

## SRP-WREP Grant Final Report – Clint Wyatt

Date: 25 April 2012

To: Salt River Project

From: Clinton J. Wyatt

Subject: Watershed Research and Education Program Grant Final Report

### Background:

This grant covered expenses for travel and activities related to my master's thesis at Northern Arizona University, tentatively titled “Estimating Groundwater Yield Following Landscape-Scale Forest Restoration Along the Mogollon Rim, Arizona.” The purpose of this research is to estimate how climate change and proposed forest restoration thinning treatments conducted by the U.S. Forest Service on Coconino and Kaibab National Forest lands will impact groundwater recharge to regional aquifers, springs, and streams. Funding was requested for a meeting with hydrology professionals in Santa Fe, New Mexico where similar forest thinning treatments have been conducted; other funding was requested for state travel for one of my thesis committee members, Dr. Peter Kroopnick, to travel from Prescott to Flagstaff to assist in running the Northern Arizona Regional Groundwater-Flow Model that I am using for my thesis.

### Work Completed:

#### *Work completed before the interim report:*

I (Clint Wyatt), Dr. Abraham Springer (my thesis advisor), and Sharon Masek-Lopez (NAU Watershed Research Specialist and unofficial committee member) took a trip to New Mexico from 9/30/12 to 10/3/12 to visit professionals who worked on the Santa Fe Watershed before, during, and after forest restoration thinning treatments within the Santa Fe National Forest.

We met with Darin Desilets of Hydroinnova LLC in Albuquerque, traveled to Santa Fe, and spent the day on the Valles Caldera where his company, as well as others, have instrumentation set up. The two Hydroinnova instruments included a snow pillow and soil moisture probe. Darin helped develop the moisture probe and provided us with a lot of information and support relating to these two instruments. We also visited a site on the Caldera instrumented with an Eddy Covariance Tower. This instrument is used to measure changes in evapotranspiration and has been used on forest lands surrounding Flagstaff, AZ. Several trees surrounding the tower were also instrumented with sap flux tools to measure ET. These instruments, especially the soil moisture probe, are currently being looked at for use in paired watershed studies to be completed before major 4FRI forest treatments are undertaken. These techniques, and others, will help us understand all the components of the water-balance and constrain changes in associated parameters (soil moisture, ET, recharge, runoff) following forest restoration.

We also met with Amy Lewis, who did monitoring on the Santa Fe Watershed pre- and post-forest treatment. The purpose of the meeting with Amy was to better understand how she did her measurements and for her to provide us with her expertise and guidance on the issue. She used a paired-watershed approach, similar to what is being planned for watersheds around Flagstaff and in 4FRI prescription areas. Some of the techniques she used, including water collection cylinders and chloride-mass balance, may provide us with a relatively novel, reliable, and inexpensive tool set that can be used on watersheds in and around Flagstaff.

*Work completed since the interim report:*

I had the opportunity to travel to the 39<sup>th</sup> International Association of Hydrogeologists Congress in Niagara Falls, Canada from 16-21 September 2012. Though I did not use my WREP funds for my travel, I presented my research during Session TH1-A: Groundwater Recharge I on Thursday 20 September at 11:00 am. I also had the opportunity to meet with international, professional

hydrogeologist and discuss some of the most important issues facing water users and managers throughout the world. This helped me frame my project in a larger context and understand some of the ways that water use in Arizona is both more and less progressive than water use in other locations.

During the Spring semester I traveled with my advisor, Dr. Abe Springer, and a fellow student, Victoria Stempniewicz, to Tuscon for the Water Resources Research Center's Annual Conference on 5 March. The conference was organized in partnership with the United States Geological Survey and was held at the University of Arizona's Student Union Memorial Center. There were approximately 300 attendees to the event, which was set up as an interactive dialogue between prominent water experts and interested parties. The theme of the conference was “Water Sustainability From the Ground Up” and dealt with the issues of water sustainability, environmental implications of stress water supplies, and policy options for local region and federal decisions makers.

This was my only travel and the only time I used my WREP grant for travel. It allowed me to meet with water professionals and learn about some of the most important issues facing Arizona and the southwestern United States today and into the future.. I was able to learn a few things that aided the completion of my thesis and to network with hydrological professionals. The most new item I learned was about Reclamation's Colorado River Basin Water Supply and Demand Study. I was able to use this document, along with the Arizona Department of Water Resources' Water Resources Development Commission Report, to supplement some of water supply and demand issues I found in my research. These documents, and what I learned from the conference, helped me detail a few of the solutions that may be used to minimize the impact of groundwater overdrafting and water shortages in the future.

I successfully defended my thesis on 3 April and am currently finishing edits on my thesis. I currently have one of my chapters, a systematic review of the effects of tree removal on the water budget, in review at the journal *GroundWater*. I have addressed the concerns of a number of editors from my thesis committee, the Ecological Restoration Institute at NAU, and Salt River Project. These included creating a new baseline scenario, choosing new climate scenarios to better simulate wetter-

and drier-than-average conditions based off the precipitation period of record, and focusing my results on the Verde Valley groundwater catchment basin, an area of prime interest for Salt River Project.

#### Problems:

There have been no problems associated with the proposed work. However, Dr. Peter Kroopnick, has not been able to travel to Flagstaff as often as was expected. He has still provided technical support via e-mail and phone whenever needed but due to unforeseen circumstances has not been as available in person as he might otherwise have been. There were no repercussions to my modeling as of yet and it is not anticipated that this will severely impact my work or the quality of results that I produce.

#### Work Scheduled:

Currently, I am finishing edits on my groundwater modeling chapter so that I may submit it as a manuscript to a journal, possibly *GroundWater*, before I graduate on 11 May. Furthermore, I am currently working with Sharon Masek Lopez and Tayloe Dubay to draft up fact sheets for both the systematic review and the groundwater modeling that I have completed. These fact sheets will be used to help water managers, policy makers, and other interested parties to make decisions on how best to deal with possible changes in water yield and groundwater recharge following forest treatment and climate change. These will be completed before 11 May.