**USDA CONSERVATION INNOVATION GRANT**
**Final Progress Report**

**Project Title: Limited Irrigation Cropping for Conserving Water Resources in the Pumpkin Creek Watershed**

**Project Director:** Gary W. Hergert, University of Nebraska Panhandle Research and Extension Center, Scottsbluff, NE

**Project Collaborators:** Gary Stone, Jim Schild, Dean Yonts

**Project Cooperators:** Alton Lerwick, Gary and Lane Darnall, Kirk Laux

**Project Objectives:**

The overall goal of this project was to initiate a program of demonstration and education to reduce the surface and ground water conflicts in the Pumpkin Creek watershed.
The individual objectives were: 1. to demonstrate limited irrigation no-tillage cropping systems that make the best use of natural precipitation and limited ground water supplies; 2. to educate area farmers, natural resource groups, local and state government agencies and related agricultural businesses (fertilizer and agri-chemical dealers, irrigation and equipment dealers) about the implications of different management scenarios on production, cultural practices, economics and natural resource impacts; and 3. to develop economic scenario case studies of what different limited irrigation and cropping system options might provide as income to individuals and area agribusiness.

**Project Deliverables:**

This project was designed to demonstrate improved ground water management in an area that is under pumping allocations. The primary deliverables were establishing on-farm whole-field demonstrations that could be used to teach other producers and agribusiness interests about the techniques. Beyond the educational programming associated with the sites of field days, other presentations were made at local, regional and national meetings. A primary outlet to reach a wider audience was the creation of a web site that discussed the project and also discussed practical steps and additional references, websites and publications that could help producers adopt and adapt similar management. We felt this project was innovative because nothing like this has been attempted in the Pumpkin Creek watershed. We planned to build on research and demonstration projects conducted in other areas of Nebraska during the past 10 to 30 years. However, another part of the innovation was that major adjustments and adaptations were required because in western NE the annual precipitation is lower than other work conducted farther east in Nebraska. The soils in the panhandle are also much sandier and the cropping mix is different than previous locations where these techniques were used.

Past progress reports detail the accomplishments and progress on this grant. We fulfilled all of the original goals except for fully developing the economic scenarios. We created our Steering Committee of NRCS, NRD and University personnel; we selected and worked effectively with our three cooperators; we held numerous field days during the course of the project, we made numerous presentations at local, regional and national meetings discussing the project; we created a web page on

the project (http://www.panhandle.unl.edu/pumpkin_creek/index.htm) and, we demonstrated the water management program Water Optimizer at many of the workshops held.

**Project Scope/Location:**

The Pumpkin Creek watershed is located in the Southern Tablelands of the North Platte Natural Resources District (NPNRD) in western Nebraska (Fig. 1). It stretches across three counties over a 50-mile area. Over 20 years ago, Pumpkin Creek was closed to the issuance of new surface water rights by the Nebraska Department of Natural Resources due to low stream flow. Because of ground and surface water conflicts caused by the increased consumptive use of ground water, better management was required to reduce the causes of conflict. The NPNRD Board of Directors approved a 2004 allocation of 14 acre-inches for irrigation in Pumpkin Creek Basin Groundwater Management Sub-Area during late winter 2004. That allocation will be lowered to 12 inches beginning in 2009.

