USGS National Ground-Water Monitoring Network Cooperative Agreement G18AC00083

A. Final Technical Report

1. Project Title: University of Nebraska-Lincoln, Conservation & Survey Division cooperative agreement to support persistent data services and well maintenance.

2. Technical Contacts

Aaron Young
University of Nebraska-Lincoln
School of Natural Resources, Conservation & Survey Division
3310 Holdrege St., 602 Hardin Hall
Lincoln, NE, 68583-0996
402-472-8339, ayoung3@unl.edu

Mark Burbach
University of Nebraska-Lincoln
School of Natural Resources, Conservation & Survey Division
3310 Holdrege St., 623 Hardin Hall
Lincoln, NE, 68583-0996
402-472-8210, mburbach1@unl.edu

3. Term: 7/1/2018-6/30/2019

4. Final Report date 8/9/2019

B. Project description

Under the terms of the agreement, the University of Nebraska-Lincoln, Conservation and Survey Division (CSD) was awarded funding under Objective 2 and Objective 4.

Funds provided under Objective 2 were applied to re-coding data import software. The formatting needs of the NGWMN caused instability in our system and downtime to modify software. In order to address the instability in our system caused by the formatting issues, temporary changes were hastily made to our data import software while setting up our web services. Funds provided under Objective 2 were used to re-programmed our data import software to make permanent fixes for existing temporary changes. The permanent fixes were copied to our backup server, and extensively tested for reliability. This work was performed under contract with the Nebraska State Climate Office, and was completed in December 2018. As of July 2019, we have not had any downtime due to failure of the updated software.

Funds provided under Objective 4 were applied toward pumping eight existing monitoring wells to verify connection to the aquifer. The eight wells were:

Well Name	NGWMN Number
Hardy	19
Inavale	21
Nora	20
Burress 1	4
Burress 2	59
Rising City 1	5
Rising City 2	58
Elmwood	32

C. Methods

Updates and software re-coding was completed using a Linux based bash shell script. The exact details of coding cannot be provided due to IT security concerns.

Pumping procedures varied slightly based on the diameter, depth and static water level of the well. The basic procedure consisted of lowering a pump into the well approximately 10 feet below the static water level, and pumping a minimum of three volumes of water from the well at either the maximum rate of the pump or the maximum capacity of the well. Wells were pumped using either a Mega Monsoon®, or a 3" ½ HP submersible pump. Recovery of water levels was monitored after pumping, and specific capacity was calculated for wells where possible. Specific capacity was calculated using the standard formula SC=Q/s where SC is specific capacity in gpm/ft, Q is discharge in gpm, and s is drawdown in feet. A well is considered to be in adequate connection with the aquifer if the pumping rate is greater than the maximum volume of water required to account for the largest one-hour water-level change observed at a particular site.

D. Data Collected

No data was collected under Objective 2.

Under Objective 4, the following information was collected while pumping wells:

Hardy (NGWMN well #19):
The Hardy well was pumped on 7/20/2018, using a ½ HP 3" diameter submersible pump.

Total depth	63'
Well diameter	4 "
Screened interval	20-63'
Beginning DTW	58.48'
Pumping DTW	60.10'
Pumping Rate	8 gpm
Recovery time	< 5 minutes*
Volume of water in casing	3.6 gal
# of water volumes pumped	44.5 volumes
Specific capacity	4.9 gpm/foot

*Due to the low drawdown of the well and the back-drainage of the pump, it is difficult to estimate a true recovery period for the well. The well was fully recovered in less than 5 minutes.
Notes: A minimal amount of sediment was pumped from the well. Water ran cloudy for a very brief time until clearing approximately two minutes after beginning of pumping. Based on the results of pumping, this well is in excellent connection to the aquifer.

Inavale (NGWMN well #21):
The Inavale well was pumped on 7/19/2018, using a Mega Monsoon® submersible pump.

Total depth	54'
Well diameter	2"
Screened interval	49-54'
Beginning DTW	42.86'
Pumping DTW	44.33'
Pumping Rate	1.5 gpm
Recovery time	< 2 minutes*
Volume of water in casing	1.82 gal
# of water volumes pumped	37.1 volumes
Specific capacity	1.02 gpm/foot

*Due to the low drawdown of the well and the back-drainage of the pump, it is difficult to estimate a true recovery period for the well. The well was fully recovered in less than 2 minutes.
Notes: Water ran cloudy from 3-15 minutes. Water flowed completely clear after 15 minutes. Based on the results of pumping, this well is in excellent connection to the aquifer.

Nora (NGWMN well #20):
The Nora well was pumped on 7/20/2018, using a Mega Monsoon® submersible pump.

Total depth	108'
Well diameter	2"
Screened interval	103-108'

Beginning DTW	13.39’
Pumping DTW	45.00’
Pumping Rate	1.8 gpm
Recovery time	90 min
Volume of water in casing	15.44 gal
# of water volumes pumped	7.6 volumes
Specific capacity	0.06 gpm/foot

Notes: Water pumped clear throughout testing. From 5-15 minutes of pumping, water had a strong Sulphur odor and ant parts were pumped from well. From 15-90 minutes, the Sulphur odor and ant parts had dissipated. Based on the results of pumping, this well is in good connection to the aquifer.

