80.91	97.09	66.95	224.57	5.18	2.81
10	80.56	97.44	66.37	227.69	5.18	2.81
11	80.21	97.79	65.80	230.82	5.18	2.82
12	79.86	98.14	65.22	303.91	7.55	2.83
13	79.23	98.77	64.20	307.31	7.55	2.84
14	78.60	99.40	63.18	310.71	7.55	2.86
15	77.97	100.03	62.17	314.10	7.55	2.87
16	77.34	100.66	61.17	317.50	7.55	2.88
17	76.71	101.29	60.18	320.90	7.55	2.89
18	76.08	101.92	59.20	324.31	7.54	2.91
19	75.45	102.55	58.23	327.71	7.54	2.92
20	74.82	103.18	57.26	331.11	7.54	2.93
21	74.20	103.80	56.30	334.51	7.54	2.95
22	73.57	104.43	55.35	337.91	7.54	2.96
23	72.94	105.06	54.41	341.31	7.54	2.97
24	72.31	105.69	53.48	344.71	7.54	2.99
25	71.68	106.32	52.55	348.11	7.54	3.00
26	71.05	106.95	51.63	351.51	7.54	3.01
27	70.43	107.57	50.73	354.91	7.53	3.02
28	69.80	108.20	49.82	358.31	7.53	3.04
29	69.17	108.83	48.93	361.71	7.53	3.05
30	68.54	109.46	48.05	365.11	7.53	3.06
31	67.92	110.08	47.17	368.51	7.53	3.08
32	67.29	110.71	46.30	371.91	7.53	3.09
33	66.66	111.34	45.45	375.31	7.53	3.10
34	66.03	111.97	44.59	378.72	7.53	3.12
35	65.41	112.59	43.75	382.12	7.53	3.13
36	64.78	113.22	42.92	385.52	7.53	3.14
37	64.15	113.85	42.09	388.92	7.53	3.16
38	63.52	114.48	41.27	392.32	7.53	3.17
39	62.90	115.10	40.46	395.72	7.53	3.18
40	62.27	115.73	39.66	399.12	7.53	3.19
41	61.64	116.36	38.86	402.53	7.53	3.21
42	61.02	116.98	38.08	405.93	7.53	3.22
43	60.39	117.61	37.30	409.33	7.53	3.23
44	59.76	118.24	36.53	412.73	7.53	3.25
45	59.14	118.86	35.77	416.13	7.52	3.26
46	58.51	119.49	35.01	419.53	7.52	3.27
47	57.88	120.12	34.27	422.94	7.52	3.29
48	57.26	120.74	33.53	426.34	7.52	3.30
49	56.63	121.37	32.80	429.74	7.52	3.31
50	56.00	122.00	32.08	433.14	7.52	3.32
51	55.38	122.62	31.36	436.54	7.52	3.34
52	54.75	123.25	30.66	439.94	7.52	3.35
53	54.12	123.88	29.96	443.35	7.52	3.36
54	53.50	124.50	29.27	446.75	7.53	3.38
55	52.87	125.13	28.59	450.15	7.53	3.39
56	52.24	125.76	27.91	453.55	7.53	3.40
57	51.62	126.38	27.25	456.95	7.53	3.42
58	50.99	127.01	26.59	460.35	7.53	3.43
59	50.36	127.64	25.94	463.76	7.53	3.44
60	49.73	128.27	25.30	467.16	7.53	3.45

Net Present Value of Net Returns (NPV)/Acre $9,033.15

Table G.18. Yoakum County 10 Year Buyout General Data

Period	Saturated Thickness Feet	Pump Lift Feet	GPC Acre in.	Nominal Net Return ($/Acre)	Average Water Applied Per Cropland Acre (in.)	Nominal Pumping Cost ($/Acre in.)
1	54.00	94.00	46.04	108.95	10.91	2.74
2	53.20	94.80	44.68	99.29	4.69	2.76
3	52.98	95.02	44.32	101.29	4.68	2.76
4	52.76	95.24	43.95	103.29	4.68	2.77
5	52.54	95.46	43.59	105.29	4.68	2.77
6	52.32	95.68	43.23	107.29	4.68	2.78
7	52.11	95.89	42.87	109.29	4.67	2.78
8	51.89	96.11	42.51	111.29	4.67	2.79
9	51.67	96.33	42.16	113.29	4.67	2.79
10	51.46	96.54	41.81	115.29	4.66	2.80
11	51.24	96.76	41.45	117.29	4.66	2.80
12	51.02	96.98	41.11	178.27	9.26	2.80
13	50.38	97.62	40.07	181.56	9.25	2.82
14	49.73	98.27	39.04	184.85	9.24	2.83
15	49.08	98.92	38.04	188.14	9.24	2.85
16	48.43	99.57	37.04	191.42	9.23	2.86
17	47.79	100.21	36.06	194.71	9.23	2.87
18	47.14	100.86	35.09	198.00	9.22	2.89
19	46.50	101.50	34.14	201.29	9.21	2.90
20	45.85	102.15	33.20	204.58	9.21	2.91
21	45.21	102.79	32.27	207.86	9.20	2.93
22	44.57	103.43	31.36	211.15	9.19	2.94
23	43.93	104.07	30.47	214.44	9.19	2.95
24	43.29	104.71	29.58	217.73	9.18	2.97
25	42.64	105.36	28.71	221.02	9.17	2.98
26	42.00	106.00	27.86	224.31	9.17	2.99
27	41.36	106.64	27.02	227.60	9.16	3.01
28	40.73	107.27	26.19	230.89	9.15	3.02
29	40.09	107.91	25.37	234.17	9.14	3.03
30	39.45	108.55	24.57	237.46	9.14	3.05
31	38.81	109.19	23.79	240.75	9.13	3.06
32	38.18	109.82	23.01	244.04	9.12	3.07
33	37.54	110.46	22.25	247.33	9.11	3.08
34	36.91	111.09	21.51	250.62	9.11	3.10
35	36.27	111.73	20.77	253.91	9.10	3.11
36	35.64	112.36	20.06	257.20	9.09	3.12
37	35.01	112.99	19.35	260.49	9.08	3.14
38	34.38	113.62	18.66	263.78	9.07	3.15
39	33.74	114.26	17.98	267.07	9.07	3.16
40	33.11	114.89	17.31	270.36	9.06	3.18
41	32.49	115.51	16.66	273.65	9.05	3.19
42	31.86	116.14	16.02	276.94	9.04	3.20
43	31.23	116.77	15.40	280.23	9.03	3.22
44	30.60	117.40	14.79	283.52	9.02	3.23
45	29.98	118.02	14.19	286.80	9.01	3.24
46	29.35	118.65	13.60	290.09	9.00	3.25
47	28.73	119.27	13.03	293.60	8.99	3.27
48	28.10	119.90	12.47	297.26	8.98	3.28
49	27.48	120.52	11.92	300.92	8.97	3.29
50	26.86	121.14	11.39	304.58	8.96	3.31
51	26.24	121.76	10.87	308.24	8.95	3.32
52	25.62	122.38	10.36	311.90	8.94	3.33
53	25.00	123.00	9.87	315.56	8.93	3.35
54	24.38	123.62	9.39	319.22	8.92	3.36
55	23.77	124.23	8.92	322.88	8.91	3.37
56	23.15	124.85	8.46	325.22	8.46	3.38
57	22.58	125.42	8.05	326.84	8.05	3.40
58	22.04	125.96	7.67	327.98	7.67	3.41
59	21.54	126.46	7.33	328.78	7.33	3.42
60	21.08	126.92	7.01	329.37	7.01	3.43

Net Present Value of Net Returns (NPV)/Acre $5,554.15

Section 3: 20 Year Buyout General Data

Table G.19. Cochran County 20 Year Buyout General Data

Period	Saturated Thickness Feet	Pump Lift Feet	GPC Acre in.	Nominal Net Return ($/Acre)	Average Water Applied Per Cropland Acre (in.)	Nominal Pumping Cost ($/Acre in.)
1	35.00	143.00	20.56	104.36	10.02	3.76
2	34.29	143.71	19.73	96.44	4.98	3.78
3	34.11	143.89	19.53	98.19	4.97	3.78
4	33.93	144.07	19.32	99.93	4.95	3.78
5	33.76	144.24	19.12	101.67	4.94	3.79
6	33.58	144.42	18.92	104.25	4.92	3.79
7	33.41	144.59	18.73	106.95	4.91	3.79
8	33.23	144.77	18.54	109.65	4.89	3.80
9	33.06	144.94	18.35	112.35	4.87	3.80
10	32.90	145.10	18.16	115.04	4.86	3.80
11	32.73	145.27	17.98	117.73	4.84	3.81
12	32.56	145.44	17.80	120.41	4.82	3.81
13	32.40	145.60	17.62	123.09	4.80	3.81
14	32.24	145.76	17.44	125.77	4.78	3.82
15	32.08	145.92	17.27	128.44	4.76	3.82
16	31.93	146.07	17.10	131.11	4.74	3.82
17	31.77	146.23	16.94	133.77	4.72	3.83
18	31.62	146.38	16.78	136.43	4.70	3.83
19	31.47	146.53	16.62	139.08	4.67	3.83
20	31.32	146.68	16.46	141.73	4.65	3.84
21	31.18	146.82	16.31	144.37	4.63	3.84
22	31.03	146.97	16.16	199.59	8.95	3.84
23	30.44	147.56	15.55	202.48	8.91	3.86
24	29.84	148.16	14.95	205.35	8.86	3.87
25	29.26	148.74	14.36	208.21	8.80	3.88
26	28.67	149.33	13.80	211.06	8.75	3.89
27	28.10	149.90	13.25	213.89	8.70	3.90
28	27.53	150.47	12.72	216.70	8.64	3.92
29	26.96	151.04	12.20	219.51	8.58	3.93
30	26.40	151.60	11.70	222.29	8.53	3.94
31	25.85	152.15	11.22	225.05	8.46	3.95
32	25.30	152.70	10.75	227.80	8.40	3.96
33	24.77	153.23	10.29	230.52	8.34	3.97
34	24.23	153.77	9.85	233.22	8.27	3.98
35	23.71	154.29	9.43	235.90	8.21	3.99
36	23.19	154.81	9.02	238.55	8.14	4.01
37	22.68	155.32	8.63	241.18	8.07	4.02
38	22.17	155.83	8.25	243.78	7.99	4.03
39	21.68	156.32	7.88	246.07	7.88	4.04
40	21.19	156.81	7.54	246.09	7.54	4.05
41	20.74	157.26	7.22	246.11	7.22	4.06
42	20.33	157.67	6.93	246.16	6.93	4.07
43	19.94	158.06	6.67	246.29	6.67	4.07
44	19.58	158.42	6.44	246.52	6.44	4.08
45	19.25	158.75	6.22	246.86	6.22	4.09
46	18.94	159.06	6.02	247.32	6.02	4.09
47	18.65	159.35	5.84	247.91	5.84	4.10
48	18.38	159.62	5.67	248.63	5.67	4.11
49	18.13	159.87	5.52	249.47	5.52	4.11
50	17.89	160.11	5.37	250.44	5.37	4.12
51	17.67	160.33	5.24	251.53	5.24	4.12
52	17.46	160.54	5.12	252.73	5.12	4.12
53	17.27	160.73	5.01	254.05	5.01	4.13
54	17.09	160.91	4.90	255.48	4.90	4.13
55	16.92	161.08	4.80	257.01	4.80	4.14
56	16.76	161.24	4.71	258.63	4.71	4.14
57	16.60	161.40	4.63	260.35	4.63	4.14
58	16.46	161.54	4.55	262.15	4.55	4.15
59	16.33	161.67	4.47	264.04	4.47	4.15
60	16.20	161.80	4.40	266.00	4.40	4.15