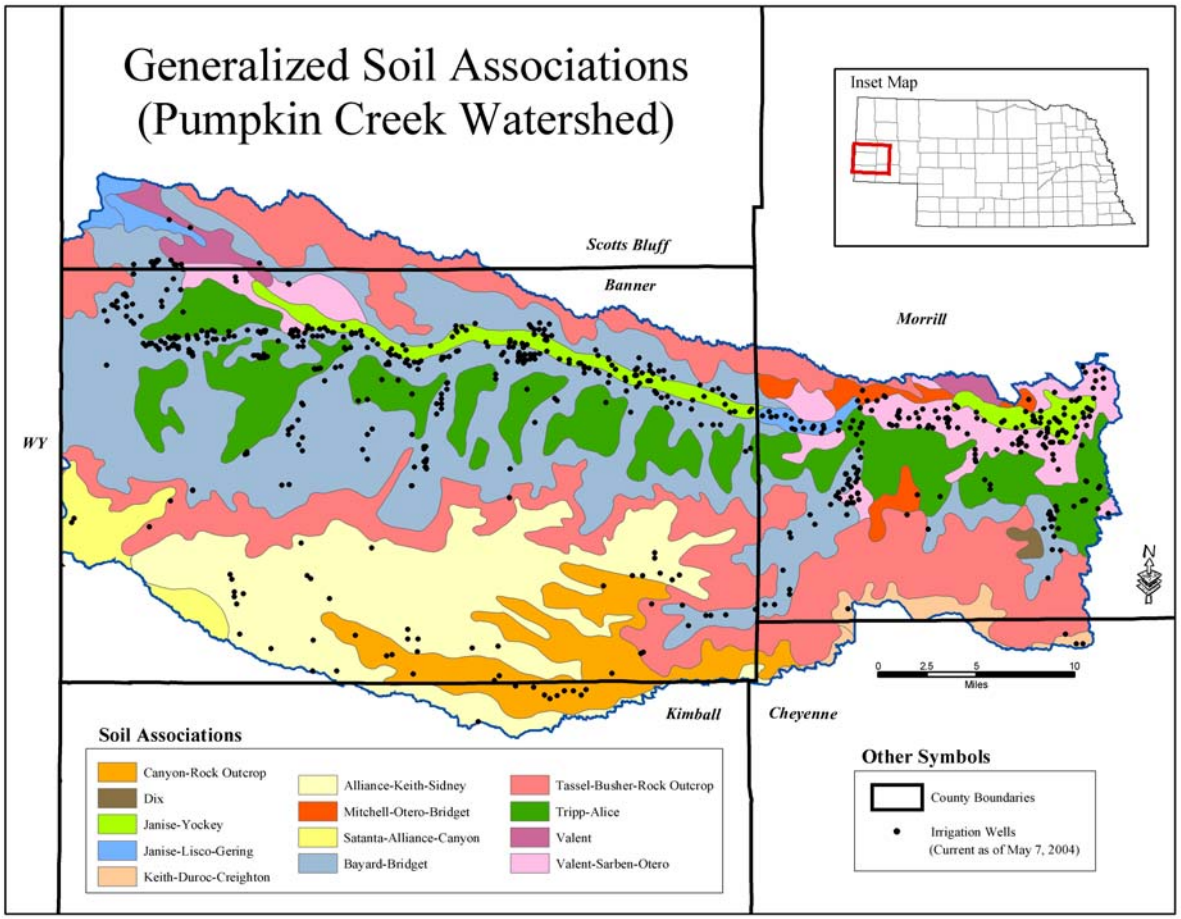



Figure 1. Soil associations and GPS-referenced registered irrigation wells (small black dots) in the Pumpkin Creek Watershed.

The three cooperator sites were spread across the watershed from east to west. Similar projects have already been on-going in southwest Nebraska, so this work has wide application to similar regions across the high plains which cover eastern WY, Eastern CO and parts of western KS.

**Project State and End Date:** October 1, 2004 to September 30, 2008

**National Category:** Technology Category

**Application Review Category:** Water Quantity

**Declaration of EQIP Eligibility:**

A listing of EQIP-eligible producers involved in the project, identified by name and social security number or taxpayer identification number were:

Lane Darnall – numbers provided on first report, not reported here for security

Kirk Laux – numbers provided on first report, not reported here for security

Alton Lerwick – numbers provided on first report, not reported here for security

The dollar amount of any direct or indirect payment made to each individual producer or entity for any structural, vegetative, or management practices. Both biennial and cumulative payment amounts must be submitted.

For the current project, no payments have been made to cooperators. EQIP cost share for other practices or other parts of their operations may have been made but have not been a part of this project.

A self-certification statement indicating that each individual or entity receiving a direct or indirect payment for any structural, vegetative, or management practice through this grant is in compliance with the adjusted gross income (AGI) and highly-erodible lands and wetlands conservation (HEL/WC) compliance provisions of the Farm Bill.

Since no payments were made, we assume no statement is required.

