

NEW MEXICO BUREAU OF GEOLOGY AND MINERAL RESOURCES REGIONAL GROUNDWATER LEVEL MONITORING NETWORK

Award Number: G17AC00182
Term of award: July 15, 2017 to July 14, 2018
Date: August 21, 2018

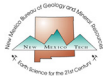
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MAJOR GOALS 2017-2018

Become a new data provider to the National Groundwater Monitoring Network

PROJECT SUMMARY

New Mexico Bureau of Geology and Mineral Resources was awarded Grant No. G17AC00182 to become a new data provider to the NGWMN water-level network, the period of work is between July 15, 2017 and July 14, 2018. Work included selecting sites for inclusion and providing data to the NGWMN. This was successful for 11 wells.

OVERVIEW OF NMBGMR GROUNDWATER LEVEL MONITORING

The New Mexico Bureau of Geology and Mineral Resources (NMBGMR) is a non-regulatory research and service division of New Mexico Institute of Mining and Technology (NMIMT). The NMBGMR serves as New Mexico's geologic survey, tucked within the higher education branch of state government. The mission of the NMBGMR includes numerous tasks including conducting research about geological resources (including groundwater), distributing accurate information and mapping about our geologic resources, serving as a repository for data (i.e. groundwater level data), and making it publicly available.

There are six principle aquifers, as designated by the U.S. Geological Survey, throughout New Mexico; Colorado Plateau aquifer, Rio Grande aquifer system, High Plains aquifer, Basin and Range basin-fill aquifers, Roswell Basin aquifer system and Pecos River Basin alluvial aquifer (Figure 1). In addition to the six principle aquifers, there are also many small, local aquifers that serve communities and dispersed residents throughout the State, as well as fulfill industrial and agricultural needs.

Majority of the groundwater monitoring throughout New Mexico has traditionally been undertaken through cooperative funding between the U.S. Geological Survey and the New Mexico Office of the State Engineer. The network is divided up by administrative groundwater basins (not shown) and monitoring is done on continuous, biannual, annual and 5-year schedules (Figure 2). Through time the network has decreased in the number of monitoring locations and measurements taken due to funding limitations and well attrition.

The New Mexico Bureau of Geology & Mineral Resources has conducted a number of hydrogeology projects through the Aquifer Mapping Program (AMP). The AMP group maintains a growing groundwater monitoring network with a goal to collect, maintain and document long-term records of groundwater level changes. Many of these well locations are in areas where we have performed hydrogeologic research and detailed review of groundwater quality, quantity and movement (Johnson et al., 2016a, 2016b; Mamer et al., 2014; Newton et al., 2012; Person et al., 2013; Timmons, 2013). Upon completion of projects in these areas, we have been able to maintain equipment and monitoring in select wells.