Net Present Value of Net Returns (NPV)/Acre $4,787.28

Table G.20. Floyd County 20 Year Buyout General Data

Period	Saturated Thickness Feet	Pump Lift Feet	GPC Acre in.	Nominal Net Return ($/Acre)	Average Water Applied Per Cropland Acre (in.)	Nominal Pumping Cost ($/Acre in.)
1	76.00	226.00	75.23	130.33	9.91	5.48
2	75.22	226.78	73.71	159.46	6.70	5.50
3	74.85	227.15	72.97	162.32	6.70	5.51
4	74.47	227.53	72.24	165.18	6.69	5.52
5	74.10	227.90	71.52	168.04	6.69	5.52
6	73.73	228.27	70.80	170.90	6.69	5.53
7	73.35	228.65	70.08	173.76	6.69	5.54
8	72.98	229.02	69.37	176.62	6.68	5.55
9	72.61	229.39	68.66	179.49	6.68	5.55
10	72.23	229.77	67.96	182.35	6.68	5.56
11	71.86	230.14	67.26	185.21	6.67	5.57
12	71.49	230.51	66.57	188.07	6.67	5.58
13	71.12	230.88	65.88	190.93	6.67	5.59
14	70.75	231.25	65.19	193.79	6.66	5.59
15	70.38	231.62	64.51	196.65	6.66	5.60
16	70.01	231.99	63.83	199.51	6.66	5.61
17	69.64	232.36	63.16	202.38	6.65	5.62
18	69.27	232.73	62.49	205.24	6.65	5.62
19	68.90	233.10	61.83	208.10	6.65	5.63
20	68.53	233.47	61.17	210.96	6.65	5.64
21	68.16	233.84	60.51	213.82	6.64	5.65
22	67.79	234.21	59.86	286.22	11.95	5.65
23	66.76	235.24	58.05	289.41	11.95	5.68
24	65.73	236.27	56.27	292.60	11.94	5.70
25	64.70	237.30	54.52	295.79	11.93	5.72
26	63.67	238.33	52.80	298.99	11.93	5.74
27	62.64	239.36	51.11	302.18	11.92	5.76
28	61.61	240.39	49.44	305.37	11.92	5.78
29	60.58	241.42	47.81	308.57	11.91	5.80
30	59.56	242.44	46.20	311.77	11.91	5.83
31	58.53	243.47	44.62	314.96	11.90	5.85
32	57.50	244.50	43.07	318.16	11.90	5.87
33	56.48	245.52	41.55	321.36	11.89	5.89
34	55.46	246.54	40.06	324.55	11.89	5.91
35	54.43	247.57	38.59	327.75	11.88	5.93
36	53.41	248.59	37.15	330.95	11.88	5.95
37	52.39	249.61	35.74	334.15	11.87	5.97
38	51.36	250.64	34.36	337.35	11.87	6.00
39	50.34	251.66	33.01	340.55	11.87	6.02
40	49.32	252.68	31.68	343.75	11.86	6.04
41	48.30	253.70	30.39	346.95	11.86	6.06
42	47.28	254.72	29.12	350.16	11.85	6.08
43	46.26	255.74	27.87	353.36	11.85	6.10
44	45.24	256.76	26.66	356.56	11.85	6.12
45	44.22	257.78	25.47	359.77	11.85	6.14
46	43.20	258.80	24.31	362.97	11.84	6.16
47	42.18	259.82	23.18	366.17	11.84	6.19
48	41.17	260.83	22.07	369.38	11.84	6.21
49	40.15	261.85	21.00	372.58	11.84	6.23
50	39.13	262.87	19.94	375.79	11.83	6.25
51	38.11	263.89	18.92	378.99	11.83	6.27
52	37.10	264.90	17.92	382.20	11.83	6.29
53	36.08	265.92	16.96	385.41	11.83	6.31
54	35.06	266.94	16.01	388.61	11.83	6.33
55	34.05	267.95	15.10	391.82	11.83	6.35
56	33.03	268.97	14.21	395.03	11.83	6.38
57	32.01	269.99	13.35	398.23	11.83	6.40
58	31.00	271.00	12.51	401.44	11.83	6.42
59	29.98	272.02	11.71	404.58	11.71	6.44
60	28.98	273.02	10.94	406.30	10.94	6.46

Net Present Value of Net Returns (NPV)/Acre $7,098.92

Table G.21. Gaines County 20 Year Buyout General Data

Period	Saturated Thickness Feet	Pump Lift Feet	GPC Acre in.	Nominal Net Return ($/Acre)	Average Water Applied Per Cropland Acre (in.)	Nominal Pumping Cost ($/Acre in.)
1	80.00	106.00	114.06	78.74	12.96	2.99
2	78.62	107.38	110.16	78.19	4.40	3.02
3	78.40	107.60	109.55	80.62	4.40	3.03
4	78.19	107.81	108.95	83.05	4.40	3.03
5	77.97	108.03	108.35	85.49	4.40	3.03
6	77.75	108.25	107.75	88.59	4.40	3.04
7	77.54	108.46	107.16	91.98	4.40	3.04
8	77.32	108.68	106.56	95.37	4.39	3.05
9	77.11	108.89	105.97	98.76	4.39	3.05
10	76.90	109.10	105.38	102.15	4.39	3.06
11	76.68	109.32	104.80	105.55	4.39	3.06
12	76.47	109.53	104.21	108.94	4.39	3.07
13	76.25	109.75	103.63	112.33	4.39	3.07
14	76.04	109.96	103.05	115.72	4.39	3.07
15	75.82	110.18	102.47	119.11	4.38	3.08
16	75.61	110.39	101.89	122.50	4.38	3.08
17	75.40	110.60	101.32	125.89	4.38	3.09
18	75.19	110.81	100.75	129.28	4.38	3.09
19	74.97	111.03	100.18	132.67	4.38	3.10
20	74.76	111.24	99.61	136.06	4.38	3.10
21	74.55	111.45	99.04	139.45	4.38	3.11
22	74.33	111.67	98.48	194.90	9.00	3.11
23	73.49	112.51	96.26	199.19	9.00	3.13
24	72.65	113.35	94.07	203.49	8.99	3.14
25	71.81	114.19	91.90	207.79	8.99	3.16
26	70.97	115.03	89.76	212.09	8.99	3.18
27	70.12	115.88	87.64	216.39	8.98	3.20
28	69.28	116.72	85.55	220.69	8.98	3.21
29	68.44	117.56	83.49	224.99	8.98	3.23
30	67.60	118.40	81.45	229.29	8.98	3.25
31	66.76	119.24	79.44	233.59	8.97	3.27
32	65.92	120.08	77.46	237.90	8.97	3.28
33	65.08	120.92	75.50	242.20	8.97	3.30
34	64.25	121.75	73.56	246.50	8.97	3.32
35	63.41	122.59	71.66	250.80	8.97	3.34
36	62.57	123.43	69.77	255.10	8.96	3.35
37	61.73	124.27	67.92	259.41	8.96	3.37
38	60.89	125.11	66.09	263.71	8.96	3.39
39	60.06	125.94	64.28	268.01	8.96	3.41
40	59.22	126.78	62.50	272.31	8.96	3.42
41	58.38	127.62	60.75	276.62	8.96	3.44
42	57.54	128.46	59.02	280.92	8.96	3.46
43	56.71	129.29	57.31	285.22	8.95	3.48
44	55.87	130.13	55.63	289.53	8.95	3.49
45	55.03	130.97	53.98	293.83	8.95	3.51
46	54.20	131.80	52.35	298.14	8.95	3.53
47	53.36	132.64	50.75	302.44	8.95	3.55
48	52.52	133.48	49.17	306.74	8.95	3.56
49	51.69	134.31	47.61	311.05	8.95	3.58
50	50.85	135.15	46.09	315.35	8.95	3.60
51	50.01	135.99	44.58	319.66	8.95	3.61
52	49.18	136.82	43.10	323.96	8.95	3.63
53	48.34	137.66	41.65	328.26	8.95	3.65
54	47.50	138.50	40.22	332.57	8.96	3.67
55	46.67	139.33	38.81	336.87	8.96	3.68
56	45.83	140.17	37.43	341.18	8.96	3.70
57	44.99	141.01	36.08	345.48	8.96	3.72
58	44.15	141.85	34.75	349.78	8.96	3.74
59	43.32	142.68	33.44	354.09	8.97	3.75
60	42.48	143.52	32.16	358.39	8.97	3.77

Net Present Value of Net Returns (NPV)/Acre $4,925.72

Table G.22. Hale County 20 Year Buyout General Data

Period	Saturated Thickness Feet	Pump Lift Feet	GPC Acre in.	Nominal Net Return ($/Acre)	Average Water Applied Per Cropland Acre (in.)	Nominal Pumping Cost ($/Acre in.)
1	73.00	219.00	59.20	211.63	13.82	5.34
2	71.32	220.68	56.51	195.88	9.36	5.37
3	70.61	221.39	55.38	199.46	9.32	5.39
4	69.90	222.10	54.27	203.04	9.28	5.40
5	69.19	222.81	53.19	206.61	9.23	5.42
6	68.50	223.50	52.13	210.17	9.19	5.43
7	67.82	224.18	51.10	213.71	9.14	5.45
8	67.15	224.85	50.09	217.25	9.09	5.46
9	66.49	225.51	49.11	220.77	9.04	5.47
10	65.84	226.16	48.15	224.27	8.99	5.49
11	65.20	226.80	47.22	227.77	8.94	5.50
12	64.57	227.43	46.32	231.25	8.89	5.51
13	63.96	228.04	45.44	234.71	8.83	5.53
14	63.35	228.65	44.58	238.15	8.77	5.54
15	62.76	229.24	43.75	241.57	8.72	5.55
16	62.18	229.82	42.95	244.98	8.66	5.56
17	61.61	230.39	42.17	248.36	8.60	5.57
18	61.06	230.94	41.41	251.72	8.53	5.59
19	60.52	231.48	40.68	255.06	8.47	5.60
20	59.99	232.01	39.98	258.37	8.40	5.61
21	59.48	232.52	39.30	261.65	8.33	5.62
22	58.98	233.02	38.64	361.58	13.77	5.63
23	57.32	234.68	36.49	364.59	13.65	5.66
24	55.68	236.32	34.43	367.56	13.53	5.70
25	54.06	237.94	32.47	370.49	13.40	5.73
26	52.48	239.52	30.59	373.38	13.27	5.76
27	50.92	241.08	28.80	376.21	13.14	5.80
28	49.39	242.61	27.10	379.00	13.01	5.83
29	47.89	244.11	25.48	381.74	12.87	5.86
30	46.42	245.58	23.94	384.41	12.72	5.89
31	44.98	247.02	22.47	387.02	12.58	5.92
32	43.57	248.43	21.09	389.57	12.43	5.95
33	42.20	249.80	19.78	392.04	12.27	5.98
34	40.85	251.15	18.54	394.43	12.11	6.01
35	39.54	252.46	17.37	396.74	11.95	6.03
36	38.27	253.73	16.27	398.97	11.78	6.06
37	37.03	254.97	15.23	401.09	11.61	6.09
38	35.83	256.17	14.26	403.12	11.44	6.11
39	34.67	257.33	13.35	405.03	11.25	6.13
40	33.54	258.46	12.50	406.83	11.07	6.16
41	32.46	259.54	11.70	408.51	10.88	6.18
42	31.41	260.59	10.96	410.05	10.68	6.20
43	30.41	261.59	10.27	408.17	10.27	6.22
44	29.50	262.50	9.67	402.49	9.67	6.24
45	28.72	263.28	9.16	398.00	9.16	6.26
46	28.04	263.96	8.73	394.60	8.73	6.27
47	27.46	264.54	8.37	392.19	8.37	6.28
48	26.95	265.05	8.07	390.66	8.07	6.29
49	26.51	265.49	7.81	389.90	7.81	6.30
50	26.12	265.88	7.58	389.83	7.58	6.31
51	25.79	266.21	7.39	390.35	7.39	6.32
52	25.49	266.51	7.22	391.39	7.22	6.32
53	25.23	266.77	7.07	392.89	7.07	6.33
54	25.01	266.99	6.95	394.79	6.95	6.33
55	24.81	267.19	6.84	397.04	6.84	6.34
56	24.63	267.37	6.74	399.59	6.74	6.34
57	24.47	267.53	6.65	402.42	6.65	6.35
58	24.34	267.66	6.58	405.48	6.58	6.35
59	24.22	267.78	6.51	408.76	6.51	6.35
60	24.11	267.89	6.46	412.21	6.46	6.35