**Total Cost of Project:** $239,600

**Federal Funds Requested:** $119,700

**Recent Progress**

The management team of Hergert and Stone completed analysis of yield and soil water information for the 2008 growing season, for both the Pumpkin Creek Watershed cooperators and the Panhandle Research and Extension Center (PHREC) replicated limited irrigation research plots. WaterMark™ soil moisture sensors and atmometers (ET gages) were installed and monitored throughout the growing season at all 3 locations. The WaterMark™ and ET gage data were collected on a weekly basis by Stone. The data from each cooperator's field was plotted and sent to them each week via e-mail. This provided the cooperators with the necessary information to schedule their irrigation applications in a timely manner with the limited water available to them. Seasonal data from the WaterMark™ sensors for all of the cooperator's fields are shown in Figures 1 through 4. Figure 2 (Lerwick) is for sunflowers. He has a very limited amount of water he can apply, usually less than 6 inches. Timely (heavy) precipitation is reflected in the graph down to the 4-foot level later in the growing season. Figure 3 (Darnall) is for corn silage. Figures 4 and 5 (Laux) is for high moisture corn. Figure 4 is for corn following corn and Figure 5 is for corn following alfalfa, both on the same center pivot. Both Darnall and Laux were able to manage their water resources and keep their crops watered with minimal stress without over-application and pushing water past the 4-foot level.

The ET gage data from the Pumpkin Creek Watershed cooperators and ET gage data from other cooperator sites across the North and South Platte NRDs was collected during the 2008 growing season. The data was posted weekly on the Nebraska Agricultural Water Management Demonstration Network (NAWMDN) web site for weekly ET data (http://elkhorn.unl.edu/ETGage/xml/NE_counties_2.jsp).

The PHREC replicated limited irrigation research plots have completed their fourth year of data; four years of data for corn, hard white winter wheat and dry beans and three years of data for spring canola. From this data, Hergert has developed limited irrigation, no-till crop production functions. These crop production functions show what yields a producer can expect from these crops using a given limited amount of water using a no-till cropping system. All of this information has been presented to various groups and meetings during the summer and fall.

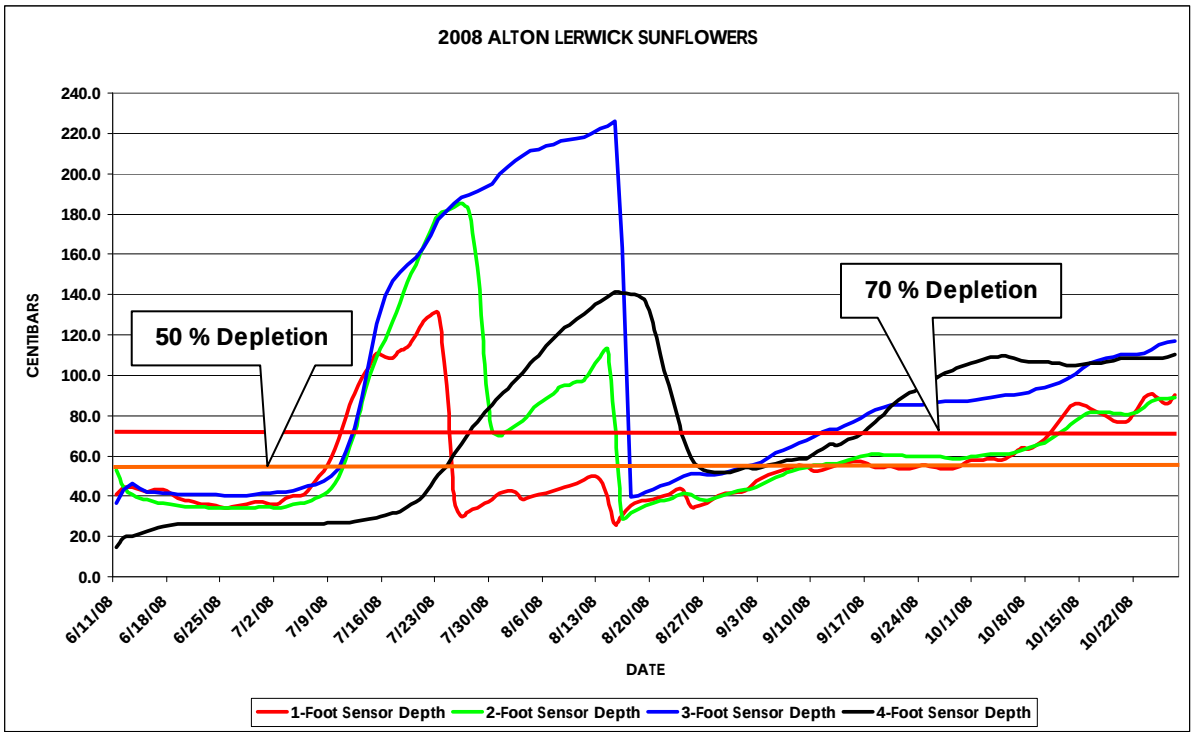



Figure 2. Soil moisture depletion / soil water use by sunflowers during the 2008 growing season.

