

# NATURAL RESOURCES COMMISSION

Water Sustainability Fund

Application for Funding

Section A.

## ADMINISTRATIVE

PROJECT NAME: GeoScene 3D aquifer characterization of Western Sarpy County

### *PRIMARY CONTACT INFORMATION*

Entity Name: Papio-Missouri River Natural Resources District (NRD)

Contact Name: Paul Woodward

Address: 8901 South 154<sup>th</sup> Street, Omaha, NE 68138-3621

Phone: 402-315-1772

Email: pwoodward@papionrd.org

Partners / Co-sponsors, if any: U.S. Geological Survey

1. Dollar amounts requested: (Grant, Loan, or Combination)

Grant amount requested. \$120,000

Loan amount requested. N/A

If Loan, how many years repayment period? [Click here to enter text.](#)

If Loan, supply a complete year-by-year repayment schedule.

[Click here to enter text.](#)

2. Permits Needed - Attach copy for each obtained (N/A = not applicable)

Nebraska Game & Parks Commission

(G&P) consultation on Threatened and

Endangered Species and their Habitat N/A  Obtained: YES  NO

Surface Water Right N/A  Obtained: YES  NO

USACE (e.g., 404 Permit) N/A  Obtained: YES  NO

Cultural Resources Evaluation N/A  Obtained: YES  NO

Other (provide explanation below) N/A  Obtained: YES  NO

[Click here to enter text.](#)

3. Are you applying for funding for a combined sewer over-flow project?

YES  NO

If yes, do you have a Long Term Control Plan that is currently approved by the Nebraska Department of Environmental Quality?

YES  NO

If yes attach a copy to your application. [Click here to enter text.](#)

If yes what is the population served by your project? [Click here to enter text.](#)

If yes provide a demonstration of need. [Click here to enter text.](#)

If yes and you were approved for funding in the most recent funding cycle, then resubmit the above information updated annually but you need not complete the remainder of the application.

4. If you are or are representing an NRD, do you have an Integrated Management Plan in place, or have you initiated one?

N/A  YES  NO

5. Has this application previously been submitted for funding assistance from the Water Sustainability Fund and not been funded?

YES  NO

If yes, have any changes been made to the application in comparison to the previously submitted application? Yes.

If yes, describe the changes that have been made since the last application.

*Grant amount has been slightly increased to reflect current anticipated costs. Dates have been updated to reflect a revised schedule to begin once grant funds are approved. Responses to specific criterion have been revised and updated to reflect the most recent information available for the proposed project.*

No, I certify the application is a true and exact copy of the previously submitted and scored application. (Signature required) [Click here to enter text.](#)

6. Complete the following if your project has or will commence prior to next July 1<sup>st</sup>.

As of the date of submittal of this application, what is the Total Net Local Share of Expenses incurred for which you are asking cost share assistance from this fund? \$ 0

Attach all substantiating documentation such as invoices, cancelled checks etc. along with an itemized statement for these expenses. [Click here to enter text.](#)

Estimate the Total Net Local Share of Expenses and a description of each you will incur between the date of submittal of this application and next July 1<sup>st</sup> for which you are asking cost share assistance from this fund.

\$ 0

## Section B.

### DNR DIRECTOR'S FINDINGS

Does your project include physical construction (defined as moving dirt, directing water, physically constructing something, or installing equipment)?

YES  NO

1(a). If yes (structural), submit a feasibility report [\(to comply with Title 261, CH 2\)](#) including engineering and technical data and the following information:

A discussion of the plan of development [\(004.01 A\)](#);  
[Click here to enter text.](#)

A description of all field investigations made to substantiate the feasibility report [\(004.01 B\)](#);  
[Click here to enter text.](#)

Maps, drawings, charts, tables, etc., used as a basis for the feasibility report [\(004.01 C\)](#);  
[Click here to enter text.](#)

A description of any necessary water and land rights and pertinent water supply and water quality information, if appropriate [\(004.01 D\)](#);  
[Click here to enter text.](#)

A discussion of each component of the final plan including, when applicable [\(004.01 E\)](#);

Required geologic investigation [\(004.01 E 1\)](#); [Click here to enter text.](#)

Required hydrologic data [\(004.01 E 2\)](#); [Click here to enter text.](#)

Design criteria for final design including, but not limited to, soil mechanics, hydraulic, hydrologic, structural, embankments and foundation criteria [\(004.01 E 3\)](#). [Click here to enter text.](#)

1(b). If no (non-structural), submit data necessary to establish technical feasibility including, but not limited to the following [\(004.02\)](#):

A discussion of the plan of development [\(004.02 A\)](#);

*The geologic system in Western Sarpy County is very complex, as the area has seen uplift, glacial deposition, and erosion. Due to the complexity of the geologic history this area has not been mapped in detail. The extent and volumes of the aquifers being utilized for new domestic and municipal usage is unknown. Previous sampling in the area has shown nitrate contamination. The extent of contamination in the aquifers is also unknown. See study area map in Figure B1-1:*