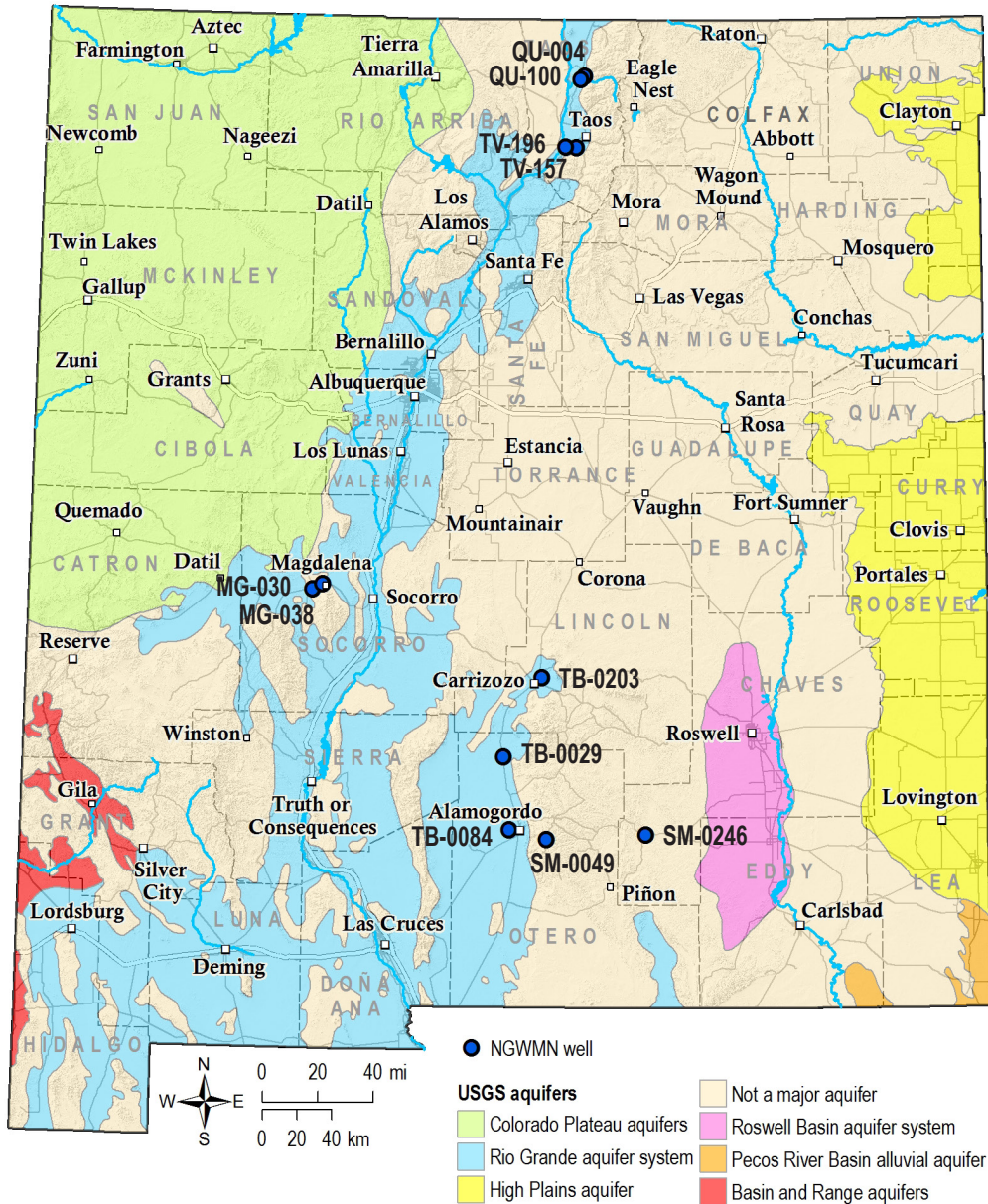


Figure 1. Principle aquifers and NMBGMR 11 sites selected for inclusion in the NGWMN in 2017-2018.

Additionally, in 2016, AMP implemented the Collaborative Groundwater Monitoring Network which aims to fill spatial and temporal groundwater level monitoring gaps throughout the state, as well as provide education to the public on groundwater conditions throughout the state (Figure 3). This is accomplished by finding new wells in key areas to manually measure or instrument with continuous monitoring. In some regions, we are also receiving groundwater level data from other individuals, organization, or agencies, such as well owners, municipalities and water operators. This Network also provides a program where we can incorporate key wells monitored as part of a short-term study into long-term monitoring sites. Currently there are 58 wells that have been incorporated into the Collaborative Groundwater Monitoring Network from smaller, short-term studies and a number of new wells. As this network grows, and trends in groundwater data are established, many of these wells will become available to the NGWMN, in areas of interest.