Net Present Value of Net Returns (NPV)/Acre $8,489.34

Table G.23. Hockley County 20 Year Buyout General Data

Period	Saturated Thickness Feet	Pump Lift Feet	GPC Acre in.	Nominal Net Return ($/Acre)	Average Water Applied Per Cropland Acre (in.)	Nominal Pumping Cost ($/Acre in.)
1	40.00	127.00	53.04	134.20	8.52	3.43
2	39.19	127.81	50.91	120.67	5.37	3.45
3	38.81	128.19	49.94	123.17	5.35	3.45
4	38.44	128.56	48.98	125.67	5.34	3.46
5	38.07	128.93	48.04	128.17	5.33	3.47
6	37.70	129.30	47.12	130.66	5.31	3.48
7	37.33	129.67	46.20	133.15	5.30	3.48
8	36.97	130.03	45.30	135.64	5.28	3.49
9	36.61	130.39	44.42	138.13	5.27	3.50
10	36.24	130.76	43.55	140.61	5.25	3.51
11	35.89	131.11	42.69	143.09	5.23	3.51
12	35.53	131.47	41.85	145.57	5.22	3.52
13	35.18	131.82	41.02	148.04	5.20	3.53
14	34.82	132.18	40.20	150.87	5.18	3.54
15	34.47	132.53	39.40	153.76	5.17	3.54
16	34.13	132.87	38.61	156.65	5.15	3.55
17	33.78	133.22	37.84	159.54	5.13	3.56
18	33.44	133.56	37.07	162.42	5.11	3.56
19	33.10	133.90	36.33	165.30	5.09	3.57
20	32.77	134.23	35.59	168.17	5.07	3.58
21	32.43	134.57	34.87	171.03	5.05	3.59
22	32.10	134.90	34.17	220.25	8.02	3.59
23	31.36	135.64	32.60	223.28	7.99	3.61
24	30.62	136.38	31.09	226.30	7.95	3.62
25	29.89	137.11	29.62	229.30	7.91	3.64
26	29.16	137.84	28.19	232.30	7.87	3.65
27	28.44	138.56	26.82	235.29	7.83	3.67
28	27.73	139.27	25.48	238.27	7.79	3.68
29	27.01	139.99	24.19	241.24	7.75	3.70
30	26.31	140.69	22.95	244.19	7.71	3.71
31	25.61	141.39	21.74	247.13	7.66	3.73
32	24.92	142.08	20.58	250.06	7.62	3.74
33	24.23	142.77	19.46	252.97	7.57	3.76
34	23.55	143.45	18.39	255.86	7.52	3.77
35	22.88	144.12	17.35	258.74	7.47	3.78
36	22.21	144.79	16.35	261.60	7.42	3.80
37	21.55	145.45	15.40	264.44	7.37	3.81
38	20.90	146.10	14.48	267.26	7.32	3.82
39	20.25	146.75	13.60	270.06	7.26	3.84
40	19.62	147.38	12.76	272.83	7.21	3.85
41	18.99	148.01	11.95	275.58	7.15	3.86
42	18.37	148.63	11.18	278.31	7.09	3.88
43	17.75	149.25	10.45	281.00	7.03	3.89
44	17.15	149.85	9.75	283.67	6.96	3.90
45	16.55	150.45	9.08	286.30	6.90	3.92
46	15.96	151.04	8.45	288.90	6.83	3.93
47	15.39	151.61	7.85	291.46	6.76	3.94
48	14.82	152.18	7.28	293.99	6.69	3.95
49	14.26	152.74	6.74	296.47	6.62	3.96
50	13.71	153.29	6.23	295.03	6.23	3.97
51	13.22	153.78	5.79	292.14	5.79	3.98
52	12.78	154.22	5.42	289.55	5.42	3.99
53	12.40	154.60	5.10	287.36	5.10	4.00
54	12.06	154.94	4.83	285.60	4.83	4.01
55	11.76	155.24	4.59	284.28	4.59	4.01
56	11.50	155.50	4.38	283.37	4.38	4.02
57	11.26	155.74	4.20	282.86	4.20	4.02
58	11.05	155.95	4.05	282.71	4.05	4.03
59	10.86	156.14	3.91	282.89	3.91	4.03
60	10.68	156.32	3.78	283.33	3.78	4.04

Net Present Value of Net Returns (NPV)/Acre $5,535.32

Table G.24. Lamb County 20 Year Buyout General Data

Period	Saturated Thickness Feet	Pump Lift Feet	GPC Acre in.	Nominal Net Return ($/Acre)	Average Water Applied Per Cropland Acre (in.)	Nominal Pumping Cost ($/Acre in.)
1	66.00	170.00	59.20	202.20	12.58	4.32
2	64.88	171.12	57.20	187.41	8.45	4.34
3	64.30	171.70	56.19	190.99	8.43	4.36
4	63.73	172.27	55.20	194.56	8.40	4.37
5	63.16	172.84	54.22	198.13	8.38	4.38
6	62.60	173.40	53.25	201.69	8.35	4.39
7	62.04	173.96	52.30	205.25	8.32	4.40
8	61.48	174.52	51.36	208.81	8.29	4.41
9	60.92	175.08	50.44	212.36	8.26	4.43
10	60.37	175.63	49.53	215.90	8.23	4.44
11	59.83	176.17	48.64	219.44	8.20	4.45
12	59.29	176.71	47.76	222.97	8.17	4.46
13	58.75	177.25	46.90	226.49	8.14	4.47
14	58.21	177.79	46.05	230.01	8.10	4.48
15	57.68	178.32	45.22	233.52	8.07	4.49
16	57.16	178.84	44.40	237.02	8.03	4.50
17	56.64	179.36	43.60	240.51	8.00	4.52
18	56.13	179.87	42.81	243.99	7.96	4.53
19	55.61	180.39	42.03	247.46	7.92	4.54
20	55.11	180.89	41.27	250.92	7.88	4.55
21	54.61	181.39	40.53	254.37	7.84	4.56
22	54.12	181.88	39.80	357.92	13.46	4.57
23	52.88	183.12	38.00	361.48	13.39	4.59
24	51.65	184.35	36.26	365.03	13.31	4.62
25	50.44	185.56	34.57	368.55	13.23	4.64
26	49.23	186.77	32.93	372.06	13.15	4.67
27	48.03	187.97	31.35	375.55	13.07	4.69
28	46.85	189.15	29.82	379.01	12.99	4.72
29	45.67	190.33	28.35	382.46	12.90	4.74
30	44.51	191.49	26.92	385.87	12.82	4.77
31	43.36	192.64	25.55	389.26	12.73	4.79
32	42.22	193.78	24.22	392.62	12.63	4.81
33	41.09	194.91	22.95	395.95	12.54	4.84
34	39.98	196.02	21.72	399.25	12.44	4.86
35	38.87	197.13	20.54	402.51	12.34	4.88
36	37.78	198.22	19.40	405.74	12.24	4.91
37	36.71	199.29	18.31	408.92	12.14	4.93
38	35.65	200.35	17.27	412.07	12.03	4.95
39	34.60	201.40	16.27	415.16	11.92	4.97
40	33.57	202.43	15.31	418.21	11.81	4.99
41	32.55	203.45	14.40	421.21	11.69	5.02
42	31.54	204.46	13.52	424.15	11.57	5.04
43	30.56	205.44	12.69	427.04	11.45	5.06
44	29.59	206.41	11.90	429.86	11.32	5.08
45	28.63	207.37	11.14	431.99	11.14	5.10
46	27.70	208.30	10.43	427.28	10.43	5.12
47	26.86	209.14	9.81	422.76	9.81	5.13
48	26.11	209.89	9.26	418.60	9.26	5.15
49	25.43	210.57	8.79	414.88	8.79	5.16
50	24.81	211.19	8.36	411.66	8.36	5.18
51	24.24	211.76	7.99	408.93	7.99	5.19
52	23.73	212.27	7.65	406.70	7.65	5.20
53	23.26	212.74	7.35	404.95	7.35	5.21
54	22.83	213.17	7.08	403.66	7.08	5.22
55	22.44	213.56	6.84	402.80	6.84	5.23
56	22.07	213.93	6.62	402.33	6.62	5.23
57	21.74	214.26	6.42	402.24	6.42	5.24
58	21.43	214.57	6.24	402.49	6.24	5.25
59	21.15	214.85	6.08	403.06	6.08	5.25
60	20.89	215.11	5.93	403.92	5.93	5.26

Net Present Value of Net Returns (NPV)/Acre $8,450.48

Table G.25. Lubbock County 20 Year Buyout General Data

Period	Saturated Thickness Feet	Pump Lift Feet	GPC Acre in.	Nominal Net Return ($/Acre)	Average Water Applied Per Cropland Acre (in.)	Nominal Pumping Cost ($/Acre in.)
1	57.00	130.00	91.45	168.15	10.96	3.49
2	55.83	131.17	87.73	152.48	7.86	3.51
3	55.13	131.87	85.56	155.56	7.84	3.53
4	54.44	132.56	83.42	158.64	7.81	3.54
5	53.75	133.25	81.33	161.72	7.79	3.56
6	53.07	133.93	79.27	164.79	7.76	3.57
7	52.39	134.61	77.25	167.86	7.73	3.59
8	51.71	135.29	75.27	170.93	7.70	3.60
9	51.04	135.96	73.33	173.99	7.67	3.61
10	50.38	136.62	71.43	177.05	7.64	3.63
11	49.71	137.29	69.56	180.10	7.61	3.64
12	49.06	137.94	67.73	183.15	7.58	3.66
13	48.40	138.60	65.94	186.19	7.55	3.67
14	47.75	139.25	64.19	189.23	7.52	3.68
15	47.11	139.89	62.47	192.26	7.48	3.70
16	46.47	140.53	60.79	195.29	7.45	3.71
17	45.84	141.16	59.14	198.31	7.42	3.72
18	45.21	141.79	57.54	201.32	7.38	3.74
19	44.59	142.41	55.96	204.32	7.34	3.75
20	43.97	143.03	54.43	207.32	7.30	3.76
21	43.36	143.64	52.93	210.31	7.26	3.77
22	42.76	144.24	51.46	255.14	10.57	3.79
23	41.65	145.35	48.82	258.10	10.51	3.81
24	40.55	146.45	46.28	261.05	10.45	3.83
25	39.46	147.54	43.82	263.99	10.38	3.85
26	38.37	148.63	41.45	266.91	10.32	3.88
27	37.30	149.70	39.16	269.82	10.25	3.90
28	36.24	150.76	36.97	272.71	10.19	3.92
29	35.19	151.81	34.85	275.58	10.12	3.94
30	34.15	152.85	32.82	278.44	10.04	3.96
31	33.12	153.88	30.87	281.28	9.97	3.99
32	32.10	154.90	29.00	284.10	9.90	4.01
33	31.09	155.91	27.21	286.90	9.82	4.03
34	30.09	156.91	25.49	289.68	9.74	4.05
35	29.11	157.89	23.85	292.43	9.66	4.07
36	28.14	158.86	22.29	295.15	9.58	4.09
37	27.18	159.82	20.79	297.85	9.49	4.11
38	26.23	160.77	19.37	300.51	9.41	4.13
39	25.30	161.70	18.02	303.15	9.32	4.15
40	24.38	162.62	16.73	305.75	9.22	4.17
41	23.48	163.52	15.52	308.31	9.13	4.19
42	22.59	164.41	14.36	310.84	9.03	4.20
43	21.71	165.29	13.27	313.33	8.93	4.22
44	20.85	166.15	12.24	315.77	8.83	4.24
45	20.01	166.99	11.27	318.16	8.73	4.26
46	19.18	167.82	10.35	320.51	8.62	4.28
47	18.37	168.63	9.50	322.80	8.51	4.29
48	17.57	169.43	8.69	325.03	8.39	4.31
49	16.80	170.20	7.94	323.30	7.94	4.33
50	16.09	170.91	7.29	318.30	7.29	4.34
51	15.48	171.52	6.75	313.99	6.75	4.35
52	14.96	172.04	6.30	310.42	6.30	4.36
53	14.50	172.50	5.92	307.60	5.92	4.37
54	14.10	172.90	5.60	305.57	5.60	4.38
55	13.75	173.25	5.32	304.28	5.32	4.39
56	13.45	173.55	5.09	303.61	5.09	4.39
57	13.18	173.82	4.89	303.46	4.89	4.40
58	12.94	174.06	4.71	303.74	4.71	4.41
59	12.72	174.28	4.56	304.38	4.56	4.41
60	12.53	174.47	4.42	305.34	4.42	4.41