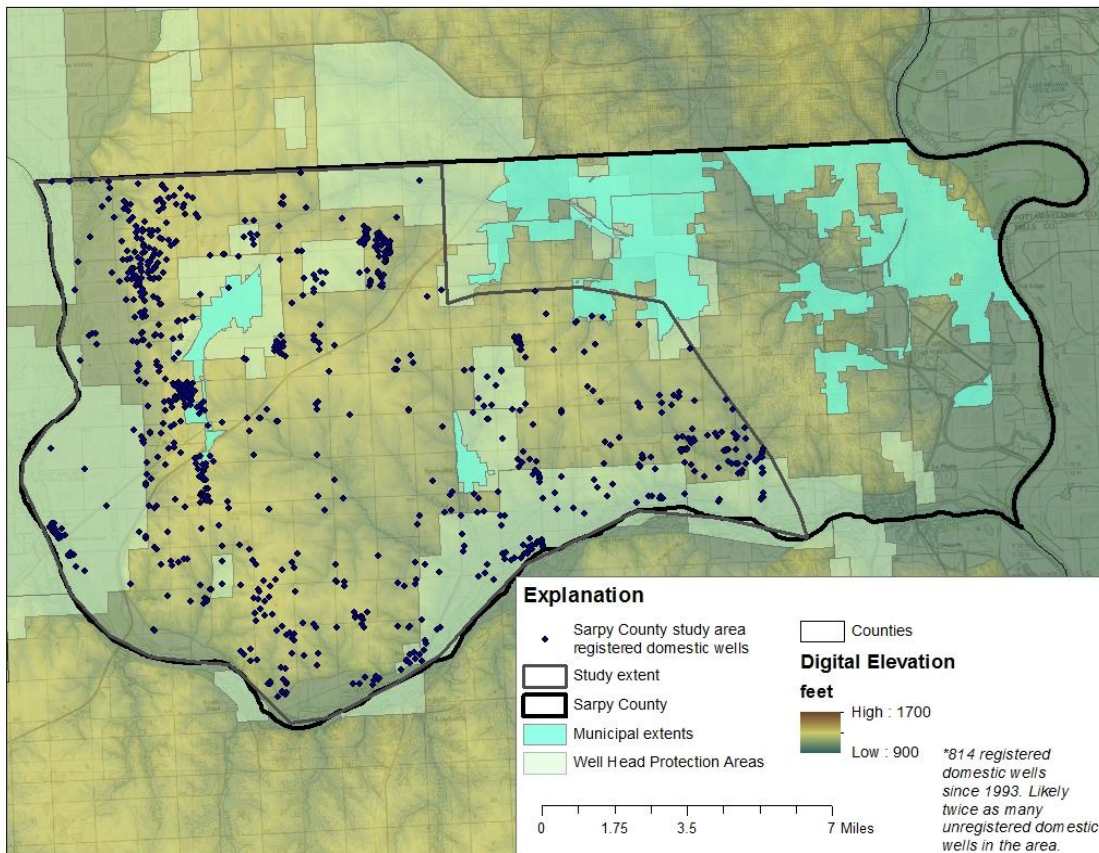


FIGURE B1-1. Study Area Map

*The population of rural Sarpy County has been increasing steadily since 1950 into areas that had previously been used for agricultural purposes. As of 2015, approximately 5,000 people obtain their water through domestic wells in western Sarpy County around the communities of Springfield and Gretna. Sampling of these new wells has shown elevated nitrate levels, and some areas have nitrates above the Environmental Protection Agency maximum contaminant limit of 10mg/L, see Figure B1-2. Additionally, the municipalities of Springfield and Gretna, which serve nearly 7,000 people, have also been impacted by high nitrate levels, which has led to drilling new municipal supply wells.*

*The P-MRNRD needs to better understand the aquifer extents and thicknesses within Sarpy County to decide on management plans for both quantity and quality. The NRD has been collecting many different types of data from various sources, including geologic testholes, monitoring wells and Airborne Electromagnetic (AEM) surveys, but the data have not been compiled or interpreted for a complete understanding of the complex system.*

*A GeoScene 3D project of western Sarpy County would provide the greatest understanding of the AEM data and other geological data, and bridge the gap needed to understand water quantity and quality issues. GeoScene 3D is a graphical 3D interface which would allow the managers to visualize the aquifers, the placement of wells within the aquifers, and the connections of the aquifers with the land surface and to each*

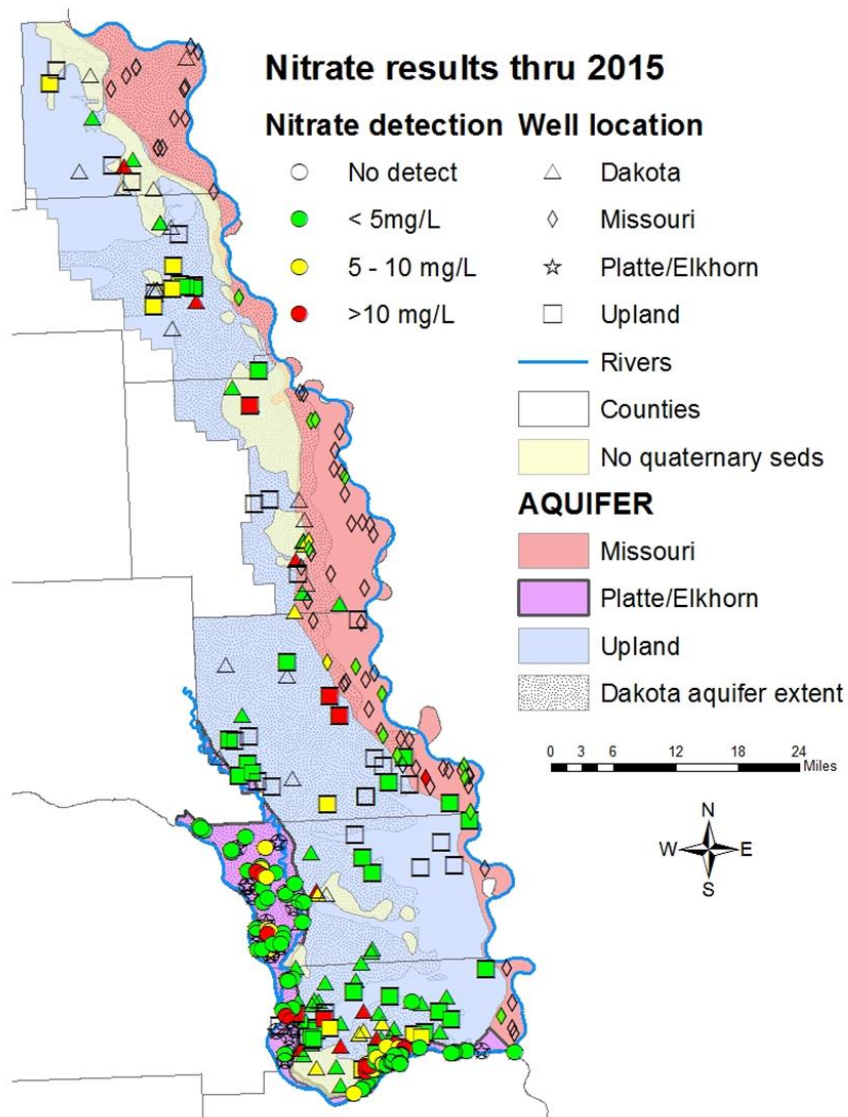


FIGURE B1-2. A. Flynn (2015) USGS - Papio-Missouri River NRD Groundwater Quality Monitoring Results