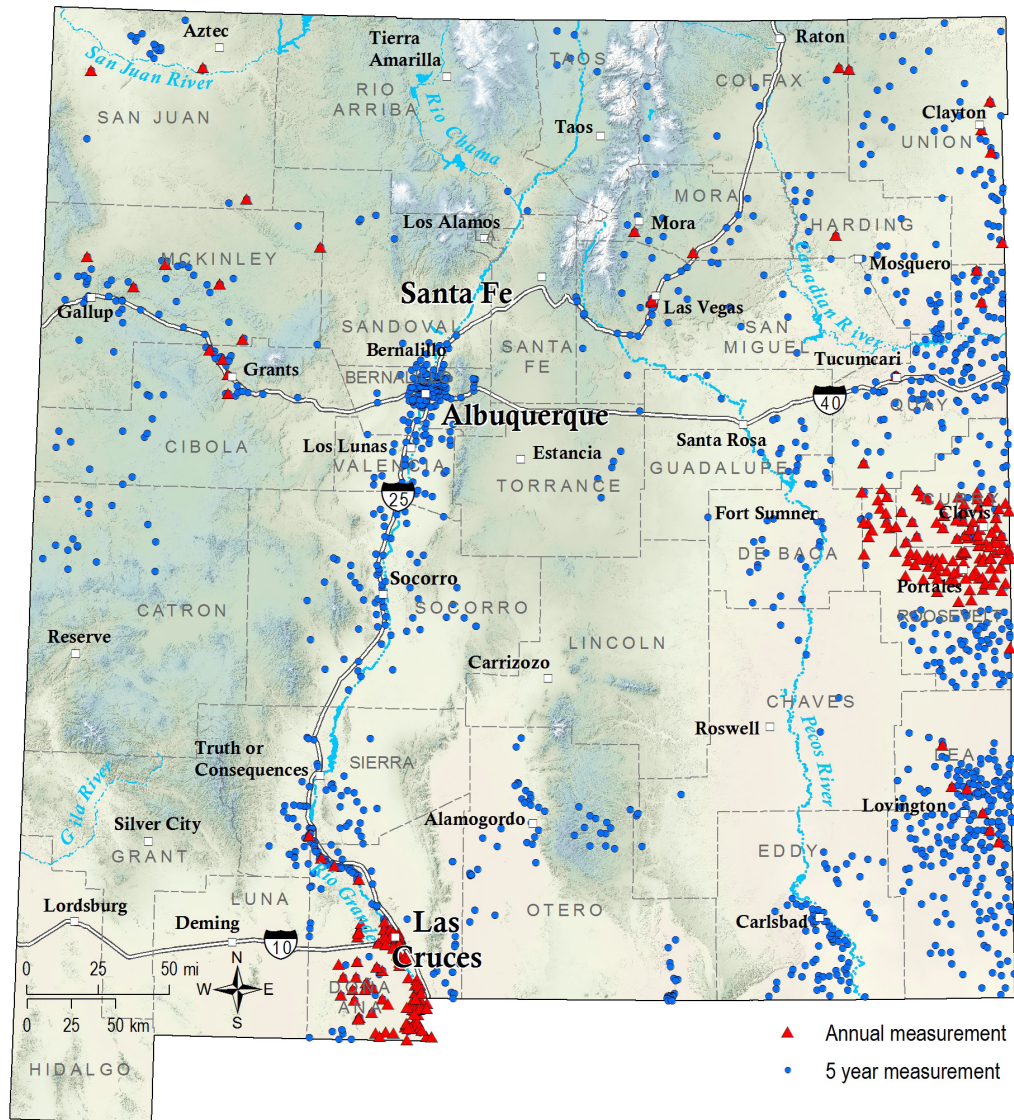


Figure 2. The NM Office of State Engineer and USGS NM Water Science Center approximate monitoring network, as of 2018. Red triangles are annual, continuous or biannually measured. Blue points are measured on a regionally rotating basis every 5 years.

NMBGMR SITE SELECTION FOR INCLUSION IN THE NGWMN

To select wells for inclusion in the NGWMN, the Bureau of Geology selected wells with at least five years of monitoring data, and would fit into the various subnetworks and monitoring categories. Once wells were selected that had at least 5 years of data, the well logs and water level trends were evaluated to ensure the wells being selected were representative of a regional aquifer, rather than perched or thin, confined zones.