Alton Lerwick, our cooperator located in the western part of the Pumpkin Creek Watershed has the least amount of water to pump, compared to the other cooperators, usually less than six inches. The irrigation allocation for the Pumpkin Creek Watershed through the 2008 growing season was 14 inches. The irrigation allocation has been set at 12 inches for the 2009 growing season and beyond by the North Platte NRD. He does have a slightly "better" soil than the other two cooperators in that it can hold slightly more soil moisture. Alton's no-till cropping system centers on sunflowers. Crop residue and soil moisture management is a must for his system to work. Utilizing no-till and crop residue management help Alton start the growing season with a full soil moisture profile for this crop.

The use of the WaterMark™ soil moisture sensors help him to know when to apply the limited amount of irrigation he has available. From this graph, we can see that as the crop and its root system develop, it starts to deplete the soil moisture, when irrigation was applied and when the significant precipitation event took place. His residue management strategy insured that little, if any, of the precipitation ran off, but entered the soil, even down to the 4-foot level!

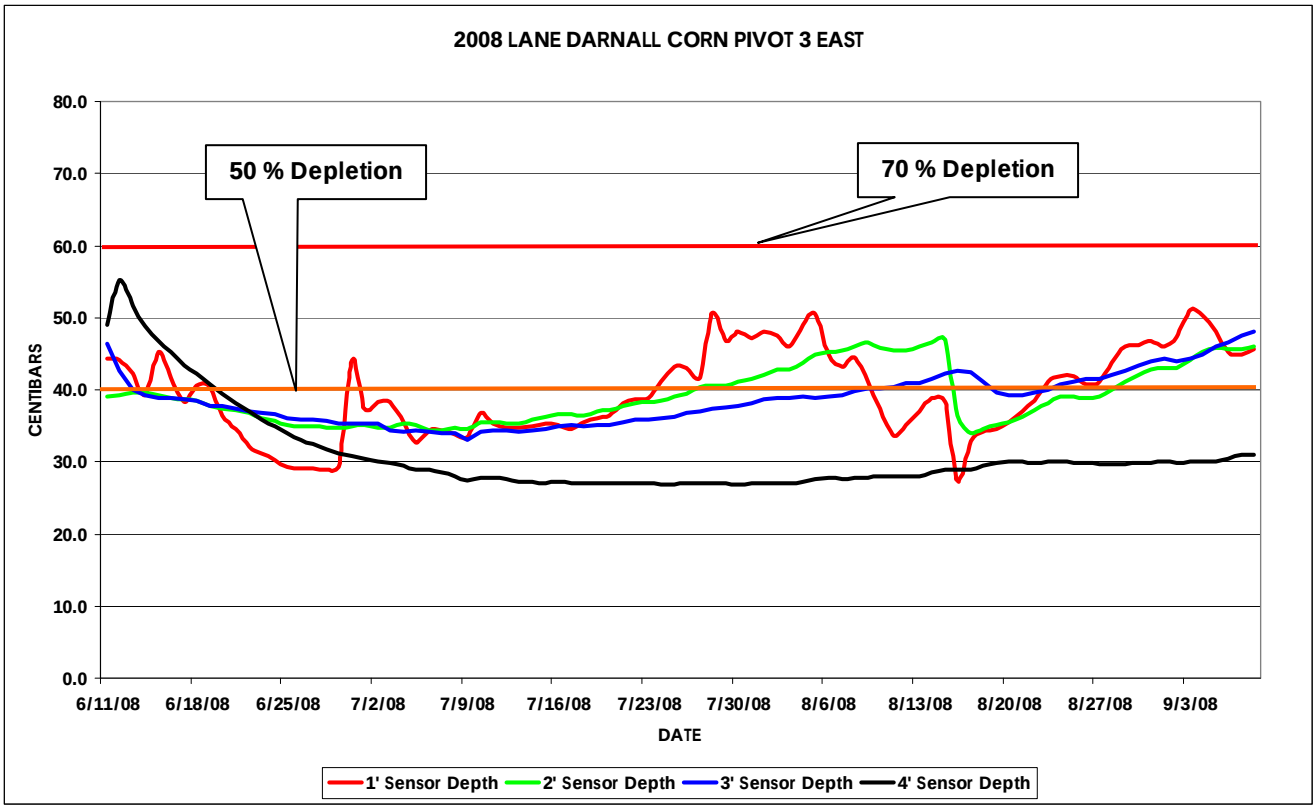
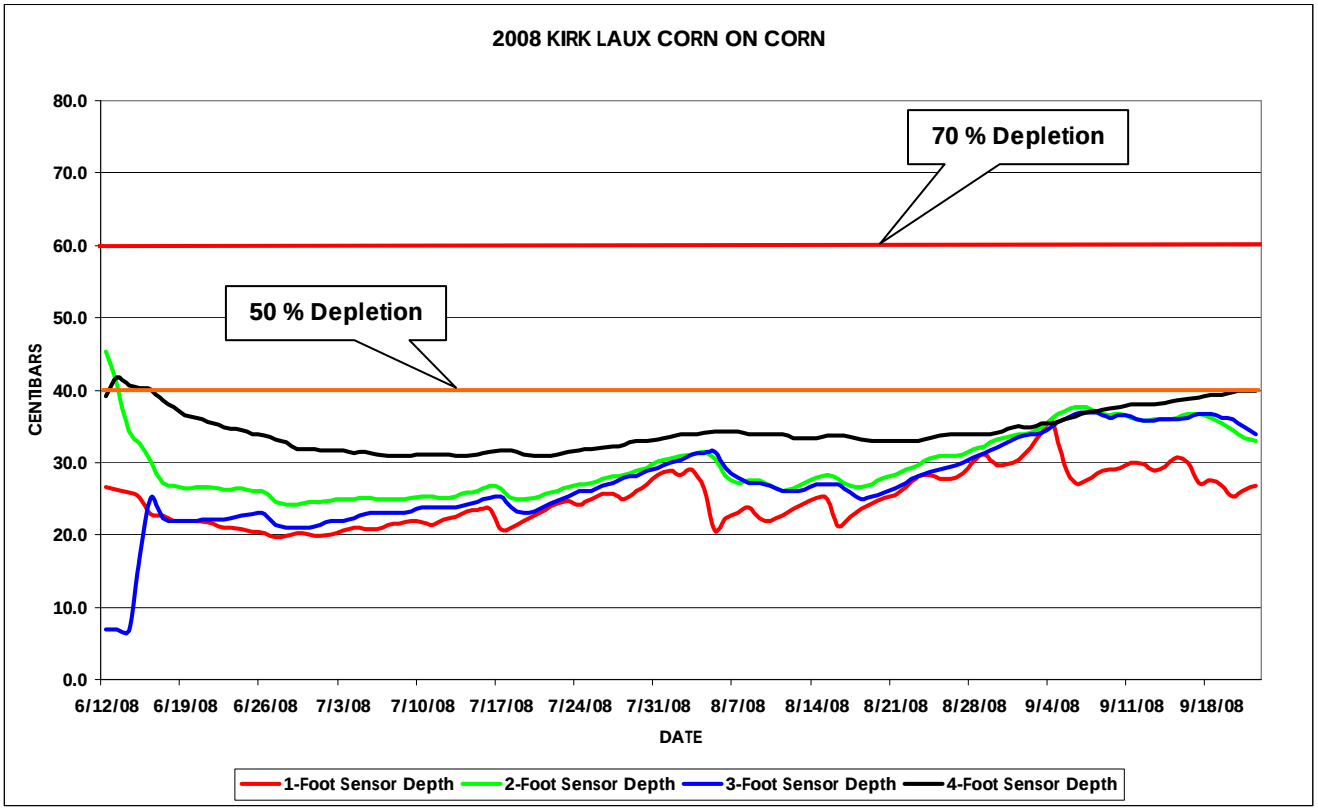



Figure 3. Soil moisture depletion / soil water use by corn silage during the 2008 growing season.

Lane and Gary Darnall are the cooperators located near the center part of the Pumpkin Creek Watershed. Both Lane and Kirk Laux, the third cooperator at the east end of the Pumpkin Creek Watershed, have similar irrigation strategies and soil types. Under the special irrigation water management unit for Pumpkin Creek, the producers can "move" water to other fields with higher crop ET demands, as long as the total overall amount of water pumped does not exceed the 14 inch cap (now 12 inches). Crops with lower ET demands such as winter wheat, summer forages and dry beans are planted on their remaining ground.