other. GeoScene 3D allows for the import of AEM data, borehole logs, and hand-drawn cross sections to interpolate the aquifer properties from multiple sources. The proposed GeoScene 3D model will also incorporate all of the registered wells and screen locations in the study area to determine their relationship to elevated nitrate samples. Once the data is uploaded into the project, the layers can be exported from the program to make maps. The area has multiple viable aquifers, including the Dakota Aquifer which is made up of water producing sandstone interbedded with clay and shale aquicludes. Producing a 3D model and isopach map of the location and thickness of the Dakota Aquifer sandstone in southwest Sarpy County will aid stakeholders in understanding the extent and possible limitations of the aquifer.



*The GeoScene 3D project will be provided to the NRD as a tool for managers to use to understand the aquifers, and aquifer interactions, within the county. A USGS Open-File Report (OFR) will be written, explaining the data used to create the project, how to use the project as a tool to understand the resource, and the limitations of the project. Additionally, a USGS Scientific Investigations Map (SIM) will be generated focusing on the top and bottom elevations of the Dakota Aquifer in southwest Sarpy County. A shapefile and associated metadata will be released with the SIM.*

A description of field or research investigations utilized to substantiate the project conception (004.02 B);

*Construction of the GeoScene 3D project will require compilation of all geologic data previously collected. Geologic data includes AEM data, published cross sections, registered well logs, testhole logs, and unregistered well logs. AEM data will be provided from ENWRA and the District. Published cross sections will be collected from the University of Nebraska, School of Natural Resources, Conservation Survey Division. Registered well data will be collected from the Nebraska Department of Natural Resources. Unregistered well data (wells where no water was found, or wells that did not meet the criteria of registration at the time of development) has been collected by many drillers as part of ENWRA and provided to the USGS. Drillers that had not been previously approached for their information will be contacted for this effort. All data will be reviewed by a geologist and categorized based on aquifer units (aquifer materials, combined with understanding of the geological stratigraphic units in the area). This categorization will help the District managers visualize the connections between land surface and the various aquifers. After the GeoScene project has been constructed, the top and bottom of the Dakota Aquifer will be exported from the project, and a top surface and a bottom surface isopach contours will be generated from the data.*

*GeoScene3D projects are currently in development in various areas around the United States. The University of Illinois-Champaign and the USGS Crustal Geophysics and Geochemistry Science Center are using GeoScene3D to build geologic models in the areas which they are studying. Additionally, GeoScene3D is used worldwide. A complete hydrostratigraphic model of Tonder, Denmark was recently completed. Information can be found on (<http://www.geoscene3d.com/news>). GeoScene3D is used in additional projects in Denmark, and in Sweden, Italy and other countries worldwide. GeoScene3D is used not only to visualize the three-dimensional structures underground, but also as a tool for decision makers focusing on the resources. GeoScene has been used by mineral managers to understand the extent of the ore they are interested in excavating, and to guide drillers in placing wells in the most beneficial areas. GeoScene3D was developed to handle AEM data, in addition to borehole data, so that all information used to describe and understand geologic systems could be integrated into one project for complete understanding of the system.*

A description of the necessary water and/or land rights, if applicable (004.02 C); Not applicable

A discussion of the anticipated effects, if any, of the project upon the development and/or operation of existing or envisioned structural measures including a brief description of any such measure (004.02 D).

*This study will provide a better understanding of aquifer extents and thicknesses, including secondary bedrock aquifers, within Sarpy County for managing groundwater resources. This information will be used to guide district managers on the feasibility of protecting the aquifer as a drinking water supply and managing its long-term use. As this study is focusing on data collection and interpretation, no effects on existing structural measures are anticipated.*

2. Provide evidence that there are no known means of accomplishing the same purpose or purposes more economically, by describing the next best alternative.

*The next best alternative is to not assess aquifer extents, which could lead to unmanaged drinking water supplies with high nitrates and the development of aquifer systems in areas where the resource is limited or not sustainable for long term municipal, domestic, commercial/industrial or agricultural use (see table in next item, Section B #3 for potential costs related to gathering no data).*

3. Document all sources and report all costs and benefit data using current data, (commodity prices, recreation benefit prices, and wildlife prices as prescribed by the Director) using both dollar values and other units of measurement when appropriate (environmental, social, cultural, data improvement, etc.). The period of analysis for economic feasibility studies shall be fifty (50) years or with prior approval of the Director, up to one hundred (100) years [T261 CH 2 (005)].

- Describe any relevant cost information including, but not limited to the engineering and inspection costs, capital construction costs, annual operation and maintenance costs, and replacement costs. Cost information shall also include the estimated construction period as well as the estimated project life (005.01).

*Costs associated with the project are for research related activities. No construction will be necessary. The project will commence in July of 2018 and conclude by June 2020.*

	PMRNRD FY 19(July 2018-June 2019)	PMRNRD FY 20 (July 2019-June 2020)	Totals
WSF	\$72,000	\$48,000	\$120,000
PMRNRD	\$48,000	\$32,000	\$80,000
USGS	\$66,000	\$11,700	\$77,700
Totals	\$186,000	\$91,700	\$277,700

- Only primary tangible benefits may be counted in providing the monetary benefit information and shall be displayed by year for the project life. In a multi-purpose project, estimate benefits for each purpose, by year, for the life of the project. Describe any intangible or secondary benefits separately. In a case where there is no generally



accepted method for calculation of primary tangible benefits describe how the project will increase water sustainability, such that the economic feasibility of the project can be approved by the Director and the Commission (005.02).