This year, eleven wells were selected for inclusion into the NGWMN (Figure 1), additional wells have been selected to be included in the next two years. After initial well selection, the Bureau met with the USGS New Mexico Water Science Center to share information regarding wells each

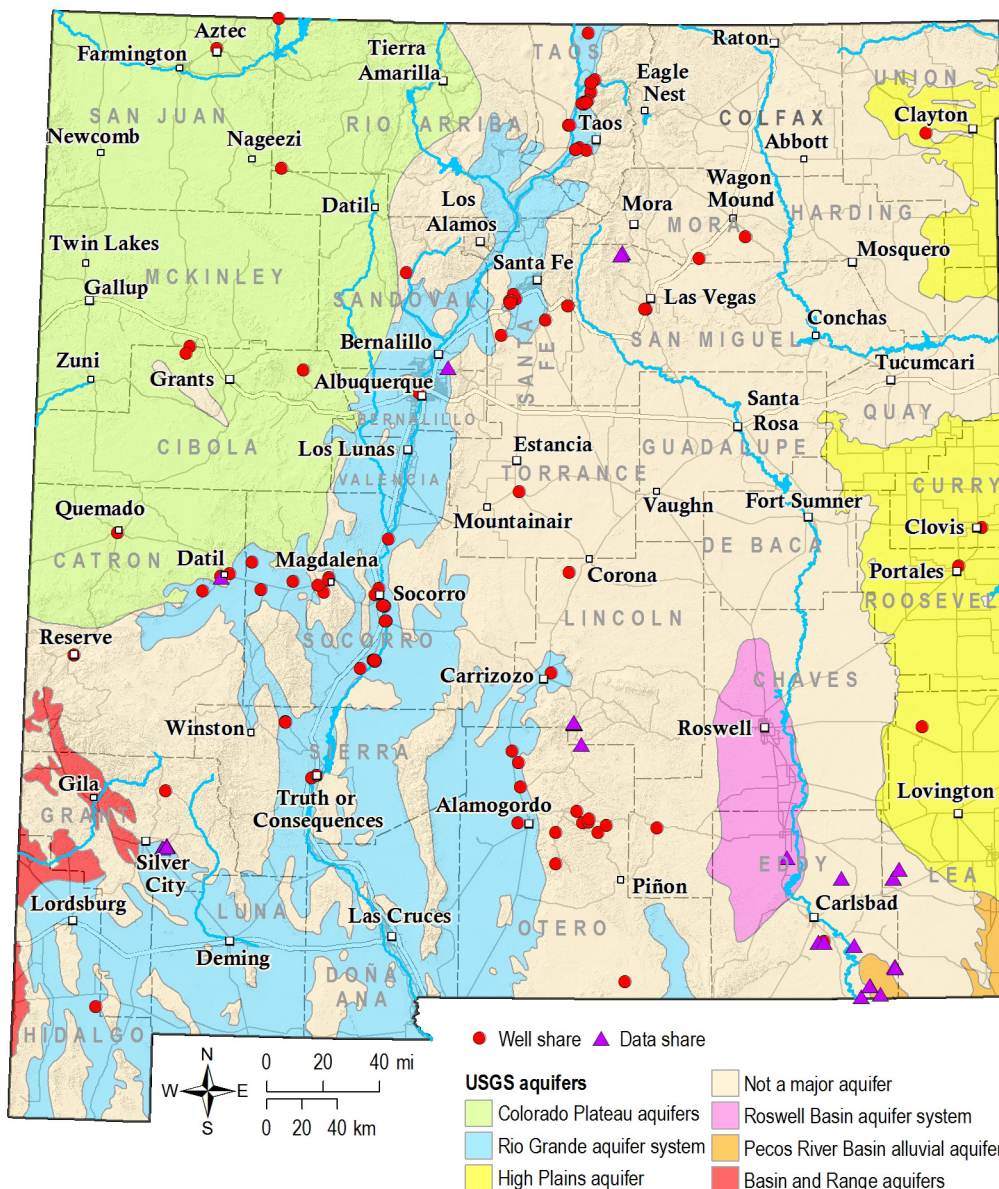
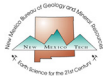


Figure 3. Principle aquifers and location of wells in the NMBGMR Collaborative Groundwater Monitoring Network

party would be including in the NGWMN. This was an effort to avoid overlap in wells being submitted to the NGWMN and to ensure spatial distribution throughout the State.