Lane has a large feedlot, so corn silage and alfalfa are his main crops. Using the WaterMark™ soil moisture sensors helped Lane manage his irrigation applications so that the proper amount in a timely manner is applied to the crop. From Lane's graph, he did an excellent job of maintaining a soil moisture level around the 50% depletion mark. He did not over-apply and did not stress his crop to any extreme.



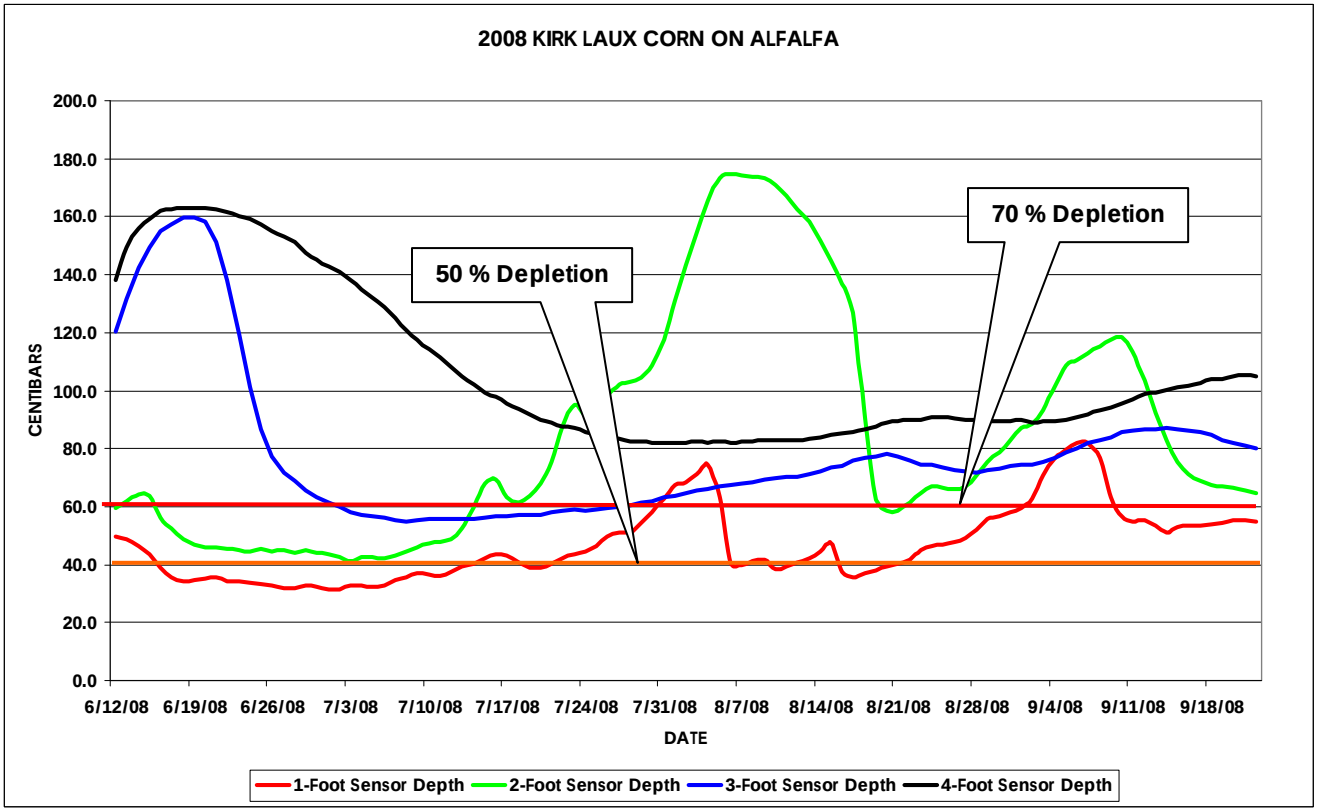




Figure 4 (top) & 5 (bottom). Soil moisture depletion / soil water use by corn following corn and corn following alfalfa during the 2008 growing season.