Net Present Value of Net Returns (NPV)/Acre $6,502.02

Table G.26. Terry County 20 Year Buyout General Data

Period	Saturated Thickness Feet	Pump Lift Feet	GPC Acre in.	Nominal Net Return ($/Acre)	Average Water Applied Per Cropland Acre (in.)	Nominal Pumping Cost ($/Acre in.)
1	84.00	94.00	72.16	243.97	7.56	2.74
2	83.37	94.63	71.08	202.69	5.19	2.76
3	83.02	94.98	70.48	205.82	5.19	2.76
4	82.66	95.34	69.89	208.94	5.19	2.77
5	82.31	95.69	69.29	212.07	5.19	2.78
6	81.96	96.04	68.70	215.19	5.19	2.79
7	81.61	96.39	68.12	218.32	5.19	2.79
8	81.26	96.74	67.53	221.44	5.19	2.80
9	80.91	97.09	66.95	224.57	5.19	2.81
10	80.56	97.44	66.37	227.70	5.18	2.81
11	80.20	97.80	65.79	230.82	5.18	2.82
12	79.85	98.15	65.21	233.95	5.18	2.83
13	79.50	98.50	64.64	237.07	5.18	2.84
14	79.15	98.85	64.07	240.20	5.18	2.84
15	78.80	99.20	63.51	243.33	5.18	2.85
16	78.45	99.55	62.94	246.45	5.18	2.86
17	78.10	99.90	62.38	249.58	5.18	2.87
18	77.75	100.25	61.82	252.70	5.18	2.87
19	77.40	100.60	61.26	255.83	5.18	2.88
20	77.05	100.95	60.71	258.96	5.18	2.89
21	76.70	101.30	60.16	262.08	5.18	2.89
22	76.35	101.65	59.61	338.53	7.55	2.90
23	75.72	102.28	58.63	341.93	7.55	2.92
24	75.09	102.91	57.66	345.33	7.55	2.93
25	74.46	103.54	56.70	348.73	7.54	2.94
26	73.83	104.17	55.75	352.13	7.54	2.95
27	73.20	104.80	54.80	355.53	7.54	2.97
28	72.57	105.43	53.86	358.93	7.54	2.98
29	71.94	106.06	52.93	362.33	7.54	2.99
30	71.31	106.69	52.01	365.73	7.54	3.01
31	70.69	107.31	51.10	369.13	7.54	3.02
32	70.06	107.94	50.19	372.53	7.54	3.03
33	69.43	108.57	49.30	375.93	7.54	3.05
34	68.80	109.20	48.41	379.34	7.54	3.06
35	68.17	109.83	47.53	382.74	7.54	3.07
36	67.54	110.46	46.66	386.14	7.54	3.08
37	66.92	111.08	45.79	389.54	7.54	3.10
38	66.29	111.71	44.94	392.94	7.54	3.11
39	65.66	112.34	44.09	396.34	7.53	3.12
40	65.03	112.97	43.25	399.74	7.53	3.14
41	64.40	113.60	42.42	403.14	7.53	3.15
42	63.78	114.22	41.60	406.54	7.53	3.16
43	63.15	114.85	40.78	409.94	7.53	3.18
44	62.52	115.48	39.98	413.35	7.53	3.19
45	61.89	116.11	39.18	416.75	7.53	3.20
46	61.27	116.73	38.39	420.15	7.53	3.22
47	60.64	117.36	37.60	423.55	7.53	3.23
48	60.01	117.99	36.83	426.95	7.53	3.24
49	59.38	118.62	36.06	430.35	7.53	3.25
50	58.75	119.25	35.31	433.75	7.53	3.27
51	58.13	119.87	34.56	437.15	7.53	3.28
52	57.50	120.50	33.81	440.56	7.53	3.29
53	56.87	121.13	33.08	443.96	7.53	3.31
54	56.24	121.76	32.35	447.36	7.53	3.32
55	55.62	122.38	31.63	450.76	7.53	3.33
56	54.99	123.01	30.92	454.16	7.53	3.35
57	54.36	123.64	30.22	457.56	7.53	3.36
58	53.73	124.27	29.53	460.96	7.54	3.37
59	53.11	124.89	28.84	464.37	7.54	3.38
60	52.48	125.52	28.16	467.77	7.54	3.40

Net Present Value of Net Returns (NPV)/Acre $8,589.54

Table G.27. Yoakum County 20 Year Buyout General Data

Period	Saturated Thickness Feet	Pump Lift Feet	GPC Acre in.	Nominal Net Return ($/Acre)	Average Water Applied Per Cropland Acre (in.)	Nominal Pumping Cost ($/Acre in.)
1	54.00	94.00	46.04	109.05	11.04	2.74
2	53.18	94.82	44.66	99.33	4.73	2.76
3	52.96	95.04	44.29	101.33	4.73	2.76
4	52.74	95.26	43.92	103.33	4.73	2.77
5	52.52	95.48	43.55	105.33	4.73	2.77
6	52.29	95.71	43.18	107.33	4.73	2.78
7	52.07	95.93	42.81	109.33	4.73	2.78
8	51.85	96.15	42.45	111.33	4.73	2.79
9	51.63	96.37	42.08	113.34	4.73	2.79
10	51.40	96.60	41.72	115.34	4.73	2.80
11	51.18	96.82	41.36	117.34	4.72	2.80
12	50.96	97.04	41.00	119.61	4.72	2.81
13	50.74	97.26	40.65	122.08	4.72	2.81
14	50.52	97.48	40.29	124.55	4.72	2.82
15	50.29	97.71	39.94	127.01	4.72	2.82
16	50.07	97.93	39.59	129.48	4.72	2.82
17	49.85	98.15	39.24	131.95	4.72	2.83
18	49.63	98.37	38.89	134.42	4.72	2.83
19	49.41	98.59	38.55	136.89	4.71	2.84
20	49.19	98.81	38.20	139.36	4.71	2.84
21	48.97	99.03	37.86	141.83	4.71	2.85
22	48.75	99.25	37.52	212.45	9.36	2.85
23	48.09	99.91	36.51	215.74	9.36	2.87
24	47.43	100.57	35.52	219.03	9.35	2.88
25	46.77	101.23	34.54	222.32	9.35	2.89
26	46.12	101.88	33.58	225.61	9.35	2.91
27	45.46	102.54	32.63	228.90	9.35	2.92
28	44.80	103.20	31.69	232.18	9.34	2.93
29	44.15	103.85	30.77	235.47	9.34	2.95
30	43.49	104.51	29.86	238.76	9.34	2.96
31	42.84	105.16	28.97	242.05	9.34	2.97
32	42.18	105.82	28.09	245.34	9.34	2.99
33	41.52	106.48	27.22	248.63	9.33	3.00
34	40.87	107.13	26.37	251.92	9.33	3.02
35	40.21	107.79	25.53	255.21	9.33	3.03
36	39.56	108.44	24.71	258.50	9.33	3.04
37	38.90	109.10	23.90	261.79	9.33	3.06
38	38.25	109.75	23.10	265.08	9.32	3.07
39	37.59	110.41	22.32	268.37	9.32	3.08
40	36.94	111.06	21.55	271.66	9.32	3.10
41	36.29	111.71	20.79	274.95	9.32	3.11
42	35.63	112.37	20.05	278.24	9.32	3.12
43	34.98	113.02	19.32	281.53	9.32	3.14
44	34.32	113.68	18.60	284.83	9.32	3.15
45	33.67	114.33	17.90	288.12	9.32	3.17
46	33.02	114.98	17.21	291.41	9.31	3.18
47	32.36	115.64	16.54	294.92	9.31	3.19
48	31.71	116.29	15.88	298.58	9.31	3.21
49	31.06	116.94	15.23	302.24	9.31	3.22
50	30.40	117.60	14.60	305.91	9.31	3.23
51	29.75	118.25	13.97	309.57	9.31	3.25
52	29.10	118.90	13.37	313.24	9.31	3.26
53	28.44	119.56	12.77	316.90	9.31	3.27
54	27.79	120.21	12.19	320.56	9.31	3.29
55	27.14	120.86	11.63	324.23	9.31	3.30
56	26.49	121.51	11.08	327.89	9.31	3.31
57	25.83	122.17	10.54	331.56	9.31	3.33
58	25.18	122.82	10.01	335.22	9.31	3.34
59	24.53	123.47	9.50	338.89	9.31	3.35
60	23.87	124.13	9.00	342.29	9.00	3.37

Net Present Value of Net Returns (NPV)/Acre $5,182.23

APPENDIX H

3% DISCOUNT RATE CROP DATA

Section 1: Baseline Crop Data

Table H.1. Cochran County Baseline Crop Data

Sum of %		YEAR				
CROP	SYSTEM	1	15	30	45	60
CORN	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
CORN Total		0.00%	0.00%	0.00%	0.00%	0.00%
COTTON	DRY	26.08%	42.72%	42.72%	50.28%	46.40%
	IRRLEPA	36.96%	57.28%	57.28%	49.72%	53.60%
	IRRDRIP	2.32%	0.00%	0.00%	0.00%	0.00%
COTTON Total		65.35%	100.00%	100.00%	100.00%	100.00%
PEANUTS	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	6.57%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
PEANUTS Total		6.57%	0.00%	0.00%	0.00%	0.00%
SORGHUM	DRY	13.36%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	9.29%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM Total		22.65%	0.00%	0.00%	0.00%	0.00%
WHEAT	DRY	3.09%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	2.14%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
WHEAT Total		5.24%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK	DRY	0.19%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK Total		0.19%	0.00%	0.00%	0.00%	0.00%
Grand Total		100.00%	100.00%	100.00%	100.00%	100.00%

Table H.2. Floyd County Baseline Crop Data

Sum of %		YEAR				
CROP	SYSTEM	1	15	30	45	60
CORN	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
CORN Total		0.00%	0.00%	0.00%	0.00%	0.00%
COTTON	DRY	18.16%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	36.18%	57.45%	57.45%	57.45%	57.45%
	IRRDRIP	6.38%	0.00%	0.00%	0.00%	0.00%
COTTON Total		60.73%	57.45%	57.45%	57.45%	57.45%
PEANUTS	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
PEANUTS Total		0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM	DRY	7.33%	42.55%	42.55%	42.55%	42.55%
	IRRLEPA	12.38%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM Total		19.71%	42.55%	42.55%	42.55%	42.55%
WHEAT	DRY	16.93%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	2.50%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
WHEAT Total		19.43%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK	DRY	0.13%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK Total		0.13%	0.00%	0.00%	0.00%	0.00%
Grand Total		100.00%	100.00%	100.00%	100.00%	100.00%

Table H.3. Gaines County Baseline Crop Data

Sum of %		YEAR				
CROP	SYSTEM	1	15	30	45	60
CORN	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
CORN Total		0.00%	0.00%	0.00%	0.00%	0.00%
COTTON	DRY	21.02%	24.23%	24.23%	24.23%	24.23%
	IRRLEPA	49.08%	75.77%	75.77%	75.77%	75.77%
	IRRDRIP	0.06%	0.00%	0.00%	0.00%	0.00%
COTTON Total		70.16%	100.00%	100.00%	100.00%	100.00%
PEANUTS	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	19.31%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
PEANUTS Total		19.31%	0.00%	0.00%	0.00%	0.00%
SORGHUM	DRY	1.60%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	1.10%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM Total		2.70%	0.00%	0.00%	0.00%	0.00%
WHEAT	DRY	1.51%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	6.22%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
WHEAT Total		7.73%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK	DRY	0.10%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK Total		0.10%	0.00%	0.00%	0.00%	0.00%
Grand Total		100.00%	100.00%	100.00%	100.00%	100.00%

Table H.4. Hale County Baseline Crop Data

Sum of %		YEAR				
CROP	SYSTEM	1	15	30	45	60
CORN	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
CORN Total		0.00%	0.00%	0.00%	0.00%	0.00%
COTTON	DRY	7.67%	13.91%	13.91%	13.91%	13.91%
	IRRLEPA	65.62%	86.09%	86.09%	86.09%	86.09%
	IRRDRIP	3.31%	0.00%	0.00%	0.00%	0.00%
COTTON Total		76.60%	100.00%	100.00%	100.00%	100.00%
PEANUTS	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
PEANUTS Total		0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM	DRY	2.13%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	11.36%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM Total		13.49%	0.00%	0.00%	0.00%	0.00%
WHEAT	DRY	4.01%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	5.80%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
WHEAT Total		9.81%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK	DRY	0.10%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK Total		0.10%	0.00%	0.00%	0.00%	0.00%
Grand Total		100.00%	100.00%	100.00%	100.00%	100.00%

Table H.5. Hockley County Baseline Crop Data

Sum of %		YEAR				
CROP	SYSTEM	1	15	30	45	60
CORN	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
CORN Total		0.00%	0.00%	0.00%	0.00%	0.00%
COTTON	DRY	37.90%	45.45%	45.45%	45.45%	54.84%
	IRRLEPA	43.65%	54.55%	54.55%	54.55%	45.16%
	IRRDRIP	1.89%	0.00%	0.00%	0.00%	0.00%
COTTON Total		83.45%	100.00%	100.00%	100.00%	100.00%
PEANUTS	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	2.41%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
PEANUTS Total		2.41%	0.00%	0.00%	0.00%	0.00%
SORGHUM	DRY	6.82%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	6.19%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM Total		13.01%	0.00%	0.00%	0.00%	0.00%
WHEAT	DRY	0.62%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.40%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
WHEAT Total		1.02%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK	DRY	0.12%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK Total		0.12%	0.00%	0.00%	0.00%	0.00%
Grand Total		100.00%	100.00%	100.00%	100.00%	100.00%

Table H.6. Lamb County Baseline Crop Data

Sum of %		YEAR				
CROP	SYSTEM	1	15	30	45	60
CORN	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
CORN Total		0.00%	0.00%	0.00%	0.00%	0.00%
COTTON	DRY	15.58%	27.27%	27.27%	27.27%	27.27%
	IRRLEPA	53.94%	72.73%	72.73%	72.73%	72.73%
	IRRDRIP	2.27%	0.00%	0.00%	0.00%	0.00%
COTTON Total		71.79%	100.00%	100.00%	100.00%	100.00%
PEANUTS	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
PEANUTS Total		0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM	DRY	6.76%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	13.28%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM Total		20.04%	0.00%	0.00%	0.00%	0.00%
WHEAT	DRY	4.80%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	3.23%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
WHEAT Total		8.03%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK	DRY	0.14%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK Total		0.14%	0.00%	0.00%	0.00%	0.00%
Grand Total		100.00%	100.00%	100.00%	100.00%	100.00%