To determine which subnetwork and monitoring category each well would fit in to the hydrograph was examined for long term and seasonal trends. Groundwater and surface water availability and uses within the vicinity were also examined to establish potential influences on the site. Upon completion of well selection, well log evaluation and subnetwork and monitoring category selection the wells were entered manually into the NGWMN well registry. The summary of wells below list information for each site, including any missing elements.



SUMMARY OF WELLS SELECTED FOR INCLUSION IN THE NGWMN

Eleven wells were selected for inclusion in the NGWMN for the first year. Seven of the wells are located within the Rio Grande Aquifer System, the remaining five are located in what is categorized as “other aquifers” (Table 1 and Figure 1).

Table 1: Wells selected for the NGWMN with subnetwork and category designations and missing elements.

Point ID	National Aquifer	Subnetwork	Surveillance or Trend	Missing elements
MG-030	Other	Known changes	Surveillance	Coordinate accuracy
MG-038	Other	Known changes	Trend	Screen interval and material, casing depth and material, lithology, coordinate accuracy.
QU-004	Rio Grande	Background	Trend	Coordinate accuracy
QU-100	Rio Grande	Background	Trend	Coordinate accuracy
TB-0029	Rio Grande	Suspected/ Anticipated changes	Trend	Screen interval and material, casing depth and material, lithology, coordinate accuracy.
TB-0084	Rio Grande	Suspected/ Anticipated changes	Trend	Coordinate accuracy
TB-0203	Rio Grande	Background	Trend	Screen interval and material, casing depth and material, lithology, coordinate accuracy.
TV-157	Rio Grande	Suspected/ Anticipated changes	Trend	Screen interval and material, casing depth and material, lithology, coordinate accuracy.
TV-196	Rio Grande	Suspected/ Anticipated changes	Trend	Coordinate accuracy
SM-0049	Other	Background	Trend	Screen interval and material, casing depth and material, lithology, coordinate accuracy.
SM-0246	Other	Background	Trend	Coordinate accuracy

NMBGMR FIELD METHODOLOGY FOR GROUNDWATER LEVELS

The NMBGMR follows protocols outlined for the NGWMN but on uncalibrated equipment. We do not currently have the funding, facilities or supply of back-up equipment to calibrate our steel and electric tapes. Our procedures for measuring water levels are outlined below:

Prior to leaving for field work

1. Schedule well access with well owners
2. Print out schedule, contact information and other well information as available
3. Gather gear and check that you know how to use each item:
 - a. At least 2 steel tapes
 - b. Electric probe
 - c. Sonic Water level Meter + instruction manual
 - d. Tools to access wells (large channel locks, socket, other wrenches)
 - e. Work gloves
 - f. GPS
 - g. Camera

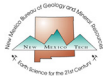
- h. Chalk for marking steel tape (large pieces)
- i. Extra batteries for E-probe
- j. Field notebook
- k. Extra writing utensils
- l. Clorox wipes – disinfecting tape between wells
- m. Ladder
- n. Rubber gloves
- o. Paper towels

