# State-of-the-Art Center Pivot System for Education, Research and Demonstration

## Final Project Report

prepared by

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# State-of-the-Art Center Pivot System for Education, Research and Demonstration

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## Executive Summary

The North Plains Research Field (NPRF), Etter, Texas is a 326-acre research field owned and supported by the North Plains Groundwater Conservation District in Dumas, Texas that is leased to the Texas Agricultural Experiment Station-Amarillo primarily for irrigation research. Through support of the groundwater district board and this Texas Water Development Board grant, a new state-of-the-art center pivot was designed and installed by a local contractor. Personnel of the NPRF installed a manual, dual nozzling system to accommodate flow from two differing wells on the research station. This unique capability enhances the ability for research personnel to schedule and accommodate irrigation protocols in an effective manner on the station. The operational and enhancement development objective set forth in the project were completed and should provide enhanced opportunity for development and demonstration of new operational and management potentials with center pivot irrigation systems for the northern Texas High Plains. This is in addition to the water savings to be realized as compared to the prior surface flow irrigation method used since the 1960's.

## Background

Irrigation and water management personnel of The Texas A&M University System - Texas Agricultural Experiment Station (TAES) have been heavily involved in and dedicated to the development of accurate crop water use measurement and application for several decades. Using lysimeters, these personnel have been able to accurately assess crop water use requirements (crop evapotranspiration or ET) whereby irrigation requirements can be estimated in a near real time (daily) basis). These research assessments have been correlated and calibrated to reference ET measurements. Thus, accurate estimates of for multiple crop ET's can be made for the Texas Panhandle and Rolling Plains region on a daily basis through the use of a distribution of strategically placed and well-maintained meteorological stations, known as the Texas High Plains ET network (TXHPET). All of these efforts have been strongly supported by the North Plains Water District and their Board of Directors since the station was established, whom themselves are irrigated producers. Application of this precision requirement however must be applied through improved irrigation application systems such as a well designed and managed center pivot system.

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leased to the TAES primarily for irrigation research. The NPRF facility has been predominantly surface irrigated (62%). This level of surface flow irrigation within the area is rapidly becoming unacceptable from a groundwater utilization, efficiency, and management standpoint. Regional irrigation system percentages have progressed to the level of approximately 55% sprinkler irrigated versus 45% surface irrigated. The continuing trend is towards increasing center pivot sprinkler utilization, primarily for economic advantages through savings of labor and associated costs, water conservation, and management capability.

While substantial research has been conducted with center pivot systems, all is not known regarding design and management potential with the units. Good irrigation management is as important as good design. Management benefits of center pivot sprinkler irrigation systems can include the use of less water applied per irrigation. This significant capability allows for the increased utilization of precipitation events and minimizing deep percolation losses below the crops' root zone as compared to surface flow irrigation, as well as the ability to uniformly apply approved chemicals through the system (herbigation, fertigation, and chemigation capability). These systems also allow an operator the ability to utilize and manage irrigation scheduling in a more frequent and variant manner. Thus, the advantages of utilizing center pivot sprinkler irrigation systems warrant the use of these systems in the region over surface flow systems for advancing irrigation developments in the future. Additionally, investigators conducting scientific work at the NPRF prefer irrigation by sprinkler since it most adequately represents irrigation trends within the region and allows more flexibility in timing and quantity per irrigation applied to accommodate research project protocols and representative demonstration activities. For instance, corn and wheat breeding variety trials prefer center pivot systems for water use efficiency evaluations.

In addition to cropping systems experimentation and demonstration activities, new irrigation technologies are being developed at the NPRF by engineering personnel. These concept efforts require an electronically controlled center pivot irrigation system facility to be evaluated on a research basis. Such concepts involve the development of a variable rate application nozzling system and potentially separate chemigation laterals on the unit to allow separate, yet simultaneous or subsequent applications with the irrigation water. The use of center pivot systems promotes the conservation of groundwater. These potential, new, innovations with a center pivot irrigation system, replacing surface irrigation practice, are being initially pursued and should prolong the life of the Ogallala aquifer as well as meet the NPGCD rules of withdrawal.

## Objective

The overall purpose of this project was to improve the research and demonstration capability associated with irrigation systems in the northern Texas High Plains. To accomplish this goal, the following objective was specified for the effort:

1. Procure and install a state-of-the-art center pivot system at the North Plains Research Field for research and demonstration purposes.

## Development and Results

**Objective 1: Procure and install a state-of-the-art center pivot system.**

A quality design for a state-of-the-art center pivot system was established and bid by the North Plains Water District to regional vendors. Due to the intent of the unit, a second bidding of the center pivot system was necessary and a Lindsay Zimmatic system was approved for procurement. A local dealer. Jerry Wakefield of Circle L Irrigation of Dumas, TX, was awarded the bid and provided excellent service in installing the system as per the research and demonstration specifications. Mr Wakefield went beyond the typical call of duty in obtaining the dual flow system with the nozzling manufacturer of Senninger Inc. and in working with the NPRF research staff, who installed the dual flow nuzzling system. Patience was also exercise das the electrical and water and control systems were installed and integrate into the NPRF's telecommunications system and underground supply lines. Quality operations were conducted throughout the installation processes and the final product shows a facility that will be able to be enhanced with regards to research efforts.

Total costs of the unit exceeded the original estimates of the project. Additional costs were paid for by the North Plains Water District, with approval of the Board of Directors.

**Water Saving Estimates from this contract as requested by the TWDB**

Since the installation of the center pivot system was delayed due to weather and delayed bidding and procurement activities, no actual irrigation use of the unit was recognized during the contact period. Nonetheless, a reduction of 0.25 acre-feet per acre per year is expected and can be assumed with the irrigation system changes on the NPRF (changing from surface flow to that with a center pivot) in the upcoming years. This equates to a water savings of 21 acre-feet (6.85 million gallons) on the proposed NPRF research system acreage per year. This will equate to a water reduction or water savings on a per acre basis of 12 percent. Estimating that additional adoption in the immediate region of the NPRF will occur within next year on 5,000 additional acres with a 12 percent reduction over furrow flow, this results in a net savings of 1,250 acre-feet (over 407 million gallons). With time, potentially new irrigation technologies that can be researched and developed with the system can be used to further reduce water use and be relayed to producers using much larger acreages within the NPGCD's boundaries.

For this year during the contract period, the actual NPRF center pivot research area was partially irrigated with surface flow irrigation. This was required due to research protocols resulting in a contract period average surface flow application of 1 acre-ft per acre or a total of 83.3 ac-ft (>27 million gallons). The average application state was computed using FY05 multiple crop research plots, including fallow or lay-out areas, and may not reflect future research conditions and average water use following this installation project.

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