Table H.7. Lubbock County Baseline Crop Data

Sum of %		YEAR				
CROP	SYSTEM	1	15	30	45	60
CORN	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
CORN Total		0.00%	0.00%	0.00%	0.00%	0.00%
COTTON	DRY	29.91%	36.54%	36.54%	40.05%	55.93%
	IRRLEPA	55.95%	63.46%	63.46%	59.95%	44.07%
	IRRDRIP	1.92%	0.00%	0.00%	0.00%	0.00%
COTTON Total		87.78%	100.00%	100.00%	100.00%	100.00%
PEANUTS	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
PEANUTS Total		0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM	DRY	4.53%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	4.57%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM Total		9.11%	0.00%	0.00%	0.00%	0.00%
WHEAT	DRY	1.97%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	1.02%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
WHEAT Total		2.99%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK	DRY	0.12%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK Total		0.12%	0.00%	0.00%	0.00%	0.00%
Grand Total		100.00%	100.00%	100.00%	100.00%	100.00%

Table H.8. Terry County Baseline Crop Data

Sum of %		YEAR				
CROP	SYSTEM	1	15	30	45	60
CORN	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
CORN Total		0.00%	0.00%	0.00%	0.00%	0.00%
COTTON	DRY	43.97%	48.63%	48.63%	48.63%	48.63%
	IRRLEPA	46.35%	51.37%	51.37%	51.37%	51.37%
	IRRDRIP	0.63%	0.00%	0.00%	0.00%	0.00%
COTTON Total		90.95%	100.00%	100.00%	100.00%	100.00%
PEANUTS	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
PEANUTS Total		0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM	DRY	3.63%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	1.26%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM Total		4.89%	0.00%	0.00%	0.00%	0.00%
WHEAT	DRY	0.89%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	3.13%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
WHEAT Total		4.02%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK	DRY	0.13%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK Total		0.13%	0.00%	0.00%	0.00%	0.00%
Grand Total		100.00%	100.00%	100.00%	100.00%	100.00%

Table H.9. Yoakum County Baseline Crop Data

Sum of %		YEAR				
CROP	SYSTEM	1	15	30	45	60
CORN	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
CORN Total		0.00%	0.00%	0.00%	0.00%	0.00%
COTTON	DRY	31.09%	0.00%	0.00%	0.00%	41.80%
	IRRLEPA	38.74%	58.20%	58.20%	58.20%	58.20%
	IRRDRIP	0.32%	0.00%	0.00%	0.00%	0.00%
COTTON Total		70.16%	58.20%	58.20%	58.20%	100.00%
PEANUTS	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	13.65%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
PEANUTS Total		13.65%	0.00%	0.00%	0.00%	0.00%
SORGHUM	DRY	8.53%	41.80%	41.80%	41.80%	0.00%
	IRRLEPA	1.10%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM Total		9.63%	41.80%	41.80%	41.80%	0.00%
WHEAT	DRY	1.97%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	4.38%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
WHEAT Total		6.35%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK	DRY	0.21%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK Total		0.21%	0.00%	0.00%	0.00%	0.00%
Grand Total		100.00%	100.00%	100.00%	100.00%	100.00%

Section 2: 10 Year Water Rights Buyout Crop Data

Table H.10. Cochran County 10 Year Buyout Crop Data

Sum of %		YEAR				
CROP	SYSTEM	1	15	30	45	60
CORN	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
CORN Total		0.00%	0.00%	0.00%	0.00%	0.00%
COTTON	DRY	26.08%	42.72%	42.72%	42.72%	42.74%
	IRRLEPA	36.96%	57.28%	57.28%	57.28%	57.26%
	IRRDRIP	2.32%	0.00%	0.00%	0.00%	0.00%
COTTON Total		65.35%	100.00%	100.00%	100.00%	100.00%
PEANUTS	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	6.57%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
PEANUTS Total		6.57%	0.00%	0.00%	0.00%	0.00%
SORGHUM	DRY	13.36%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	9.29%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM Total		22.65%	0.00%	0.00%	0.00%	0.00%
WHEAT	DRY	3.09%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	2.14%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
WHEAT Total		5.24%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK	DRY	0.19%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK Total		0.19%	0.00%	0.00%	0.00%	0.00%
Grand Total		100.00%	100.00%	100.00%	100.00%	100.00%

Table H.11. Floyd County 10 Year Buyout Crop Data

Sum of %		YEAR				
CROP	SYSTEM	1	15	30	45	60
CORN	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
CORN Total		0.00%	0.00%	0.00%	0.00%	0.00%
COTTON	DRY	18.16%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	36.18%	57.45%	57.45%	57.45%	57.45%
	IRRDRIP	6.38%	0.00%	0.00%	0.00%	0.00%
COTTON Total		60.73%	57.45%	57.45%	57.45%	57.45%
PEANUTS	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
PEANUTS Total		0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM	DRY	7.33%	42.55%	42.55%	42.55%	42.55%
	IRRLEPA	12.38%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM Total		19.71%	42.55%	42.55%	42.55%	42.55%
WHEAT	DRY	16.93%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	2.50%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
WHEAT Total		19.43%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK	DRY	0.13%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK Total		0.13%	0.00%	0.00%	0.00%	0.00%
Grand Total		100.00%	100.00%	100.00%	100.00%	100.00%

Table H.12. Gaines County 10 Year Buyout Crop Data

Sum of %		YEAR				
CROP	SYSTEM	1	15	30	45	60
CORN	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
CORN Total		0.00%	0.00%	0.00%	0.00%	0.00%
COTTON	DRY	21.02%	24.23%	24.23%	24.23%	24.23%
	IRRLEPA	49.08%	75.77%	75.77%	75.77%	75.77%
	IRRDRIP	0.06%	0.00%	0.00%	0.00%	0.00%
COTTON Total		70.16%	100.00%	100.00%	100.00%	100.00%
PEANUTS	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	19.31%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
PEANUTS Total		19.31%	0.00%	0.00%	0.00%	0.00%
SORGHUM	DRY	1.60%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	1.10%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM Total		2.70%	0.00%	0.00%	0.00%	0.00%
WHEAT	DRY	1.51%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	6.22%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
WHEAT Total		7.73%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK	DRY	0.10%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK Total		0.10%	0.00%	0.00%	0.00%	0.00%
Grand Total		100.00%	100.00%	100.00%	100.00%	100.00%

Table H.13. Hale County 10 Year Buyout Crop Data

Sum of %		YEAR				
CROP	SYSTEM	1	15	30	45	60
CORN	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
CORN Total		0.00%	0.00%	0.00%	0.00%	0.00%
COTTON	DRY	7.67%	13.91%	13.91%	13.91%	13.91%
	IRRLEPA	65.62%	86.09%	86.09%	86.09%	86.09%
	IRRDRIP	3.31%	0.00%	0.00%	0.00%	0.00%
COTTON Total		76.60%	100.00%	100.00%	100.00%	100.00%
PEANUTS	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
PEANUTS Total		0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM	DRY	2.13%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	11.36%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM Total		13.49%	0.00%	0.00%	0.00%	0.00%
WHEAT	DRY	4.01%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	5.80%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
WHEAT Total		9.81%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK	DRY	0.10%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK Total		0.10%	0.00%	0.00%	0.00%	0.00%
Grand Total		100.00%	100.00%	100.00%	100.00%	100.00%

Table H.14. Hockley County 10 Year Buyout Crop Data

Sum of %		YEAR				
CROP	SYSTEM	1	15	30	45	60
CORN	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
CORN Total		0.00%	0.00%	0.00%	0.00%	0.00%
COTTON	DRY	37.90%	45.45%	45.45%	45.45%	51.05%
	IRRLEPA	43.65%	54.55%	54.55%	54.55%	48.95%
	IRRDRIP	1.89%	0.00%	0.00%	0.00%	0.00%
COTTON Total		83.45%	100.00%	100.00%	100.00%	100.00%
PEANUTS	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	2.41%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
PEANUTS Total		2.41%	0.00%	0.00%	0.00%	0.00%
SORGHUM	DRY	6.82%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	6.19%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM Total		13.01%	0.00%	0.00%	0.00%	0.00%
WHEAT	DRY	0.62%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.40%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
WHEAT Total		1.02%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK	DRY	0.12%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK Total		0.12%	0.00%	0.00%	0.00%	0.00%
Grand Total		100.00%	100.00%	100.00%	100.00%	100.00%

Table H.15. Lamb County 10 Year Buyout Crop Data

Sum of %		YEAR				
CROP	SYSTEM	1	15	30	45	60
CORN	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
CORN Total		0.00%	0.00%	0.00%	0.00%	0.00%
COTTON	DRY	15.58%	27.27%	27.27%	27.27%	27.27%
	IRRLEPA	53.94%	72.73%	72.73%	72.73%	72.73%
	IRRDRIP	2.27%	0.00%	0.00%	0.00%	0.00%
COTTON Total		71.79%	100.00%	100.00%	100.00%	100.00%
PEANUTS	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
PEANUTS Total		0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM	DRY	6.76%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	13.28%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM Total		20.04%	0.00%	0.00%	0.00%	0.00%
WHEAT	DRY	4.80%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	3.23%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
WHEAT Total		8.03%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK	DRY	0.14%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK Total		0.14%	0.00%	0.00%	0.00%	0.00%
Grand Total		100.00%	100.00%	100.00%	100.00%	100.00%

Table H.16. Lubbock County 10 Year Buyout Crop Data

Sum of %		YEAR				
CROP	SYSTEM	1	15	30	45	60
CORN	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
CORN Total		0.00%	0.00%	0.00%	0.00%	0.00%
COTTON	DRY	29.91%	36.54%	36.54%	36.54%	52.90%
	IRRLEPA	55.95%	63.46%	63.46%	63.46%	47.10%
	IRRDRIP	1.92%	0.00%	0.00%	0.00%	0.00%
COTTON Total		87.78%	100.00%	100.00%	100.00%	100.00%
PEANUTS	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
PEANUTS Total		0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM	DRY	4.53%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	4.57%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM Total		9.11%	0.00%	0.00%	0.00%	0.00%
WHEAT	DRY	1.97%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	1.02%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
WHEAT Total		2.99%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK	DRY	0.12%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK Total		0.12%	0.00%	0.00%	0.00%	0.00%
Grand Total		100.00%	100.00%	100.00%	100.00%	100.00%

Table H.17 Terry County 10 Year Buyout Crop Data

Sum of %		YEAR				
CROP	SYSTEM	1	15	30	45	60
CORN	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
CORN Total		0.00%	0.00%	0.00%	0.00%	0.00%
COTTON	DRY	43.97%	48.63%	48.63%	48.63%	48.63%
	IRRLEPA	46.35%	51.37%	51.37%	51.37%	51.37%
	IRRDRIP	0.63%	0.00%	0.00%	0.00%	0.00%
COTTON Total		90.95%	100.00%	100.00%	100.00%	100.00%
PEANUTS	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
PEANUTS Total		0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM	DRY	3.63%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	1.26%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM Total		4.89%	0.00%	0.00%	0.00%	0.00%
WHEAT	DRY	0.89%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	3.13%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
WHEAT Total		4.02%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK	DRY	0.13%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK Total		0.13%	0.00%	0.00%	0.00%	0.00%
Grand Total		100.00%	100.00%	100.00%	100.00%	100.00%

Table H.18. Yoakum County 10 Year Buyout Crop Data

Sum of %		YEAR				
CROP	SYSTEM	1	15	30	45	60
CORN	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
CORN Total		0.00%	0.00%	0.00%	0.00%	0.00%
COTTON	DRY	31.09%	0.00%	0.00%	0.00%	41.80%
	IRRLEPA	38.74%	58.20%	58.20%	58.20%	58.20%
	IRRDRIP	0.32%	0.00%	0.00%	0.00%	0.00%
COTTON Total		70.16%	58.20%	58.20%	58.20%	100.00%
PEANUTS	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	13.65%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
PEANUTS Total		13.65%	0.00%	0.00%	0.00%	0.00%
SORGHUM	DRY	8.53%	41.80%	41.80%	41.80%	0.00%
	IRRLEPA	1.10%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM Total		9.63%	41.80%	41.80%	41.80%	0.00%
WHEAT	DRY	1.97%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	4.38%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
WHEAT Total		6.35%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK	DRY	0.21%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK Total		0.21%	0.00%	0.00%	0.00%	0.00%
Grand Total		100.00%	100.00%	100.00%	100.00%	100.00%

Section 3: 20 Year Water Rights Buyout Crop Data

Table H.19. Cochran County 20 Year Buyout Crop Data

Sum of %		YEAR				
CROP	SYSTEM	1	15	30	45	60
CORN	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
CORN Total		0.00%	0.00%	0.00%	0.00%	0.00%
COTTON	DRY	26.08%	70.54%	42.72%	42.72%	42.72%
	IRRLEPA	36.96%	29.46%	57.28%	57.28%	57.28%
	IRRDRIP	2.32%	0.00%	0.00%	0.00%	0.00%
COTTON Total		65.35%	100.00%	100.00%	100.00%	100.00%
PEANUTS	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	6.57%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
PEANUTS Total		6.57%	0.00%	0.00%	0.00%	0.00%
SORGHUM	DRY	13.36%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	9.29%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM Total		22.65%	0.00%	0.00%	0.00%	0.00%
WHEAT	DRY	3.09%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	2.14%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
WHEAT Total		5.24%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK	DRY	0.19%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK Total		0.19%	0.00%	0.00%	0.00%	0.00%
Grand Total		100.00%	100.00%	100.00%	100.00%	100.00%