Onsite at well

1. In notebook or other individual site data sheet, record basic well and owner information at first site visit:
 - a. Address and directions to site
 - b. Owner information, contact information, any special requests
 - c. Well record or info: drilled date, construction material, diameter, total depth, screen intervals, well cap design
 - d. GPS coordinate (in NAD83 UTM)
 - e. Usage notes, pumping history, well status (active, unused, stock, etc)
 - f. Photos – at least 2, one up close, one from distance
 - g. Measuring point description and correction (above ground +, below ground -), drawing if needed
2. Water level measurement
 - a. Clean measurement tool, over entire portion that will touch water
 - b. Access well by removing cap, plug or otherwise. Note any special access needs. Wearing gloves, carefully move wiring out of way
 - c. If well is equipped with pump, use chalked steel tape. Record hold and cut, repeat measurements until within +/- 0.02 ft. Record all measurements with note of good, poor, discarded, etc. Note any obstructions or difficulties. Note time for each measure.
 - d. If open well with no pump, use E-probe. Access water surface repeatedly with probe to determine if water level is within +/-0.02 ft, record depth to water (DTW). Note if water surface is moving up or down and status. Note time for each measure.
 - e. Return pump wires, cap, access port, etc., to original position. Leave nothing behind.

NMBGMR DATA QUALITY AND DATA ASSURANCE PROCESS

Field personnel maintain a notebook and complete other site-specific forms to record field measurements and observations. NMBGMR field staff perform a quality check of this documentation at the completion of data collection outings to verify completeness of information. A photocopy of field notebook pages and original data collection forms are given to the NMBGMR data manager, who reviews the data for outliers and other data concerns before entering the data into the AMP database. Calculations from notes and forms are double-checked for accuracy. Forms and field sheets are stored at the NMBGMR with the data manager for archive and future reference. Electronic copy of the data is housed in our AMP database on the SQL server and is backed up on a regular basis.



MISSING REQUIRED DATA ELEMENTS

Most well construction and lithologic information we obtain for our sites comes directly from drill logs filed with the New Mexico Office of the State Engineer. Well owners and drillers are required to submit drill logs for wells that are permitted and drilled in New Mexico. However, many times these documents are not available because they were never filed, the well was drilled long ago or declared long after the well was drilled and no records exist. Therefore, for wells where we have no drill record, we are missing screen interval, casing depth, and lithology for the well. There are five wells in our network that lack this information. The only other option for identifying screen intervals or casing depth might be through the use of a well camera. The Bureau does not currently own this type of equipment. We were able to determine well depth in instances where we did not have a well record, by tagging the well bottom with a well sounder.

Another element that is missing for our network wells is the casing and screen interval material. The AMP database does not include fields that maintain casing and screen interval material, so these elements are not populated for our wells.

And finally, the level of accuracy of our coordinates from handheld GPS coordinates has been left “unknown” in the well registry. The accuracy of handheld GPS coordinates has changed over the years and we do not document this in the field.

NMBGMR NGWMN DATA SHARING OVERVIEW

NMBGMR data are publicly accessible via a lightweight REST API implemented using Python and the Flask micro web framework. Services exposed include Lithology, Well Construction and Water Levels. The services are read-only and allow querying of NMBGMR data by other web services, namely NGWMN. Users can directly access the services via a web browser at <http://maps.nmt.edu/maps/data/NGWMN>.

The services provide the following information via custom XML documents. XML documents are generated dynamically by the Python and Flask application from NMBGMR’s master SQL Aquifer Database.

Lithology

- PointID – unique site identifier
- Lithology
- Term
- StratSource
- StratTop
- StratTopUnit
- StratBottom
- StratBottomUnit

Well Construction

- PointID – unique site identifier
- CasingTop

- CasingBottom
- CasingDepthUnits
- ScreenTop
- ScreenBottom
- ScreenBottomUnits
- CasingIntervalMaterial
- ScreenIntervalMaterial

Water Level

- PointID – unique site identifier
- DepthFromLandSurfaceData
- WaterLevelUnits
- MeasuringMethod
- MeasuringMonth
- MeasuringDay
- MeasuringYear
- MeasuringTime
- MeasuringTimezone
- WaterLevelAccuracy

CONCLUSIONS

The NMBGMR successfully connected to the USGS NGWMN, and is now showing 11 sites on the USGS website with nearly complete data. This important first step will allow NMBGMR to continue to grow and add new sites, as well as improve data quality on existing sites. We look forward to continuing to work with the USGS toward this important endeavor for a national coverage of groundwater monitoring.