Kirk Laux is the cooperator located near the eastern part of the Pumpkin Creek Watershed. As stated previously, both Kirk and Lane Darnall have similar irrigation strategies and soil types. Kirk has a smaller feedlot, but uses a different cropping system than the Darnall's. Corn, alfalfa, winter wheat, dry beans are his main crops and a forage turnip / radish combination is used as part of his grazing program. Using the WaterMark™ soil moisture sensors helped Kirk manage his irrigation applications so the proper irrigation amount is applied to the crop in a timely manner. Both of Kirk's graphs are from the same center pivot. One half was corn following corn, which had good soil moisture at the start of the growing season and the other half was corn following alfalfa, which had a drier soil profile at the start of the growing season.

The corn following corn graph shows that Kirk could have stressed his crop a little, as he maintained the soil moisture below the 50% depletion. The corn following alfalfa graph shows that Kirk had barely adequate moisture at the 1 and 2-foot levels and much drier at the 3 and 4-foot levels at planting. He was able to get moisture down to the 4-foot level without over-application and it also shows where the greatest percentage of the roots are and when the crop required more water, at the 1 and 2-foot levels. Figure 5 shows the pivot where the WaterMark soil moisture sensors were installed, the corn on the left of the road is corn following corn and the corn on the right of the road is corn following alfalfa. Kirk has taken the next step as a cooperator and producer and plans to purchase and install WaterMark™ soil moisture sensors on all of his pivots for the 2009 growing season.

Figure 6. Kirk Laux center pivot shows corn following corn (left) and corn following alfalfa (right) during the 2008 growing season.

**Describe significant results, accomplishments, and lessons learned. Compare actual accomplishments to the project goals in your proposal.**

Since the web site for the "Limited Irrigation Cropping for Conserving Water Resources in the Pumpkin Creek Watershed" went on line in December of 2007, there has been an average of 253 hits per month through November 2008. Further refinements will be made to the web page as needed and a voice-over PowerPoint presentation describing limited irrigation, past and current research and progress on the project will be added early 2009.

Educational meetings and information on the Pumpkin Creek project and limited irrigation were presented by Hergert and Stone during the most recent reporting period at a number of locations and are listed in Table 1.

| Date | Presenter | Location | Audience |
|---|---|---|---|
| 4/08 NE LEAD group | Stone | Scottsbluff, NE | 35 |
| 4/08 NE LEAD group | Hergert | Banner county, NE | 35 |
| 7/08 Chamber Water Tour | Hergert / Stone | NE & WY | 44 |
| 7/29 PREC Field Day | Hergert/Stone | Scottsbluff, NE | 80 |
| 8/08 UNL NE Farm Bureau | Stone | Scottsbluff, NE | 30 |
| 8/12 4-State Mtg CO-NE-KS-WY | Hergert | Sterling, CO | 30 |
| 9/08 North Platte NRD | Hergert / Stone | Scottsbluff, NE | 50 |
| 10/08 UNL Water Colloquium | Stone | Lincoln, NE | 112 |
| 12/10 CO-NE Irrigation Mtg | Hergert | Sidney, NE | 40 |

Table 1. Education meetings and presentations on the Pumpkin Creek project April-September 2008.

The project goals were: 1. Demonstrate limited irrigation no-till cropping systems that make the best use of limited groundwater supplies. This was done on the farm with the three cooperators in the project, Alton Lerwick, Lane Darnall and Kirk Laux; and the plots on the Panhandle Research and Extension Center. Spring and winter canola was introduced into the cropping systems as alternative low water use crops. One-on-one consultations with the cooperators and other interested producers about different cropping sequence options and WaterMark™ soil moisture sensors. The cooperators tried different planter spacing's to aid in weed control and water conservation. Direct harvest methods were tried in dry beans so the soil was not disturbed and to leave more crop residue on the soil surface. WaterMark™ soil moisture sensors and ET gages were utilized to help manage their limited water resource. All of the producers found their own cropping system that best fit their farm and livestock operations.

The next goal was: 2. Educate area farmers, natural resource groups, local and state government agencies and related agricultural businesses. Numerous field days and tours of the cooperators limited irrigation no-till cropping systems were held during the project period. The cooperators, local NRDs and NRCS, PHREC specialists and extension educators all took part in doing these field days for area producers and agricultural businesses. The Pumpkin Creek web page was developed and brought on line to reach more producers and interested clientele as an outreach

educational tool. The poster was developed and presented at several conferences and meetings and was well received. Presentations by Hergert and Stone, either by PowerPoint or talks was given to producers, tour groups, at conferences and meetings throughout the project period, and they continue to do so. Partnerships and relationships have been developed with the panhandle NRDs, NRCS and FSA for this project and potential future projects. The Pumpkin Creek Project has been the "educational seed" to start producers on no-till cropping systems, knowing they will have less water in the future to produce a crop.