*No primary tangible benefits have been calculated for this study; however, intangible benefits include gathering data from many sources and organizing them into a product that will improve the understanding of aquifers that are in high demand and secondary aquifers that could be further developed. This information can be used to target development in areas where groundwater is more likely to be available.*

*Secondary benefits are realized through targeted and informed management that can help prevent expensive well installations that may extract water from non-sustainable or potentially contaminated water supplies. Municipal well installation costs (the City of Springfield has proposed a third well installation due to existing high nitrates and is awaiting funding): can range from \$400,000 to \$600,000 if you include the pump, wellhouse, controls and electrical depending on the end application (personal communication with Layne well drilling company in Valley, Nebraska 12/11/15). The domestic well installations (140+ installed in PMRNRD in last two years), typically range from \$18 to \$25 per foot (Matt Marxsen, state Conservation and Survey Division [CSD] driller and private well installer 12/11/15) for wells 50 to 350 feet deep (\$900-\$8,750). Irrigation wells (50+ installed in PMRNRD the last two years) are in the middle range with installations expected to be \$40,000 to \$80,000 in the secondary aquifers for eastern Nebraska (personal communication with representative of Grosch Irrigation Co., Inc. 12/18/15). Additionally, in areas where contaminants are above the maximum contaminant level for human consumption, in-home treatment systems would be needed. These treatment systems can range from \$25 for a single pitcher filtration system, to upwards of \$500 for a home reverse osmosis system and installation. These filtration systems would have additional yearly costs for maintenance and replacement of the filters. The cost offset would at least equal the value of the study. There are many indirect benefits of this study.*

- All benefit and cost data shall be presented in a table form to indicate the annual cash flow for the life of the proposal, not to exceed 100 years (005.03).

*No primary tangible benefit data is available for this study, the cost data is presented in the following table:*

	PMRNRD FY 19(July 2018-June 2019)	PMRNRD FY 20 (July 2019-June 2020)	Totals
WSF	\$72,000	\$48,000	\$120,000
PMRNRD	\$48,000	\$32,000	\$80,000
USGS	\$66,000	\$11,700	\$77,700
Totals	\$186,000	\$91,700	\$277,700

- In the case of projects for which there is no generally accepted method for calculation of primary tangible benefits and if the project will increase water sustainability, the economic feasibility of such proposal shall be demonstrated by such method as the Director and the Commission deem appropriate (005.04).

*There are no primary tangible benefits identified as part of this application, however, the benefits of this project will outweigh the estimated costs in the long-term. This project will provide a tool for the municipalities and P-MRNRD to understand and assess the groundwater resources in Sarpy County. The geology in this area is extremely complex and requires a detailed analysis to understand aquifer extents and the impact wells may have on the long-term availability of groundwater. There have been instances where wells have been drilled and water could not be found, and where wells have gone dry. There are also issues with the water quality in these developing areas. This project will guide the district on well placement so that wells are installed in areas that will provide clean water, while not interfering with other wells close by.*

4. Provide evidence that sufficient funds are available to complete the proposal.

*P-MRNRD has proposed \$80,000 in direct funding towards this proposal to be included in their Fiscal Year 2018/2019 and 2019/2020 budgets. The P-MRNRD's FY 2018 budget includes proposed property tax revenue of approximately \$23.6 million. The USGS has \$77,700 Cooperative Water Program fund dollars available for this project. Please see attached letter of support from USGS as a contributing financial partner.*

5. Provide evidence that sufficient annual revenue is available to repay the reimbursable costs and to cover OM&R (operate, maintain, and replace).

*No reimbursable costs prior to July 1, 2018 are anticipated and there will be no OM&R following the two year project. The USGS will hold and maintain the license for GeoScene3D at no additional cost to this project. Please see attached letter of support from USGS, which describes the funds available for the project.*

6. If a loan is involved, provide sufficient documentation to prove that the loan can be repaid during the repayment life of the proposal.

N/A

7. Describe how the plan of development minimizes impacts on the natural environment.

*No negative impacts on the natural environment are expected as part of work conducted to complete this study.*

8. Explain how you are qualified, responsible and legally capable of carrying out the project for which you are seeking funds.

*The P-MRNRD is charged with the sustainable management of groundwater resources for municipal, domestic, agricultural, and commercial/industrial uses. The P-MRNRD will serve as the local sponsor by paying USGS on a quarterly schedule. The P-MRNRD has the legal authority to enter into an Interagency Agreement with USGS to complete the proposed project. The USGS was contacted by the P-MRNRD to develop a proposal for this study as they are the only organization with the past experience, expertise, and software needed to develop the GeoScene 3D model. P-MRNRD staff members bring local knowledge of the area and groundwater resources.*

9. Explain how your project considers plans and programs of the state and resources development plans of the political subdivisions of the state.

*This project meets the objectives under Data Acquisition in the Annual Report and Plan of Work for the Nebraska State Water Planning and Review Process dated September 2015. Specifically, data acquired and evaluated as part of this project will support NDNR's ongoing numerical groundwater modeling for the Lower Platte River and Missouri Tributaries. The Papio-Missouri River NRD (P-MRNRD) has an adopted Groundwater Management Plan (GWMP), last revised in 1994. This project specifically helps carry out the objectives of the GWMP to access information as part of the District-wide groundwater quality monitoring program. The P-MRNRD has conducted a groundwater quality monitoring program since 1992, including numerous results from the proposed study area. In addition, the P-MRNRD is in the process of completely updating its current GWMP and the concurrent collection and interpretation of data from this project will help to establish measurable goals and targets for this aquifer.*

10. Are land rights necessary to complete your project?

YES  NO

If yes, provide a complete listing of all lands involved in the project.

Not applicable.

If yes, attach proof of ownership for each easements, rights-of-way and fee title currently held.

Not applicable.

If yes, provide assurance that you can hold or can acquire title to all lands not currently held.

Not applicable,

11. Identify how you possess all necessary authority to undertake or participate in the project.

*The PMRNRD has the authority under Nebraska State Statute Chapter 2 Article 32 to carry out this project under its authorized purposed relating to the development, management, utilization, and conservation of groundwater and surface water. This includes the NRD's authorities (furthered under the Nebraska Groundwater Management and Protection Act Chapter 46 Article 7 regarding groundwater) to enter into contracts or agreements, budget and expend levied property taxes, own and operate property and equipment, and conduct investigations relative to the protection and management of groundwater.*

12. Identify the probable environmental and ecological consequences that may result as the result of the project.

*An improved understanding of the available groundwater resources will lead to a number of positive environmental and ecological outcomes. It will lead to improved management of existing systems which would prevent unsustainable water use and unnecessary development of new water systems. Proper management of aquifer water supplies will potentially eliminate the need for supplemental water supplies from other existing public water supplies or rural water districts which may be further stressed during times of drought. Resulting information from the 3D model will also improve well construction in the area, as aquicludes can be accurately located and used to properly seal the annulus around the well casing, reducing surface contamination threats to the local drinking water supply.*

## Section C.

### NRC SCORING

In the NRC's scoring process, points will be given to each project in ranking the projects, with the total number of points determining the final project ranking list.