Table H.20. Floyd County 20 Year Buyout Crop Data

Sum of %		YEAR				
CROP	SYSTEM	1	15	30	45	60
CORN	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
CORN Total		0.00%	0.00%	0.00%	0.00%	0.00%
COTTON	DRY	18.16%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	36.18%	31.92%	57.45%	57.45%	57.45%
	IRRDRIP	6.38%	0.00%	0.00%	0.00%	0.00%
COTTON Total		60.73%	31.92%	57.45%	57.45%	57.45%
PEANUTS	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
PEANUTS Total		0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM	DRY	7.33%	68.08%	42.55%	42.55%	42.55%
	IRRLEPA	12.38%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM Total		19.71%	68.08%	42.55%	42.55%	42.55%
WHEAT	DRY	16.93%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	2.50%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
WHEAT Total		19.43%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK	DRY	0.13%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK Total		0.13%	0.00%	0.00%	0.00%	0.00%
Grand Total		100.00%	100.00%	100.00%	100.00%	100.00%

TableH.21 Gaines County 20 Year Buyout Crop Data

Sum of %		YEAR				
CROP	SYSTEM	1	15	30	45	60
CORN	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
CORN Total		0.00%	0.00%	0.00%	0.00%	0.00%
COTTON	DRY	21.02%	63.15%	24.23%	24.23%	24.23%
	IRRLEPA	49.08%	36.85%	75.77%	75.77%	75.77%
	IRRDRIP	0.06%	0.00%	0.00%	0.00%	0.00%
COTTON Total		70.16%	100.00%	100.00%	100.00%	100.00%
PEANUTS	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	19.31%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
PEANUTS Total		19.31%	0.00%	0.00%	0.00%	0.00%
SORGHUM	DRY	1.60%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	1.10%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM Total		2.70%	0.00%	0.00%	0.00%	0.00%
WHEAT	DRY	1.51%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	6.22%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
WHEAT Total		7.73%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK	DRY	0.10%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK Total		0.10%	0.00%	0.00%	0.00%	0.00%
Grand Total		100.00%	100.00%	100.00%	100.00%	100.00%

Table H.22. Hale County 20 Year Buyout Crop Data

Sum of %		YEAR				
CROP	SYSTEM	1	15	30	45	60
CORN	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
CORN Total		0.00%	0.00%	0.00%	0.00%	0.00%
COTTON	DRY	7.67%	48.30%	13.91%	13.91%	13.91%
	IRRLEPA	65.62%	51.70%	86.09%	86.09%	86.09%
	IRRDRIP	3.31%	0.00%	0.00%	0.00%	0.00%
COTTON Total		76.60%	100.00%	100.00%	100.00%	100.00%
PEANUTS	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
PEANUTS Total		0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM	DRY	2.13%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	11.36%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM Total		13.49%	0.00%	0.00%	0.00%	0.00%
WHEAT	DRY	4.01%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	5.80%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
WHEAT Total		9.81%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK	DRY	0.10%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK Total		0.10%	0.00%	0.00%	0.00%	0.00%
Grand Total		100.00%	100.00%	100.00%	100.00%	100.00%

Table H.23. Hockley County 20 Year Buyout Crop Data

Sum of %		YEAR				
CROP	SYSTEM	1	15	30	45	60
CORN	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
CORN Total		0.00%	0.00%	0.00%	0.00%	0.00%
COTTON	DRY	37.90%	65.84%	45.45%	45.45%	45.95%
	IRRLEPA	43.65%	34.16%	54.55%	54.55%	54.05%
	IRRDRIP	1.89%	0.00%	0.00%	0.00%	0.00%
COTTON Total		83.45%	100.00%	100.00%	100.00%	100.00%
PEANUTS	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	2.41%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
PEANUTS Total		2.41%	0.00%	0.00%	0.00%	0.00%
SORGHUM	DRY	6.82%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	6.19%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM Total		13.01%	0.00%	0.00%	0.00%	0.00%
WHEAT	DRY	0.62%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.40%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
WHEAT Total		1.02%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK	DRY	0.12%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK Total		0.12%	0.00%	0.00%	0.00%	0.00%
Grand Total		100.00%	100.00%	100.00%	100.00%	100.00%

Table H.24. Lamb County 20 Year Buyout Crop Data

Sum of %		YEAR				
CROP	SYSTEM	1	15	30	45	60
CORN	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
CORN Total		0.00%	0.00%	0.00%	0.00%	0.00%
COTTON	DRY	15.58%	57.84%	27.27%	27.27%	27.27%
	IRRLEPA	53.94%	42.16%	72.73%	72.73%	72.73%
	IRRDRIP	2.27%	0.00%	0.00%	0.00%	0.00%
COTTON Total		71.79%	100.00%	100.00%	100.00%	100.00%
PEANUTS	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
PEANUTS Total		0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM	DRY	6.76%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	13.28%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM Total		20.04%	0.00%	0.00%	0.00%	0.00%
WHEAT	DRY	4.80%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	3.23%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
WHEAT Total		8.03%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK	DRY	0.14%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK Total		0.14%	0.00%	0.00%	0.00%	0.00%
Grand Total		100.00%	100.00%	100.00%	100.00%	100.00%

Table H.25. Lubbock County 20 Year Buyout Crop Data

Sum of %		YEAR				
CROP	SYSTEM	1	15	30	45	60
CORN	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
CORN Total		0.00%	0.00%	0.00%	0.00%	0.00%
COTTON	DRY	29.91%	56.60%	36.54%	36.54%	48.74%
	IRRLEPA	55.95%	43.40%	63.46%	63.46%	51.26%
	IRRDRIP	1.92%	0.00%	0.00%	0.00%	0.00%
COTTON Total		87.78%	100.00%	100.00%	100.00%	100.00%
PEANUTS	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
PEANUTS Total		0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM	DRY	4.53%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	4.57%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM Total		9.11%	0.00%	0.00%	0.00%	0.00%
WHEAT	DRY	1.97%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	1.02%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
WHEAT Total		2.99%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK	DRY	0.12%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK Total		0.12%	0.00%	0.00%	0.00%	0.00%
Grand Total		100.00%	100.00%	100.00%	100.00%	100.00%

Table H.26. Terry County Unconstrained0 Year Buyout Crop Data

Sum of %		YEAR				
CROP	SYSTEM	1	15	30	45	60
CORN	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
CORN Total		0.00%	0.00%	0.00%	0.00%	0.00%
COTTON	DRY	43.97%	64.76%	48.63%	48.63%	48.63%
	IRRLEPA	46.35%	35.24%	51.37%	51.37%	51.37%
	IRRDRIP	0.63%	0.00%	0.00%	0.00%	0.00%
COTTON Total		90.95%	100.00%	100.00%	100.00%	100.00%
PEANUTS	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
PEANUTS Total		0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM	DRY	3.63%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	1.26%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM Total		4.89%	0.00%	0.00%	0.00%	0.00%
WHEAT	DRY	0.89%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	3.13%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
WHEAT Total		4.02%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK	DRY	0.13%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK Total		0.13%	0.00%	0.00%	0.00%	0.00%
Grand Total		100.00%	100.00%	100.00%	100.00%	100.00%

Table H.27. Yoakum County 20 Year Buyout Crop Data

Sum of %		YEAR				
CROP	SYSTEM	1	15	30	45	60
CORN	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
CORN Total		0.00%	0.00%	0.00%	0.00%	0.00%
COTTON	DRY	31.09%	0.00%	0.00%	0.00%	41.80%
	IRRLEPA	38.74%	29.30%	58.20%	58.20%	58.20%
	IRRDRIP	0.32%	0.00%	0.00%	0.00%	0.00%
COTTON Total		70.16%	29.30%	58.20%	58.20%	100.00%
PEANUTS	DRY	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	13.65%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
PEANUTS Total		13.65%	0.00%	0.00%	0.00%	0.00%
SORGHUM	DRY	8.53%	70.70%	41.80%	41.80%	0.00%
	IRRLEPA	1.10%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
SORGHUM Total		9.63%	70.70%	41.80%	41.80%	0.00%
WHEAT	DRY	1.97%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	4.38%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
WHEAT Total		6.35%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK	DRY	0.21%	0.00%	0.00%	0.00%	0.00%
	IRRLEPA	0.00%	0.00%	0.00%	0.00%	0.00%
	IRRDRIP	0.00%	0.00%	0.00%	0.00%	0.00%
LIVESTOCK Total		0.21%	0.00%	0.00%	0.00%	0.00%
Grand Total		100.00%	100.00%	100.00%	100.00%	100.00%

APPENDIX I

BASELINE DYNAMIC OPTIMIZATION MODEL

FOR LUBBOCK COUNTY

Table I.1. Lubbock County GAMS Dynamic Optimization Model

```
*  Lubbock County
*  Suppress listing of equations and columns if Limrow=0, Limcol=0
OPTION LIMCOL = 0;
OPTION LIMROW = 0;
*Surpress listing of solution in lst file if set solprint=off
Option solprint = off;

SETS
    C      CROPS / COTTON, CORN, PEANUTS, SORGHUM, WHEAT,
LIVESTOCK/
    B      IRRIG CROP PRODUCTION FUNCTION PARAMETERS /B0, B1, B2/
    I      IRRIGATION SYSTEMS / IRRLEPA, IRRDRIP, DRY /
    T      NUMBER TIME PERIODS IN OPTIMIZATION / 1*60/
    SUBT(T) NUMBER TIME PERIODS USED IN NPV CALCULATION /1*60/;

**********************************************************************
**********************************************************************
*  COUNTY SPECIFIC PARAMETERS
**********************************************************************

ACRONYM Lubbock;
PARAMETER  CNTYNAME;

CNTYNAME = Lubbock;

SCALAR AREA      COUNTY LAND AREA (acres)  /575360/;

SCALAR AREAAQ    COUNTY AREA ABOVE OGALLALA AQUIFER (acres)
/575360/;

SCALAR RECHARGE   AMOUNT OF RECHARGE IN INCHES PER ACRE /3.3196/;

SCALAR SPECYLD    SPECIFIC YIELD /.156/;

SCALAR ISATTHK    INITIAL SATURATED THICKNESS (feet) /57/;

SCALAR ILIFT      INITIAL LIFT (feet) /130/;

SCALAR IWellYld   INITIAL WELL YIELD (gpm) /600/;

SCALAR IAcPerWell INITIAL ACRES SERVED PER WELL /29/;
```

Table I.1. Continued

```
TABLE MINWATER(I,C) Minimum water application by crop per irr acre

            COTTON    CORN    PEANUTS  SORGHUM    WHEAT   LIVESTOCK
IRRLEPA        7        14        8         7         6         0
IRRDRIP        6        13        7         6         5         0
DRY            0         0        0         0         0         0;

TABLE IACRESC(C,I)  YEAR 1 ACREAGE (MAJOR IRR AND NONIRR)

            IRRLEPA   IRRDRIP    DRY
COTTON     144675       5000    74700
CORN            0          0        0
PEANUTS         0          0        0
SORGHUM     11825          0    11325
WHEAT        2625          0     4925
LIVESTOCK       0          0      300  ;

PARAMETER ICI(I) TOTAL YR1 IRR VS DRY (NOT JUST MAJOR)

    /IRRLEPA     160000
     IRRDRIP   5000
     DRY   95000 /;

PARAMETER MIACRESC YR 1 MAJOR ACREAGE BY SYSTEM(IRR VS DRY);

    MIACRESC(I) = SUM(C, IACRESC(C,I));
    DISPLAY MIACRESC;

PARAMETER TMIACRES YR 1 TOTAL MAJOR ACREAGE (IRR AND DRY);

    TMIACRES = SUM(C, SUM(I, IACRESC(C,I)));
    DISPLAY TMIACRES;

*****

PARAMETER SCALE(I) SCALE FACTOR TO ADJUST FOR OMMITTED CROPS;

    SCALE(I) = ICI(I)/MIACRESC(I);

PARAMETER RIACRES(C,I) ADJUSTED MAJOR YR1 ACREAGES IRR AND
DRY;
```

