

REPORT

Title: Effects of woody vegetation removal on groundwater recharge in the Carrizo-Wilcox aquifer

Project Number: 2011TX397B

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Abstract: The Carrizo-Wilcox aquifer is an important source of water for agricultural and municipal needs across approximately 60 counties in Texas. As use of the aquifer increases and managers look for methods to increase recharge rates, understanding the effects of woody vegetation removal on recharge is becoming more important. However, surprisingly little research has been done to quantify the impacts of such actions on recharge. This project will investigate the impacts of woody vegetation removal from the recharge zone of the Carrizo-Wilcox aquifer on downward fluxes of vadose zone soil moisture in a replicated field experiment. Given the difficulties associated with quantifying recharge in semi-arid systems such as this one, we employ multiple indirect methods across the experiment, validated by an intensive instrumentation effort. The proposed research will provide quantitative information needed by the groundwater conservation districts and landowners throughout the region.

Problem and Research Objectives: Understanding the effects of vegetation on groundwater recharge is important in areas such as the Winter Garden Groundwater Conservation District where vegetation is being managed for various outcomes and by different means. Rangelands across Texas are subject to a variety of management practices and are managed for a variety of reasons. Some land is managed to improve grazing for cattle, while some is managed to improve bird or deer habitat for hunting. Increasingly, managers are explicitly engaged in activities to improve aquifer recharge. In consideration of all of the reasons why vegetation is being removed and to what degree, it is important to understand what the impacts are on groundwater. At this time, there is very little scientific information for the Carrizo-Wilcox region to support decisions about removal of vegetation and its subsequent effects on groundwater. Even less is known about the role of soil type or texture on the effects of vegetation removals.

Our primary objective is to enhance the interpretation of planned indirect estimates of aquifer recharge in a large, manipulative field experiment through targeted direct measurements of moisture flux below the root zone. Our current approach is to estimate recharge indirectly using monthly neutron moisture meter measurements, stable isotopes and continuous moisture measurements across the experiment.

Materials/Methodology:

In this experiment we are removing woody vegetation using three commonly-applied mechanical and chemical techniques, as well as evaluating their interaction with cool-season fires and how these techniques interact with soil texture. The techniques used for removal of woody vegetation span the range of impacts associated with common brush removal techniques from no impact (control plots) to moderate

mortality (roller chopping) to near 100% mortality of woody species (chainsaw plus herbicide of all woody stems).

Quantifying recharge in these semi-arid systems is difficult and the application of multiple techniques increases the reliability of recharge estimates (Scanlon et al. 2002). We will be making assessments of water movement from volumetric water content measurements, soil texture,, and stable isotopes (d^2H and $d^{18}O$) throughout the soil profile. To allow an assessment of shorter-term responses, soil moisture stable isotope ratios will be analyzed. The combination of continuous moisture measurements and stable isotope data will provide critically important information about recharge. The additional funding provided by USGS was used to purchase the continuous moisture meters and associated data loggers. The additional instrumentation allowed us to measure volumetric water content of soils on an hourly basis to detect short term changes that would not be been in the monthly measurements using the neutron probe. The matching funds provided by the Wintergarden Groundwater Conservation District were used for graduate student support for April Mattox

Principal Findings: Soil moisture measurements have been taken continuously at 6 sandy locations since mid-January. Continuous measurements have detected changes in soil water content that would have otherwise been missed with monthly neutron moisture meter measurements. The continuous measurements are also corroborating evidence of no change in soil water content at some depths in some locations.

Significance: This additional data improves our confidence in understanding soil water dynamics *in situ* under natural conditions. The findings will help to determine the effects of woody vegetation removal on soil water movement. The additional data obtained thru funding by USGS will allow finer scale measurements of soil water movement that otherwise would not have been possible.

PUBLICATION

There was no publication of data for this project during the reporting period of the grant.

NOTABLE AWARDS AND ACHIEVEMENTS

There have not yet been notable achievements or awards resulting from work supported by section 104 and required matching funds and by supplemental grants during the reporting period.