The following 15 criteria constitute the items for which points will be assigned. Point assignments will be 0, 2, 4, or 6 for items 1 through 8; and 0, 1, 2, or 3 for items 9 through 15. Two additional points will be awarded to projects which address issues determined by the NRC to be the result of a federal mandate.

#### Notes:

- The responses to one criterion *will not* be considered in the scoring of other criteria. Repeat references as needed to support documentation in each criterion as appropriate. The 15 categories are specified by statute and will be used to create scoring matrixes which will ultimately determine which projects receive funding.
- There is a total of 69 possible points, plus two bonus points. The potential number of points awarded for each criteria are noted in parenthesis. Once points are assigned, they will be added to determine a final score. The scores will determine ranking.
- The Commission recommends providing the requested information and the requests are not intended to limit the information an applicant may provide. An applicant should include additional information that is believed will assist the Commission in understanding a proposal so that it can be awarded the points to which it is entitled.

Complete any of the following (15) criteria which apply to your project. Your response will be reviewed and scored by the NRC. Place an N/A (not applicable) in any that do not apply, an N/A will automatically be placed in any response fields left blank.

1. Remediates or mitigates threats to drinking water;

- Describe the specific threats to drinking water the project will address.
- Identify whose drinking water, how many people are affected, how will project remediate or mitigate.
- Provide a history of issues and tried solutions.
- Provide detail regarding long range impacts if issues are not resolved.

*The geologic system in Western Sarpy County is complex and has not been mapped in detail, and the extent and volumes of the aquifers being utilized for existing and future drinking water supplies is unknown. As shown in the Figure C1-1 below, these aquifers have been sampled and have high nitrates in different areas. How these water quality concerns are interrelated or connected is also unknown.*

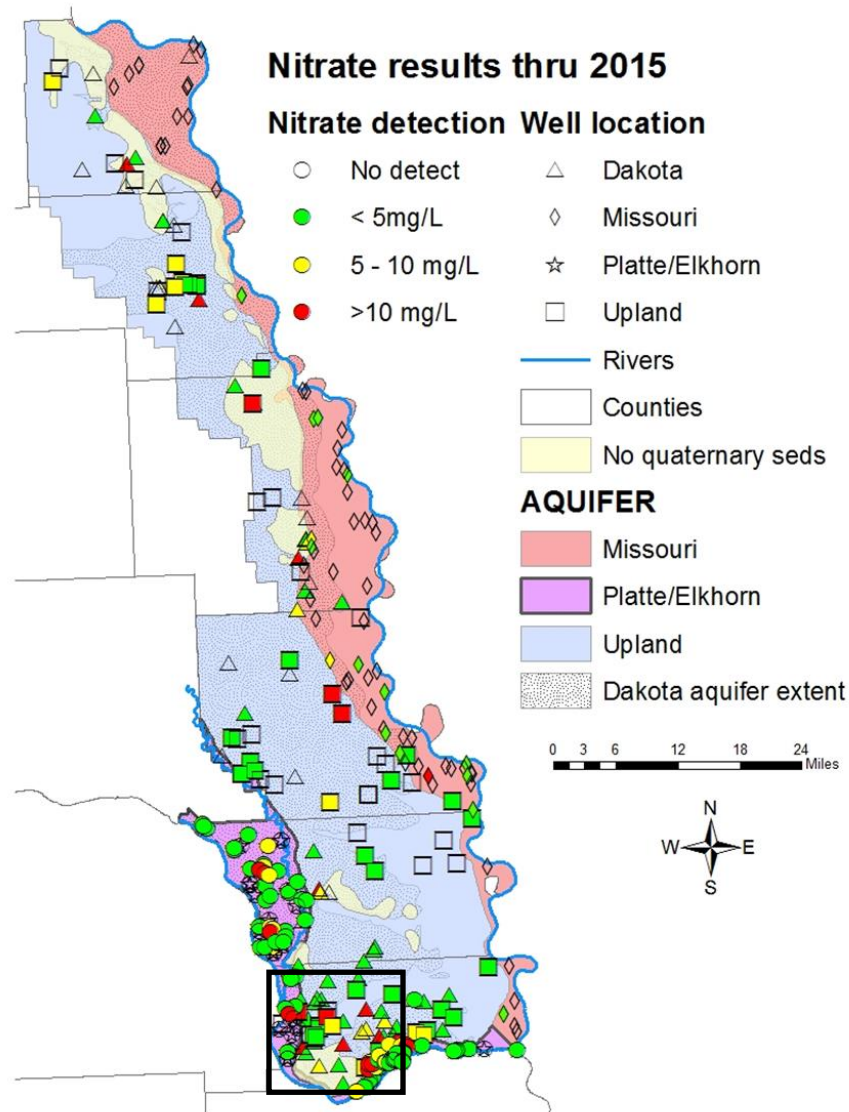


FIGURE C1-1. A. Flynn (2015) USGS - Pappo-Missouri River NRD Groundwater Quality Monitoring Results

*The population of western Sarpy County has been increasing steadily since 1950. The communities of Gretna and Springfield are 4 to 10 times the size they were in 1950 and now supply public water to nearly 7,000 people. Additionally, an estimated 5,000 rural landowners living near Springfield and Gretna obtain their water through domestic wells in western Sarpy County, see Figure C1-2 showing municipal wellhead protection areas and registered domestic wells in the study area. The combined population of over 12,000 all receive a majority of their drinking water from Dakota Sandstone or shallow sand and gravel aquifers. Understanding the complex geology in Sarpy County will help local communities and NRD managers make informed decisions concerning potential options for obtaining locally sustainable water supplies. If management decisions are made without consideration for the extent and possible contamination of these aquifers, serious water quality and supply issues may occur in the future.*



