FY16 NM WRRI Research Progress Report Form
Report Due Date: 8 September 2015
(prepare in 12 pt Times Roman with 1" margin, report should be no longer than two single-spaced pages)

1.   Project Title: Groundwater level and storage changes in alluvial basins along the Rio Grande, New Mexico

2.   Investigators (names, university/agency): Alex Rinehart, Brigitte Felix-Kludt, Ethan Mamer, Cathryn Pokorny, and Stacy Timmons. New Mexico Bureau of Geology and Mineral Resources. Nathan Myers. USGS Albuquerque WRC. Mike Johnson, NM Office of the State Engineer, Hydrology Bureau.

3.   Brief description of project, research objectives, and impacts on New Mexico (provide performance measures and outcomes)

To better understand the changing water budget in New Mexico, we are providing an estimate of groundwater storage changes in the alluvial aquifers that occur in the groundwater basins along the Rio Grande. The alluvial aquifers in the Rio Grande basins from the southern San Luis Valley through the Mesilla Valley are the primary source of groundwater for most of the metropolitan areas and much of the most intensive agricultural areas of New Mexico. Using high quality groundwater level measurements from the USGS, NMOSE and NMBGMR, the storage change estimates deliver three sets of products: an understanding of the scale of groundwater storage changes and aquifer connectivity through variogram analysis of groundwater level measurements; maps of changes in water levels using several different statistical perspectives; and time series of total changes in stored groundwater for each basin.

We will provide an internally consistent view of the changes in groundwater storage in some of the most socially important aquifers in New Mexico. Additionally, the variogram analysis will give unified metrics on differences in aquifer geometry and compartmentalization between the different groundwater basins. Our estimates use a range of internal comparators to assess data quality. The primary impact is to provide a unified initial estimates of groundwater storage changes. Groundwater storage change maps can then be attributed to changing societal water use or natural recharge variability at a later date. The total changes and the maps can then be post-processed and used in the statewide water budget model.

4.   Brief description of methodology

In order to estimate the groundwater storage changes in all of the alluvial aquifers in New Mexican Rio Grande Basins, we use a combination of data compilation and review, combined time series and spatial analysis, spatial interpolation, and change in water volume based on the interpolations and literature-derived aquifer properties. More specifically, we follow the steps below:

1. Update our database of with recent groundwater level measurements.
2. Define groundwater basins and subbasins through comparison with NMOSE data.
3. Review literature on alluvial aquifer properties in each study area.

4. Review data for each basin to cut out questionable data or data from the active irrigation season.
5. Define time intervals over which to interpolate depth to groundwater levels.
6. Determine correlation length of depth of groundwater levels through variogram analysis.
7. Perform interpolations of depth to groundwater levels using ordinary kriging (OK) and inverse distance weighting (IDW) schemes, restricting the interpolated area to be in alluvium and to be within the correlation distance.
8. Find changes in water levels within each interpolation by
    a. Subtracting more recent estimates from pre-development levels; and
    b. Finding the difference between groundwater levels from neighboring time intervals.
9. Summing the various groundwater level differences, estimate the total changes in water storage in the aquifers through time. This leads to at least four estimates of storage change per basin.

Additional complications will likely include changing sampling rates in more populated areas, recognition of mis-identified aquifers that are actually in bedrock, and the possibility of poor correlation of groundwater levels either due to a strong anthropogenic signal or to sparse spatial data.

5. Brief description of results to date and work remaining

We have received an updated groundwater level dataset from Nathan Myers at the USGS and are in the process of updating our database. We are training a new member (Ethan Mamer) of our team on the methodology, assessing concerns surrounding higher frequency repeat measurements in metropolitan areas, and deciding how to break out the groundwater basins spatially from existing NMOSE datasets.

6. Student participation - List all students participating in the project, their classification level (undergraduate, master's, Ph.D., post doc) and their field of study (degree major). *None.*
7. Provide special recognition awards or notable achievements as a result of the research. Include publications in progress (all published work supported wholly or in part of NM WRRI must bear an acknowledgment of support). *None.*
8. Include references as needed (limit to one additional page). *None.*
9. Provide a few sentences on progress toward uploading data to a common/standardized platform, if applicable. *N/A.*
10. Provide two PP slides that provide summary information on your project appropriate for viewing by state legislators. *N/A*