Table I.1. Continued

```
    RIACRES(C,I) = SCALE(I)*IACRESC(C,I);

PARAMETER RIACRESI(I) ADJUSTED YR1 IRR VS DRY ACREAGE;

    RIACRESI(I) = SUM(C, RIACRES(C,I));
    DISPLAY RIACRESI;

PARAMETER SP(I,C,T) PERCENT CROP BY SYSTEM (CROP DISTRIBUTION in
T=1);

    SP(I,C,"1") =  RIACRES(C,I)/ICI(I);
    DISPLAY SP;

PARAMETER RTOTACRES CHECKING SCALING EFFECT FOR ACCURACY;

    RTOTACRES = SUM(C, SUM(I, RIACRES(C,I)));
    DISPLAY RTOTACRES;

PARAMETER PIRRACRES YR 1 PERCENT OF ACREAGE THAT IS IRRIGATED;

    PIRRACRES = (RIACRESI("IRRLEPA")+ RIACRESI("IRRDRIP"))/RTOTACRES;
    DISPLAY PIRRACRES;

*****
PARAMETER TOTCACRES TOTAL YR1 COUNTY ACREAGE (NOT JUST
MAJOR);

    TOTCACRES = SUM(I, ICI(I));
    DISPLAY TOTCACRES;

PARAMETER PIPEANUT YR 1 IRRI PEANUT ACRES AS % OF ALL (I&D)
ACREAGE;

    PIPEANUT = (RIACRES("PEANUTS","IRRLEPA") +
RIACRES("PEANUTS","IRRDRIP"))
            /RTOTACRES;
    DISPLAY PIPEANUT;


*****************************************************************
*   CROP SPECIFIC PARAMETERS
*****************************************************************
```

Table I.1. Continued

```
*     ESTIMATED DRYLAND YIELD PARAMETERS FROM CROPMAN/EPIC
*********************************************************************
PARAMETER DY(I,C,T) DRYLAND YIELD DATA ;
* Units
* Cotton (lb lint), Corn(bu), Peanuts(lb), Sorghum(lb), Wheat(bu), Livestock (lb gain)

      DY("DRY","COTTON",T) =  443;
      DY("DRY","CORN",T)   =    0;
      DY("DRY","PEANUTS",T)=    0;
      DY("DRY","SORGHUM",T)= 3400;
      DY("DRY","WHEAT",T)  =   19;
      DY("DRY","LIVESTOCK",T)=178;
*********************************************************************
*   IRRIGATED CROP PRODUCTION FUNCTION WATER RESPONSE
PARAMETERS
*********************************************************************
TABLE PFLEPA(C,B) YIELD RESPONSE TO APPLIED WATER UNDER CP
SYSTEM 95% Eff

                B0      B1      B2
 COTTON        443    78.2   -1.68
 CORN            0       0       0
 PEANUTS         0       0       0
 SORGHUM      3400     308    -4.0
 WHEAT          19    8.63    -.19
 LIVESTOCK     178       0       0    ;

TABLE PFDRIP(C,B) YIELD RESPONSE TO APPLIED WATER UNDER CP
SYSTEM 99% Eff

                B0      B1      B2
 COTTON        443    77.3    -2.1
 CORN            0       0       0
 PEANUTS         0       0       0
 SORGHUM      3400     427    -8.0
 WHEAT          19    11.4    -.37
 LIVESTOCK     178       0       0  ;

TABLE TECH (I,C)
```

Table I.1. Continued

```
             COTTON    CORN    PEANUTS  SORGHUM    WHEAT   LIVESTOCK
IRRLEPA        8.41       0         43        94      .56           0
IRRDRIP        8.41       0         43        94      .56           0
DRY            5.24       0          0        54      .30        2.85 ;
*****************************************************************
*    CROP REVENUE AND COST PARAMETERS
*****************************************************************
PARAMETER P(C) AVERAGE PRICES OF CROPS  ACTUAL 4 YEAR AVERAGES
*Units
*Cotton($/lb lint),Corn($/bu),Peanuts($/lb),Sorghum($/lb),Wheat($/bu),Livestock($/lb
gain)

   / COTTON   0.57
     CORN     3.68
     PEANUTS  0.19
     SORGHUM  0.043
     WHEAT    3.56
     LIVESTOCK .30  /;

TABLE VCD(I,C) variable cost of dryland CROPs exc. harvest ($ per acre)
             COTTON    CORN    PEANUTS  SORGHUM    WHEAT   LIVESTOCK
 IRRLEPA       159       0         0        66       59           0
 IRRDRIP       159       0         0        66       59           0
 DRY           159       0         0        66       59           4 ;

TABLE VCI(I,C) added variable cost due to irrg ($ per acre)
             COTTON    CORN    PEANUTS  SORGHUM    WHEAT   LIVESTOCK
 IRRLEPA        98       0       349        70       52           0
 IRRDRIP        98       0       349        70       52           0
 DRY             0       0         0         0        0           0;


SCALAR  EF   Energy Use Factor for Electricity /0.164/;
*          Unit is KWH/Feet lift / acre inch

SCALAR  PSI  System Operating Pressure  /16.5/;
*          Unit is pounds per square inch

SCALAR  EP   Energy price   /.09/;
*          Unit is $/kwh for electricity

SCALAR  EFF  Pump engine efficiency /.50/;
```

Table I.1. Continued

```
PARAMETER HC(C) HARVEST COST PER UNIT OF PRODUCTION EXTENSION
* Units
*Cotton($/lb lint),Corn($/bu),Peanuts ($/lb),Sorghum ($/lb),Wheat ($/bu)

   / COTTON   0.0653
     CORN     0.0
     PEANUTS  0.0475
     SORGHUM  0.0093
     WHEAT    0.84
     LIVESTOCK 0.00   /;

PARAMETER IC(I)  PER ACRE INITIAL COSTS OF SYSTEMS

    / IRRLEPA   416.00
      IRRDRIP   900.00
      DRY  0  /;

PARAMETER L(I)   PER ACRE LABOR HOURS (irrigation system)

    / IRRLEPA    .7680
      IRRDRIP  .7680
      DRY  0 /;

PARAMETER MC(I)  PER ACRE MAINTENANCE COST;

    MC(I) = 0.08*IC(I);

PARAMETER DP(I)  PER ACRE DEPRECIATION COST OF IRRIGATION
SYSTEM;

     DP(I) = 0.05*IC(I);

PARAMETER LC(I)  Per Acre LABOR COST ($9.10 per hr);

     LC(I) = 9.10*L(I);


*     DISCOUNT RATE AND FACTOR PARAMETERS
*************************************************************

SCALAR RHO1 DISCOUNT RATE /0.03/;
```

Table I.1. Continued

```
SCALAR DISC1 DISCOUNT ;
    DISC1 = 1/(1+RHO1);

PARAMETER DELTA1(T)  DISCOUNT FACTOR ;
  DELTA1(T) = (DISC1**(ORD(T)-1));

*****************************************************************
 VARIABLES
*****************************************************************
  YLDLEPA(I,C,T)  PER ACRE YIELD CROP C SYSTEM I TIME T
  YLDDRIP(I,C,T)  PER ACRE YIELD CROP C SYSTEM I TIME T
  HARC(I,C,T)     PER ACRE HARVEST COST
  GR(I,C,T)       PER ACRE GROSS REVENUE
  CROPPERC(I,C,T) PER ACRE PERCENTAGE OF CROP C in SYSTEM I
  ST(T)          SATURATED THICKNESS (feet)
  LIFT(T)         PUMP LIFT PERIOD T (feet)
  WP(I,C,T)       PER ACRE WATER PUMPEP BY CROP (AC IN per AC)
  GPC(T)          GROSS PUMPING CAPACITY (acre inch per acre)
  PC(I,C,T)       PUMPING COST SPRINKLER ($'s per acre)
  TCOST(I,C,T)    PER ACRE TOTAL COST BY CROP AND SYSTEM
  NETR(I,C,T)     PER ACRE NET RETURN BY CROP  AND SYSTEM
  NR(T)          PER ACRE WEIGHTED NET RETURN AT T
  NPV1           NPV OF 1 WEIGHTED ACRE OVER T YEARS
  NPVTMAX         NPV OF 1 WEIGHTED ACRE OVER TMAX YEARS
*****
  NPVTOTR         NPV TOTAL COUNTY RETURN OVER TMAX YEARS
*****
  FCI(I)         PERCENT OF SYSTEM (IRR VS DRY) IN USE IN YR 50
  FCA(C)          PRECENT OF EACH CROP (IRR & DRY) GROWN IN YR 50
  CROPAC(C,T)     PERCENT CROP C ACRES (I&D)TO TOTAL ACRES (I&D)
  IRRI(I,T)       PERCENT CROPLAND IN EACH IRRIGATION SYSTEM
  IRCROP(C,T)     PERCENT CROP C IRRI TO TOTAL CROP AC (IRR & DRY)
*****
  TVWATER(T)      TOTAL COUNTY PUMPING IN YEAR T (ACRE FEET)
*****
  WT(T)          AVG WATER USE ALL ACREAGE (I&D) (AC IN per AC);

POSITIVE VARIABLES
     CROPPERC, LIFT, WP, TCOST, PC, YLD, WT, ST;

*****************************************************************
```

Table I.1. Continued

```
EQUATIONS
*EQUATIONS DEFINED
*****************************************************************
*PRODUCTION FUNCTIONS (Derived from CROPMAN Model and Data)

  IRRCROPLEPA(I,C,T)     IRRIGATED CROP RESPONSE TO APPLIED WATER
(CP)
  IRRCROPDRIP(I,C,T)     IRRIGATED CROP RESPONSE TO APPLIED WATER
(CP)
  DRYCROP(I,C,T)         DRYLAND CROP YIELDS (FROM EPIC DATA SET)

*  Irr Cotton yield (lbs per ac)
*  Irr Corn yield (bu perac)
*  Irr Peanut yield (lbs per ac)
*  Irr Sorghum yield (bu per ac)
*  Irrigated Winter Wheat(bu per ac)
*  Dryland Corn yield (bu per ac)
*  Dryland Cotton yield (lbs per ac)
*  Dryland Peanut yield (lbs per ac)
*  Dryland Grain sorghum yield (bu per ac)
*  Dryland Winter wheat yield (bu per ac)

*COST CALCULATIONS

  HARVCST(I,C,T)       PER ACRE HARVEST COST ($'s per acre)
  COSTPUMPLEPA(I,C,T)  PER ACRE IRRIGATED PUMPING COST ($'s per acre)
  COSTIRRLEPA(I,C,T)   TOTAL COST FUNCTION BY IRRI CROP ($'s per acre)
  COSTPUMPDRIP(I,C,T)  PER ACRE IRRIGATED PUMPING COST ($'s per acre)
  COSTIRRDRIP(I,C,T)   TOTAL COST FUNCTION BY IRRI CROP ($'s per acre)
  COSTDRY(I,C,T)       TOTAL COST FUNCTION BY DRY CROP ($'s per acre)

*REVENUE CALCULATIONS

  GREV(I,C,T)          GROSS REVENUE ($'s per acre)
  NETRE(I,C,T)         NET RETURN FOR EACH CROP ($'s per acre)
  REVENUN(T)           WEIGHTED AVERAGE REVENUE IN YEAR T ($'s per acre)
*****
  NPVAGR               NPV OF COUNTY AGRICULTURAL RETURN FOR TMAX
YEARS
*****

*WATER CALCULATIONS
```

Table I.1. Continued

```
  PUMPAGE(T)          WATER PUMPAGE IN T (acre inches per acre)
  MOTION(T)          LIFT IN PERIOD T (feet of lift in T)
  SAT(T)            SATURATED THICKNESS IN T (feet)
  GROSS(T)           GROSS PUMPING CAPACITY (acre incher per acre)
*****
  WATERVOL(T)        TOTAL COUNTY PUMPING YEAR T (ACRE FEET)
*****

*****

  IRRLAND(T)         IRRIGATED ACREAGE CAN NOT EXCEED YEAR 1 IRR
ACREAGE
  PEANUTC(C,T)       IRRIGATED PEANUT ACREAGE CAN NOT 33.3% IRR
ACREAGE
  PEANUTC1(T)        IRRI PEANUT ACRES LESS THAN TWICE YEAR 1 LEVEL
  MINWPLEPA(I,C,T)    MIN WATER APPLICATION PER ACRE CROP C
  MINWPDRIP(I,C,T)    MIN WATER APPLICATION PER ACRE CROP C
*****

*CONSTRAINTS
  LANC(T)            Land constraint in each period t (1 weighted acre)
*   CROPCON(I,C,T)      Acres in each crop in T must be at least 66% of T-1
  WAPPLDL(C,t)        no water is applied to dryland acres (=0)
  WATER(t)           Per Acre Water Constraint (acre inches-GPC variable)
  DRYCORN(I,C,T)      No Dryland Corn
  DRYPEANUTS(I,C,T)    No Dryland Peanuts
  IRRLEPALIVESTOCK (I,C,T)  No Lepa Irrigated Livestock
  IRRDRIPLIVESTOCK (I,C,T)  No DRIP Irrigated Livestock
*CROP ACREAGES

  FINIR(I)           YR 60 PERCENT BREAKDOWN OF AGGREGATE IRR VS
NONIRR
  FINA(C)            YR 60 PERCENT BREAKDOWN OF INDIVIDUAL CROP
ACREAGE

*OBJECTIVE FUNCTION

  OBJ1               OBJECTIVE FUNCT (NPV 1 WEIGHTED ACRE FOR T YEARS)
  OBJTMAX            TRUNCATED NPV (NPV 1 WEIGHTED ACRE FOR TMAX
YEARS)

*ACREAGE DATA
```