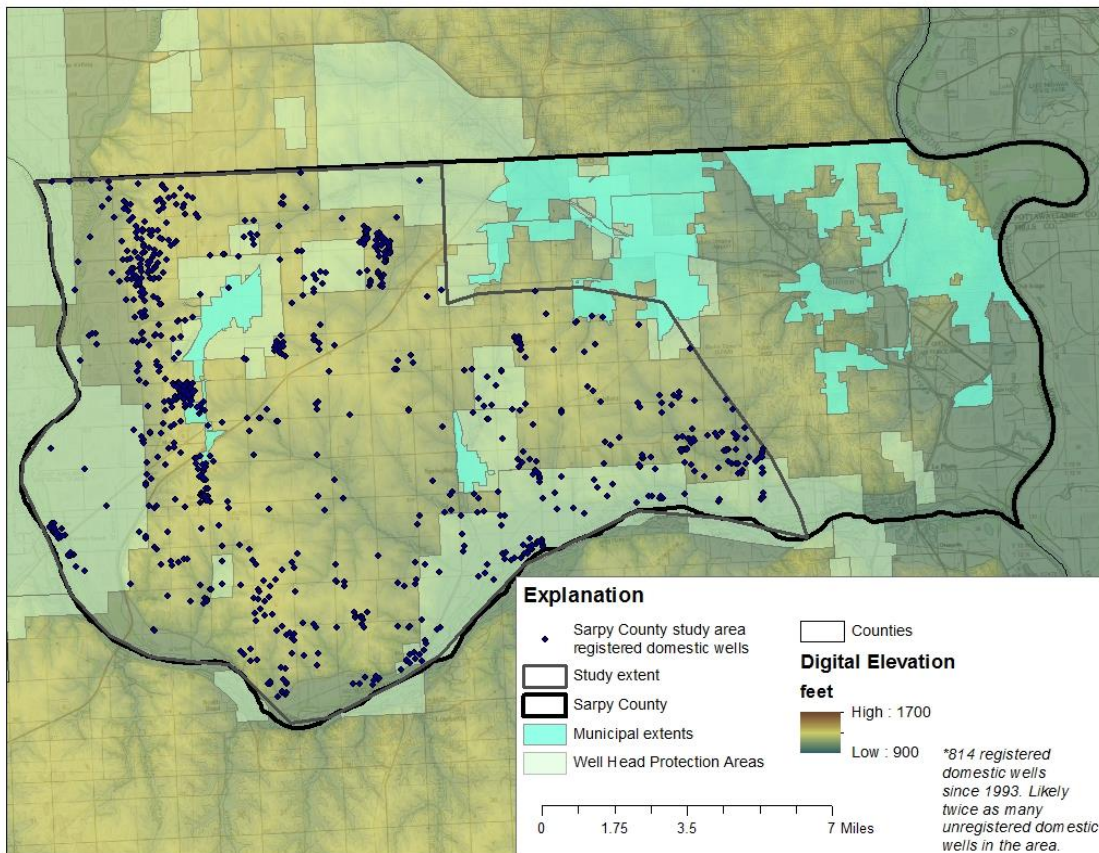


FIGURE C1-2. Study Area Map

*An improved understanding of the three-dimensional extent of aquifers is important in determining how increased development of the groundwater resource could impact the water availability or lead to contaminated drinking water supplies. This project is designed to better understand municipal and domestic water supplies that are part of the critical drinking water supply infrastructure. This study addresses the vulnerability of existing drinking water supplies to overuse and nitrate contamination. The potential to avoid improper siting of new wells or municipal systems are all possible infrastructure protection that could result from this project. Municipalities and private drillers in the area would benefit from understanding the threats of groundwater depletion or contamination prior to drilling new wells. The current infrastructure in the study area includes six active wellhead protection areas and 24 municipal wells with an estimated value today of nearly \$6 million. Resulting information from the 3D model will also improve well construction in the area, as aquicludes can be accurately located and used to properly seal the annulus around the well casing, reducing surface contamination threats to the local drinking water supply.*

2. Meets the goals and objectives of an approved integrated management plan or ground water management plan;

- Identify the specific plan that is being referenced including date, who issued it and whether it is an IMP or GW management plan.
- Provide the history of work completed to achieve the goals of this plan.
- List which goals and objectives of the management plan the project provides benefits for and how the project provides those benefits.

*This project specifically addresses the groundwater management concerns of the P-MRNRD. The original 1985/1986 Groundwater Management Plan (GWMP) for the P-MRNRD states that groundwater quantity will be monitored and managed for the use and safety of the residents and as necessary to identify, manage and establish goals concerning groundwater quality [Nebraska Revised Statute Chapter 46, Article 6, Section 73.13]. The P-MRNRD is in the process of completely updating its current GWMP and the concurrent collection and interpretation of data from this project will help to establish measurable goals and targets for this aquifer. The P-MRNRD adopted a voluntary Integrated Management Plan (IMP) with NDNR in the fall of 2014 and have moved into the implementation phase (visit <https://dnr.nebraska.gov/water-planning/papio-missouri-river-nrd>). The IMP includes both water inventory and water supply management goals relating to sustainability. This project addresses objectives outlined in Goal 1 and 2 of the P-MRNRD IMP including developing/maintaining a water supply and use inventory based on the best available data and developing/implementing policies and practices that contribute to the protection of existing groundwater uses while allowing for future water development. Each of these primary IMP goals are benefited by this project as the data being gathered will provide “best available” data for analysis and be used to protect existing water uses while safely allowing future development.*

3. Contributes to water sustainability goals by increasing aquifer recharge, reducing aquifer depletion, or increasing streamflow;

List the following information that is applicable:

- The location, area and amount of recharge;
- The location, area and amount that aquifer depletion will be reduced;
- The reach, amount and timing of increased streamflow. Describe how the project will meet these objectives and what the source of the water is;
- Provide a detailed listing of cross basin benefits, if any.

