

**USGS National Groundwater Monitoring Network Cooperative Agreement  
Final Technical Report**

**Award Number:** G17AS00009

**Agency Name:** Missouri Department of Natural Resources, Missouri Geological Survey

**Title:** Missouri Department of Natural Resources' Missouri Geological Survey proposal to reconstruct three existing observation wells in order to prevent shallow water from entering the well.

**Author and Affiliation:** Scott Kaden  
Missouri Department of Natural Resources  
Missouri Geological Survey  
P.O. Box 250  
Rolla, MO 65402

**Author's Telephone:** 573-368-2194

**Author's Email Address:** [scott.kaden@dnr.mo.gov](mailto:scott.kaden@dnr.mo.gov)

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## **Background of Proposal**

The Missouri Geological Survey (MGS) has been collecting groundwater level data for over 60 years and is an existing data provider to USGS. MGS currently operates 149 groundwater observation wells. Hydrographs for these wells are inspected weekly and checked for abnormalities. By conducting this weekly review, MGS staff were able to identify three wells whose hydrographs showed spikes in the water level following precipitation events in two wells and the third occasionally would have a flat line graph.

A downhole camera investigation was conducted in these wells. Two videos revealed a hole in the casing where shallow water was entering the well bore resulting an increase in the water level. The third also showed a leak resulting in corrosion of the casing. The hole and flow of water resulted in a mineral deposit, similar to a stalactite, causing the float to hang up on the deposit causing inaccurate water level readings.

Wells that have holes in the casing contribute shallow water to the well bore. This water could be from surface sources or aquifers overlying the monitored aquifer. In either case, this additional water can result in incorrect water level reading from the observation well as well as provide a route for possible contamination to enter the well.

Due to the verification of the holes in the casing, MGS proposed to reconstruct three existing observation wells to prevent shallow groundwater from entering the well. A smaller diameter liner was to be installed and grouted to seal out the hole and allow the well to monitor the opened interval without influence from shallow water.

This activity was proposed to be conducted under the provisions of Objective 4-Well Maintenance for well repair and well integrity testing.

## **Description of Well Repair Activities**

Prior to the commencement of well repair activities, a drill rig was set up over all three wells to clean out any accumulated sediment or collapsed material in the bottom of the well, remove mineral build up on the casing as in the case of the Drake well, and to produce water from the well to remove any mineralization that may have occurred that reduced the porosity of the formation.

The actual well repair process involved installing a 2" PVC liner from the surface to the total depth of the well with the bottom portion slotted for water movement, packers were installed along with the liner and rest just below the bottom of the existing casing, and the liner was grouted to prevent the shallow water from entering the borehole or annular space. This process effectively sealed the existing hole and any future holes that may occur in the casing.

## **Problems Encountered in Completing the Project**

The well repair projects were completed with little variation to the proposal. However, costs of the project did exceed the budget submitted in the grant proposal. In order to complete the deliverables outlined in the proposal, MGS contributed an additional \$24,930.18 in contract funds to the overall project.

## Project Results

Following reconstruction of these wells the water level returned to what is believed to be the normal level. The hydrograph below from the Asbury well shows a gap in the data near the end of 2017 marked by the red line. This was when the well was offline for repair. After the project successfully sealed out the shallow water, the water level in the well returned to the level prior to the formation of the hole. Based on the hydrograph, it is estimated that the hole began developing in mid-2013 (marked by the green line) and gradually got larger. This is based on the larger fluctuations in the graph which also correspond to precipitation events. Prior to 2013 the water level was never above 250 feet. Since the repair the water level has once again dropped below 250 feet.

Similar results occurred at the Drake and Bourbon wells also following repair activities.