Table I.1. Continued

```
  TOIRRI(I,T)         PERCENT ALL IRRIGATED ACRES TO ALL CROP ACRES
(I&D)
  TOCROP(C,T)         PERCENT ALL ACRES IN CROP C TO ALL CROP ACRES
(I&D)
  IRRCRO(C,T)         PERCENT CROP C IRRI ACRES TO ALL CROP ACRES
(I&D);

**************************************************************************
* EQUATION (FUNCTIONAL FORMS SPECIFIED)
**************************************************************************
* IRR CROP YIELD RESPONSE TO WATER, AND DRYLAND YIELD
FUNCTIONS
**************************************************************************

   IRRCROPLEPA("IRRLEPA",C,T)..  YLD("IRRLEPA",C,T)=E=(PFLEPA(C,"B0")
          +PFLEPA(C,"B1")*WP("IRRLEPA",C,T)+PFLEPA(C,"B2")*
           (SQR[WP("IRRLEPA",C,T)]))+(TECH("IRRLEPA",C)*ORD(T));
   IRRCROPDRIP("IRRDRIP",C,T)..  YLD("IRRDRIP",C,T)=E=(PFDRIP(C,"B0")
          +PFDRIP(C,"B1")*WP("IRRDRIP",C,T)+PFDRIP(C,"B2")*
           (SQR[WP("IRRDRIP",C,T)]))+(TECH("IRRDRIP",C)*ORD(T));

   DRYCROP("DRY",C,T)..
YLD("DRY",C,T)=E=(DY("DRY",C,T))+(TECH("DRY",C)*ORD(T));

*COST CALCULATIONS

  HARVCST(I,C,T)..       HARC(I,C,T)=E= (YLD(I,C,T) * HC(C));
  COSTPUMPLEPA("IRRLEPA",C,T)..
PC("IRRLEPA",C,T)=E=((EF*(LIFT(T)+2.31*PSI)*EP)
                  /(EFF))*WP("IRRLEPA",C,T);

  COSTPUMPDRIP("IRRDRIP",C,T)..
PC("IRRDRIP",C,T)=E=((EF*(LIFT(T)+2.31*PSI)*EP)
                  /(EFF))*WP("IRRDRIP",C,T);

*The VALUE 2.31 is the height of a column of water that will exert 1 psi

  COSTIRRLEPA("IRRLEPA",C,T)..
TCOST("IRRLEPA",C,T)=E=PC("IRRLEPA",C,T)+
       MC("IRRLEPA")+ DP("IRRLEPA")+LC("IRRLEPA")+VCD("IRRLEPA",C)+
       VCI("IRRLEPA",C)+HARC("IRRLEPA",C,T);
```

Table I.1. Continued

```
  COSTIRRDRIP("IRRDRIP",C,T)..   TCOST("IRRDRIP",C,T)=E=PC("IRRDRIP",C,T)
       + MC("IRRDRIP")+DP("IRRDRIP")+LC("IRRDRIP")+VCD("IRRDRIP",C)
       +VCI("IRRDRIP",C)+HARC("IRRDRIP",C,T);
  COSTDRY("DRY",C,T)..
TCOST("DRY",C,T)=E=VCD("DRY",C)+HARC("DRY",C,T);

*REVENUE CALCULATIONS

   GREV(I,C,T)..     GR(I,C,T)=E= P(C)*YLD(I,C,T);
   NETRE(I,C,T)..    NETR(I,C,T) =E= GR(I,C,T) - TCOST(I,C,T);
   REVENUN(T)..      SUM(I,SUM(C,NETR(I,C,T)*CROPPERC(I,C,t)))=E=
                NR(T);

*WATER CALCULATIONS

   PUMPAGE(T)..      WT(T) =E= SUM(C, CROPPERC("IRRLEPA",C,T)*
                WP("IRRLEPA",C,T) + CROPPERC("IRRDRIP",C,T)*
                WP("IRRDRIP",C,T));
   MOTION(T+1)..
LIFT(T+1)=E=LIFT(T)+((ICI("IRRLEPA")+ICI("IRRDRIP"))/AREAAQ)*
                ((1/SPECYLD)*((WT(T)-RECHARGE)/12));
   SAT(T+1)..        ST(T+1) =E= ST(T)-((ICI("IRRLEPA") +
ICI("IRRDRIP"))/AREAAQ)*
                ((1/SPECYLD)*((WT(T)-RECHARGE)/12));
*                  [The 12 in the denominator converts inches to feet]

   GROSS(T).. GPC(T) =E= (4.42*IWellYld/IAcPerWell)*(SQR[ST(T)/ISATTHK]);

*            Units of IWellYld/IAcPerWell is GPM/Acre
*            The factor 4.42 assumes 2000 hours of pumping per season and
*            has the units of AcIn/GPM. Thus, GPC unit is AcIn/Ac.
*            2000hrs*60min/hr / 43560 cuft/acft / 7.48 gal/cuft * 12in/ft
*            = 4.42 AcIn/GPM     {(min*acft/gal)*(in/ft)} = acin/(gal/min)

*CONSTRAINTS

   LANC(T)..         SUM(C,SUM(I,CROPPERC(I,C,T)))=E=1;
*   CROPCON(I,C,T)..  CROPPERC(I,C,T)=G=0.6666*CROPPERC(I,C,T-1);
   WAPPLDL(C,t)..    WP("DRY",C,T)=E= 0;
   WATER(t)..        SUM(C, (CROPPERC("IRRLEPA",C,T)*WP("IRRLEPA",C,T)) +
              (CROPPERC("IRRDRIP",C,T)*WP("IRRDRIP",C,T)))=L=GPC(T);
   DRYCORN(I,C,T)..      CROPPERC("DRY", "CORN", T) =E= 0;
```

Table I.1. Continued

```
  DRYPEANUTS(I,C,T)..   CROPPERC("DRY", "PEANUTS", T) =E= 0;
  IRRLEPALIVESTOCK(I,C,T).. CROPPERC("IRRLEPA", "LIVESTOCK", T) =E= 0;
  IRRDRIPLIVESTOCK(I,C,T).. CROPPERC("IRRDRIP", "LIVESTOCK", T) =E= 0;

*FINAL CROP ACREAGE IN AGGREGATE PERCENTAGE TERMS

  FINIR(I)..       FCI(I) =E= sum(C, CROPPERC(I,C,"60"));
  FINA(C)..        FCA(C) =E= sum(I, CROPPERC(I,C,"60"));

*OBJECTIVE FUNCTION

  OBJ1..           NPV1 =E= SUM(T, DELTA1(T)*NR(T));
  OBJTMAX..        NPVTMAX =E= SUM(SUBT(T), DELTA1(T)*NR(T));
*****
  NPVAGR..         NPVTOTR =E=NPVTMAX*TOTCACRES;
*****
  Tocrop(C,T)..    CROPAC(C,T) =E= SUM(I, CROPPERC(I,C,T));
  TOIRRI(I,T)..    IRRI(I,T) =E= SUM(C,CROPPERC(I,C,T));
  IRRCRO(C,T)..    IRCROP(C,T) =E= SUM(I, CROPPERC("IRRLEPA",C,T) +
                   CROPPERC("IRRDRIP",C,T));

*****
  IRRLAND(T)..     IRRI("IRRLEPA",T) + IRRI("IRRDRIP",T)=L=  PIRRACRES;
  PEANUTC(C,T)..   CROPPERC("IRRLEPA","PEANUTS",T+1) =L= 0.3333*
                   CROPPERC("IRRLEPA","COTTON", T+1);
  PEANUTC1(T)..    CROPPERC("IRRLEPA","PEANUTS",T) +
                   CROPPERC("IRRDRIP","PEANUTS",T)=L= 2*PIPEANUT;
  MINWPLEPA("IRRLEPA",C,T)..  WP("IRRLEPA",C,T) =G=
MINWATER("IRRLEPA",C);
  MINWPDRIP("IRRDRIP",C,T)..  WP("IRRDRIP",C,T) =G=
MINWATER("IRRDRIP",C);
*****

*****
  WATERVOL(T)..    TVWATER(T) =E= WT(T)*TOTCACRES/12;
*****
*                ABOVE CONVERTS FROM YEARLY AC/IN TO AC/FT)


*INITIAL VALUES (STARTING VALUES AT T=1 WHERE FX=FIXED CAN NOT
CHANGE)
```

Table I.1. Continued

```
*CROPPERC IS PERCENT OF YR1 CROP C IN SYSTEM I TO TOTAL CROP
ACREAGE

  NETR.L(I,C,T)=20;
  CROPPERC.FX(I,C,"1")= (RIACRES(C,I) / RTOTACRES);
  NR.L(T) = SUM(I, SUM(C, NETR.L(I,C,T)*CROPPERC.L(I,C,t)));
  LIFT.FX("1")=ILIFT;
  ST.FX("1")=ISATTHK;

  MODEL OGALLALA /ALL/;
      OPTION RESLIM = 100000;
      OPTION ITERLIM = 100000;
      OGALLALA.OPTFILE = 1;
*      USE "MINOS 5 OPTION FILE TO INCREASE MAJOR ITERATIONS TO 1000"
*      "MINOS 5 OPTION FILE IS NAMED MINOS5.OPT"
      SOLVE OGALLALA USING NLP MAXIMIZING NPV1;

* If do not want ascii files printed use $ontext to read as text
* and not as GAMS code.  Must insert a $offtext to read as code
* at appropriate point.
*
$ontext

* Reading as GAMS CODE again

$offtext
****** Directly writing into ExcelSpreadsheet ***********

******** Saturated Thickness Data ************************
* Make sure writing to correct county Excel Spreadsheet file

*Vaiables to be saved written to filename.GDX file
*Only one unload per run as repeated unloads erase GDX file

execute_unload "TD3Lubbock.gdx" ST.L LIFT.L GPC.L NR.L WT.L WP.L YLD.L
            GR.L HARC.L PC.L TCOST.L NETR.L CROPPERC.L
            NPV1.L NPVTMAX.L  TOTCACRES

*Writing Data to named Excel (one execute statement per variable)
*rng=sheetpage and cell where each write begins
*Rdim=1 writes many rows in one column!!!
```

Table I.1. Continued

```
execute 'gdxxrw.exe TD3Lubbock.gdx var=st.L rng=GamsData!a2 rdim=1'
execute 'gdxxrw.exe TD3Lubbock.gdx var=lift.L rng=GamsData!c2 rdim=1'
execute 'gdxxrw.exe TD3Lubbock.gdx var=gpc.L rng=GamsData!e2 rdim=1'
execute 'gdxxrw.exe TD3Lubbock.gdx var=nr.L rng=GamsData!g2 rdim=1'
execute 'gdxxrw.exe TD3Lubbock.gdx var=wt.L rng=GamsData!i2 rdim=1'


******** Net Revenue Data ******************************
* When have more than one dimension must carefully unload sets
* writing out three diminsional vector as column (gams convention) vector
* Sq=0 forces to print out zero values, must appear before var statement
* Merge statement prints over entire (i,c,t) indices for each variable
* To use  merge statement index values must already be in spreadsheet
* in correct sequence.  When this is case will only merge data with index
* values in common.

execute 'gdxxrw.exe TD3Lubbock.gdx SQ=0 var=WP.L rng=GamsData!L2 cdim=0
rdim=3 '
execute 'gdxxrw.exe TD3Lubbock.gdx SQ=0 var=YLD.L rng=GamsData!P2 cdim=0
rdim=3 '
execute 'gdxxrw.exe TD3Lubbock.gdx SQ=0 var=GR.L rng=GamsData!T2 cdim=0
rdim=3 '
execute 'gdxxrw.exe TD3Lubbock.gdx SQ=0 var=HARC.L rng=GamsData!X2 cdim=0
rdim=3 '
execute 'gdxxrw.exe TD3Lubbock.gdx SQ=0 var=PC.L rng=GamsData!AB2 cdim=0
rdim=3 '
execute 'gdxxrw.exe TD3Lubbock.gdx SQ=0 var=TCOST.L rng=GamsData!AF2
cdim=0 rdim=3 '
execute 'gdxxrw.exe TD3Lubbock.gdx SQ=0 var=NETR.L rng=GamsData!AJ2 cdim=0
rdim=3 '
execute 'gdxxrw.exe TD3Lubbock.gdx SQ=0 var=CROPPERC.L rng=GamsData!AN2
cdim=0 rdim=3 '
execute 'gdxxrw.exe TD3Lubbock.gdx SQ=0 var=NPV1.L rng=GamsData!AS2'
execute 'gdxxrw.exe TD3Lubbock.gdx SQ=0 var=NPVTMAX.L rng=GamsData!AU2'
execute 'gdxxrw.exe TD3Lubbock.gdx SQ=0 par=TOTCACRES rng=GamsData!AW2'
```