*Results from this study are likely to identify management methods which can increase aquifer recharge, reduce aquifer depletion, and increase streamflow. This study will aid in quantifying the amount of water available in the aquifers, so that reduction in depletion and determining sustainable use can be studied. This study can benefit streamflow by developing a better understanding of pumping well interaction with streams. This will be possible as the location and effects of pumping near incised streams in this area could be regulated to allow increased baseflow discharge. Future*

*studies could use this information to quantify the amount of water discharged from the aquifers into the streams which benefit Platte River flows near Louisville. Other results from this study could be used for future research related to groundwater recharge and determining the potential effects of various groundwater quality remediation efforts might have. Details about confining layers within the geology will be assessed from this proposed 3D model and will aid in outlining future vadose zone testing for high recharge areas.*

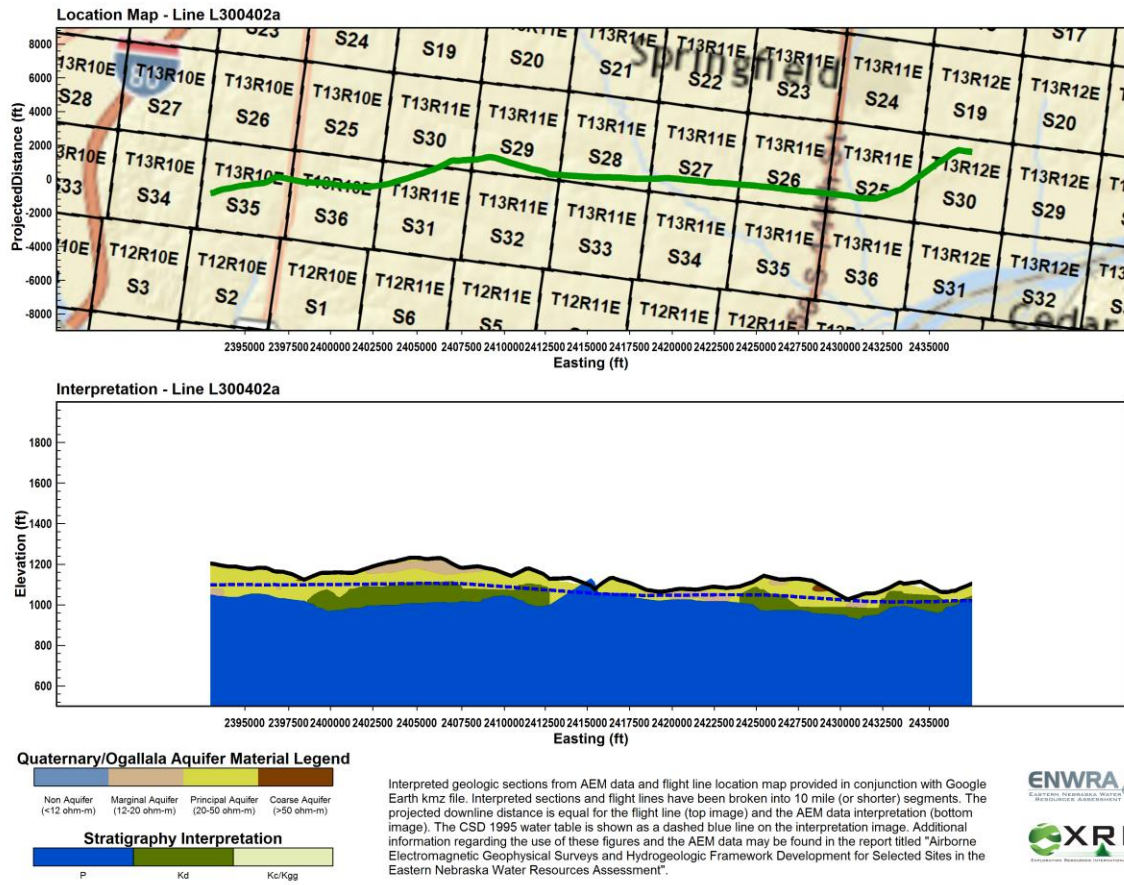
4. Contributes to multiple water supply goals, including, but not limited to, flood control, agricultural use, municipal and industrial uses, recreational benefits, wildlife habitat, conservation of water resources, and preservation of water resources;

- List the goals the project provides benefits.
- Describe how the project will provide these benefits
- Provide a long range forecast of the expected benefits this project could have versus continuing on current path.

*An improved understanding of the three-dimensional extent of aquifers is important in determining how increased development of the groundwater resource could impact the water availability or lead to contaminated drinking water supplies. The study area not only benefits rural users, but also two municipalities (Gretna and Springfield) and their wellhead protection areas. This study will contribute to multiple water supply goals, including agricultural, municipal and industrial uses, and aid in the preservation of water resources by providing additional data and insight that can be used by communities and water managers to examine if their current management plans are appropriate to meet water quality standards and provide adequate supplies. This assessment along with proper planning will determine if future groundwater development is wise or if more regional public water supplies may better serve this area into the future. This study will explore the connectivity between the various aquifer systems within the area, and will identify areas of shallow recharge depth between the ground surface and water table where future recharge studies may be appropriate. Previous reconnaissance AEM data as shown in attached Figure C4-1, demonstrates this potential disconnect between upland and Dakota aquifer units and the fairly shallow connective nature of the ground surface to these aquifers. Using 3D modeling will also help identify areas where additional vadose zone testing sites would be beneficial to understanding recharge and contaminant transport from the surface to the water table. If this project is not undertaken, the questions concerning the groundwater quality and availability of these aquifers will not be answered, and overuse or further contamination of the aquifers could occur.*



FIGURE C4-1. AEM Cross Section showing upland (yellow) and Dakota (green) aquifer disconnection.



5. Maximizes the beneficial use of Nebraska's water resources for the benefit of the state's residents;

- Describe how the project will maximize the increased beneficial use of Nebraska's water resources.
- Describe the beneficial uses that will be reduced, if any.
- Describe how the project provides a beneficial impact to the state's residents.