The last goal was: Develop economic scenario case studies of what different limited irrigation and cropping system options might provide as income to individuals and area agribusiness. The Water Optimizer, developed by the University of Nebraska will be a very useful tool for producers to review and find the optimal cropping system for their farming operation. Water Optimizer has undergone several changes and more low water use crops such as millet, sorghum Sudan-grass – summer forages, camelina, spring and winter canola, oats and forage turnip – radish combinations need to be added to the program for it to see its full potential.

The significance of having three outstanding cooperators to work with us on this project cannot be understated. Having growers as well as leaders in the communities in which they reside helped insure the progress and the results we have accomplished will continue to be promoted for no-till and limited irrigation cropping systems into the future.

Figure 7. Wild Pumpkin (Buffalo Gourd) For Which The Creek & Drainage Are Named.

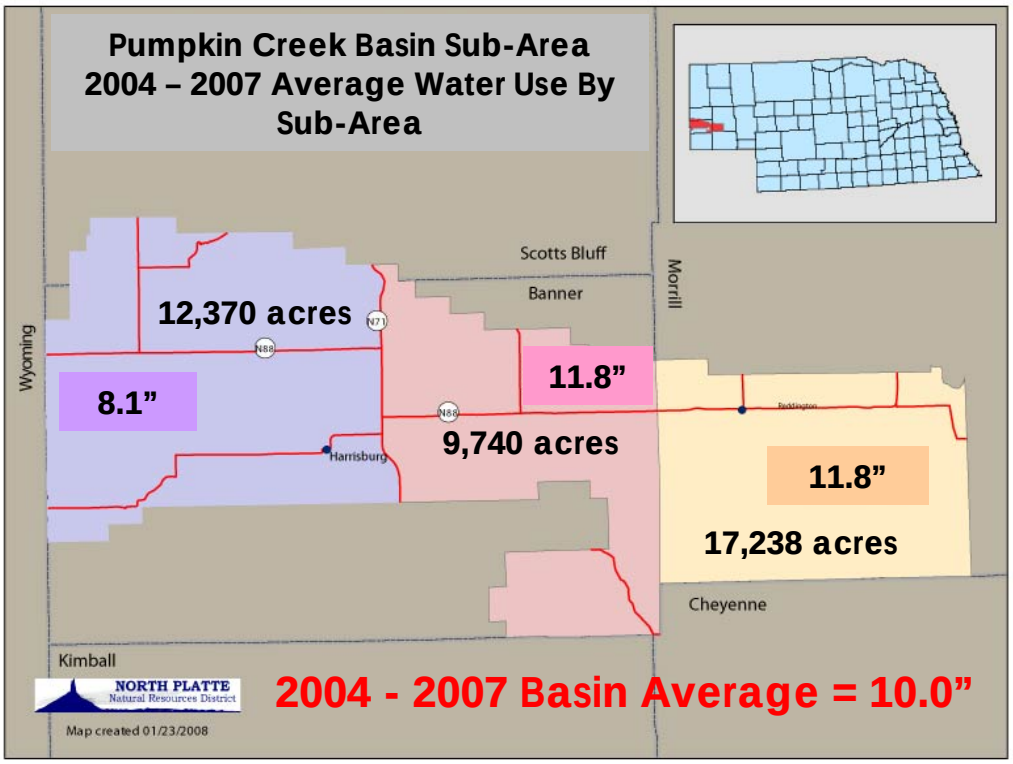



Figure 8. Water Use By Sub-Area In The Pumpkin Creek Watershed.

Figure 9. Winter Canola On The Pumpkin Creek Project.

Figure 10. Pumpkin Creek Cooperator – Producer Field Day & Tour Canola Harvest.

Figure 11. WaterMark™ Soil Moisture Sensor Field Installation.

Figure 12. No-Till Sunflowers Planted Into Corn & Winter Wheat Crop Residue.

Figure 13. Winter Wheat Planted Into Canola Crop Residue.


Figure 14. Pumpkin Creek Cooperator – Producer Field Day & Tour No-Till Planting.

Figure 15. No-Till Dry Beans Planted Into Corn Crop Residue.

Figure 16. Corn Planted Into Corn Crop Residue.

Figure 17. Winter Wheat Planted Into Dry Bean Crop Residue.