Burress 1 (NGWMN well #4):

The Burress 1 well was pumped on 7/31/2018, using a Mega Monsoon® submersible pump.

Total depth	65’
Well diameter	2”
Screened interval	45’-65’
Beginning DTW	53.10’
Pumping DTW	54.05’
Pumping Rate	1.5 gpm
Recovery time	<3 min*
Volume of water in casing	11.9 gal
# of water volumes pumped	5.7 volumes
Specific capacity	1.58 gpm/foot

*Due to the low drawdown of the well and the back-drainage of the pump, it is difficult to estimate a true recovery period for the well. The well was fully recovered in less than 3 minutes.

Notes: Water pumped cloudy for first 20 minutes of pumping. Water pumped clear for the final 25 minutes of pumping. Based on the results of pumping, this well is in excellent connection to the aquifer.

Burress 2 (NGWMN well #59):

The Burress 2 well was pumped on 3/27/2019, using a Mega Monsoon® submersible pump.

Total depth	255’
Well diameter	2”
Screened interval	230-250’
Beginning DTW	94.5’
Pumping DTW	97.8’
Pumping Rate	1.2 gpm
Recovery time	3 min*
Volume of water in casing	26.21 gal
# of water volumes pumped	3.43 volumes
Specific capacity	2.75 gpm/foot

*Due to the low drawdown of the well and the back-drainage of the pump, it is difficult to estimate a true recovery period for the well. The well was fully recovered in less than 2 minutes.

Notes: Water pumped hazy from 20-22 minutes pumping time. Water pumped clear for additional 50 minutes of pumping. Based on the results of pumping, this well is in excellent connection to the aquifer.

Rising City 1 (NGWMN well #5):

The Rising City 1 well was pumped on 7/18/2018, using a ½ HP 3” diameter submersible pump.

Total depth	131’
Well diameter	4”
Screened interval	121’-131’
Beginning DTW	86.06’
Pumping DTW	96’
Pumping Rate	10 gpm
Recovery time	~5 min*
Volume of water in casing	29.4 gal
# of water volumes pumped	20.4 volumes
Specific capacity	1 gpm/foot

*Due to the low drawdown of the well and the back-drainage of the pump, it is difficult to estimate a true recovery period for the well. The well was fully recovered after about 5 minutes.
Notes: Water pumped cloudy for first 15 minutes of pumping. Water ran clear for the final 45 minutes of pumping. Based on the results of pumping, this well is in excellent connection to the aquifer.

Rising City 2 (NGWMN well #58):
The Rising City 2 well was pumped on 7/18/2018, using a ½ HP 3” diameter submersible pump.

Total depth	205’
Well diameter	4”
Screened interval	195’-205’
Beginning DTW	115.44’
Pumping DTW	125.5’
Pumping Rate	7 gpm
Recovery time	~5 min*
Volume of water in casing	58.8 gal
# of water volumes pumped	7.15 volumes
Specific capacity	1.43 gpm/foot

*Due to the low drawdown of the well and the back-drainage of the pump, it is difficult to estimate a true recovery period for the well. The well was fully recovered about 5 minutes.
Notes: Water pumped cloudy for first 20 minutes of pumping. Water ran clear for the final 40 minutes of pumping. Based on the results of pumping, this well is in excellent connection to the aquifer.

Elmwood (NGWMN well #32):
The Elmwood well was pumped on 7/31/2018, using a Mega Monsoon® submersible pump.

Total depth	33’
Well diameter	2”
Screened interval	23-33’
Beginning DTW	7.15’
Pumping DTW	----
Pumping Rate	1.5 gpm*
Recovery time	1.5 hours
Volume of water in casing	4.22 gal
# of water volumes pumped	~8 volumes**
Specific capacity	Unknown

*Well was pumped at 1.5 gal/ minute, the slowest possible rate for the pumping equipment.

**The well pumped dry almost immediately. Following 10 minutes, the well recovered 4 feet, and pumping continued. This process of pumping followed by 10 minutes recovery was repeated eight times. Following seven cycles, the water in the well ran clear. Water levels had returned to pre pumping levels after 1.5 hours of recovery.

Notes:

The flow rate for this well was less than the lowest capability of the pump, thus a pumping rate and a specific capacity for the well are not able to be calculated. Water at this site did eventually pump clear, and the rate of recovery at in this well of 4 feet in 10 minutes is greater than the maximum historic one-hour change at this site. Additionally, this well reacts very quickly to precipitation events. Although the flow in this well is low, we are considering this well to have a good connection to the aquifer.

E. Quality Assurance

Under Objective 2, coding and software updates were verified by periodically comparing data entered into the database against raw data obtained from site transmissions. Data from all sites is currently being uploaded correctly. Visual QA/QC was performed on all wells included in the NGWMN, and all obvious erroneous data was removed.

F. Future impacts to the NGWMN

None of the data or coding produced or altered through this cooperative agreement has had any impact on data delivery to the NGWMN. Backup systems were able to continuously provide data to the NGWMN while the alterations were being performed. No future database or web services outages are planned at this time.