*This project will maximize the beneficial use of Nebraska's water resources for domestic, municipal, and irrigation by better characterizing the aquifers and their long-term sustainability in Sarpy County. The geology of the area is very complex, and there are likely isolated aquifers present due to the various geologic process that have occurred in the past. This study will provide organized data and insight that can be used by communities and water managers for the assessment and proper planning to protect existing water supplies and plan for future water development. The affected population in the study area is currently estimated at 12,000 Nebraska residents and this is expected to increase dramatically as the Omaha Metropolitan Area extends into these Platte River drainages in Western Sarpy County. Results of the study will help determine if current management and future land plans are adequate or appropriate. Results from this study will be used to determine if the aquifers could be further developed for beneficial use, but not at the expense of water quality or sustainability. Previous water quality sampling in the area has shown elevated contamination levels in parts of the aquifers. This study will help visualize the contamination in relation to the groundwater resources and will aid in understanding if the contamination is localized or at risk of spreading to other water supplies and/or aquifers.*

*Resulting information from the 3D model will also improve well construction in the area, as aquicludes can be accurately located and used to properly seal the annulus around the well casing.*

6. Is cost-effective;

- List the estimated construction costs, O/M costs, land and water acquisition costs, alternative options, value of benefits gained.
- Compare these costs to other methods of achieving the same benefits.
- List the costs of the project.
- Describe how it is a cost effective project or alternative.

*The benefits of this project will outweigh the estimated costs in the long-term. This project will provide a tool for the municipalities and the P-MRNRD to understand and assess the groundwater resources in Sarpy County. The geology in this area is complex and requires a detailed analysis to understand aquifer extents and the impact wells may have. There have been instances where wells have been drilled and water could not be found, and where wells have gone dry. There are also issues with the water quality in these developing areas. This project will serve as a guide for well placement so that wells are installed in areas that will provide clean water, while not interfering with other wells close by.*

*There are no construction, O/M, or land/water acquisition costs. Costs for this project are not expected to exceed \$277,700. Simply preventing the improper placement of one municipal well would justify this expense. The entire study is expected to help guide future drinking water supplies for the entire study area to either provide safe water supplies from the aquifer or look to other municipal or public water systems for alternative water supplies.*

*Secondary benefits are realized through targeted and informed management that can help prevent expensive well installations that may extract water from non-sustainable or potentially contaminated water supplies. Municipal well installation costs (the City of Springfield has proposed a third well installation due to existing high nitrates and is awaiting funding): can range from \$400,000 to \$600,000 if you include the pump, wellhouse, controls and electrical depending on the end application (personal communication with Layne well drilling company in Valley, Nebraska 12/11/15). The domestic well installations (140+ installed in PMRNRD in last two years), typically range from \$18 to \$25 per foot (Matt Marxsen, state Conservation and Survey Division [CSD] driller and private well installer 12/11/15) for wells 50 to 350 feet deep (\$900-\$8,750). Irrigation wells (50+ installed in PMRNRD the last two years) are in the middle range with installations expected to be \$40,000 to \$80,000 in the secondary aquifers for eastern Nebraska (personal communication with representative of Grosch Irrigation Co., Inc. 12/18/15). Additionally, in areas where contaminants are above the maximum contaminant level for human consumption, in-home treatment systems would be needed. These treatment systems can range from \$25 for a single pitcher filtration system, to upwards of \$500 for a home reverse osmosis system and installation. These filtration systems would have additional yearly costs for maintenance and replacement of the filters. The cost offset would at least equal the value of the study and there are many other indirect benefits of this study.*

7. Helps the state meet its obligations under interstate compacts, decrees, or other state contracts or agreements or federal law;

- Identify the interstate compact, decree, state contract or agreement or federal law.
- Describe how the project will help the state meet its obligations under compacts, decrees, state contracts or agreements or federal law.
- Describe current deficiencies and document how the project will reduce deficiencies.

*Portions of the study area have shown nutrient contaminants above federal regulated maximum contaminant levels (MCL). This study will show connectivity between areas and better educate the stakeholders of potential contaminant transport allowing managers to protect or prevent water supply nutrient levels above the EPA MCL. The study will also show where the surface water streams intersect groundwater resources, which will aid in understanding how the glacial aquifers contribute to the surface water system. Future studies based on this information could quantify the amount of water contributed to these tributary streams and assist the State in managing water to meet its obligation under the instream flow appropriation permit granted to the Nebraska Game and Parks Commission for the central and lower Platte River on June 26, 1998 (with a instream flow priority date of November 30, 1993).*



8. Reduces threats to property damage or protects critical infrastructure that consists of the physical assets, systems, and networks vital to the state or the United States such that their incapacitation would have a debilitating effect on public security or public health and safety;

- Identify the property that the project is intended to reduce threats to.
- Describe and quantify reductions in threats to critical infrastructure provided by the project and how the infrastructure is vital to Nebraska or the United States.
- Identify the potential value of cost savings resulting from completion of the project.
- Describe the benefits for public security, public health and safety.

*This project is designed to better understand municipal and domestic water supplies that are part of the critical drinking water supply infrastructure. This study addresses the vulnerability of existing drinking water supplies to overuse and nitrate contamination. The potential to avoid improper siting of new wells or municipal systems are all possible infrastructure protection that could result from this project. Municipalities and private drillers in the area would benefit from understanding the threats of groundwater depletion or contamination prior to drilling new wells. This study will provide a proactive approach to developing sustainable long-term supplies of drinking water for nearly 12,000 residents in Sarpy County. The current infrastructure in the study area includes six active wellhead protection areas and 24 municipal wells with an estimated value today of nearly \$6 million.*

*Damages to private property are avoided if new or existing domestic wells are located and drilled to an appropriate depth where they are less likely to have to be abandoned and replaced at some time in the future. Issues with domestic wells and drinking water supply have the potential to negatively affect property values. The availability of a GeoScene 3D model will also improve well construction in the area, as aquicludes can be accurately located and used to properly seal the annulus around the well casing.*

9. Improves water quality;

- Describe what quality issue(s) is/are to be improved.
- Describe and quantify how the project improves water quality, what is the target area, what is the population or acreage receiving benefits, what is the usage of the water: residential, industrial, agriculture or recreational.
- Describe other possible solutions to remedy this issue.
- Describe the history of the water quality issue including previous attempts to remedy the problem and the results obtained.

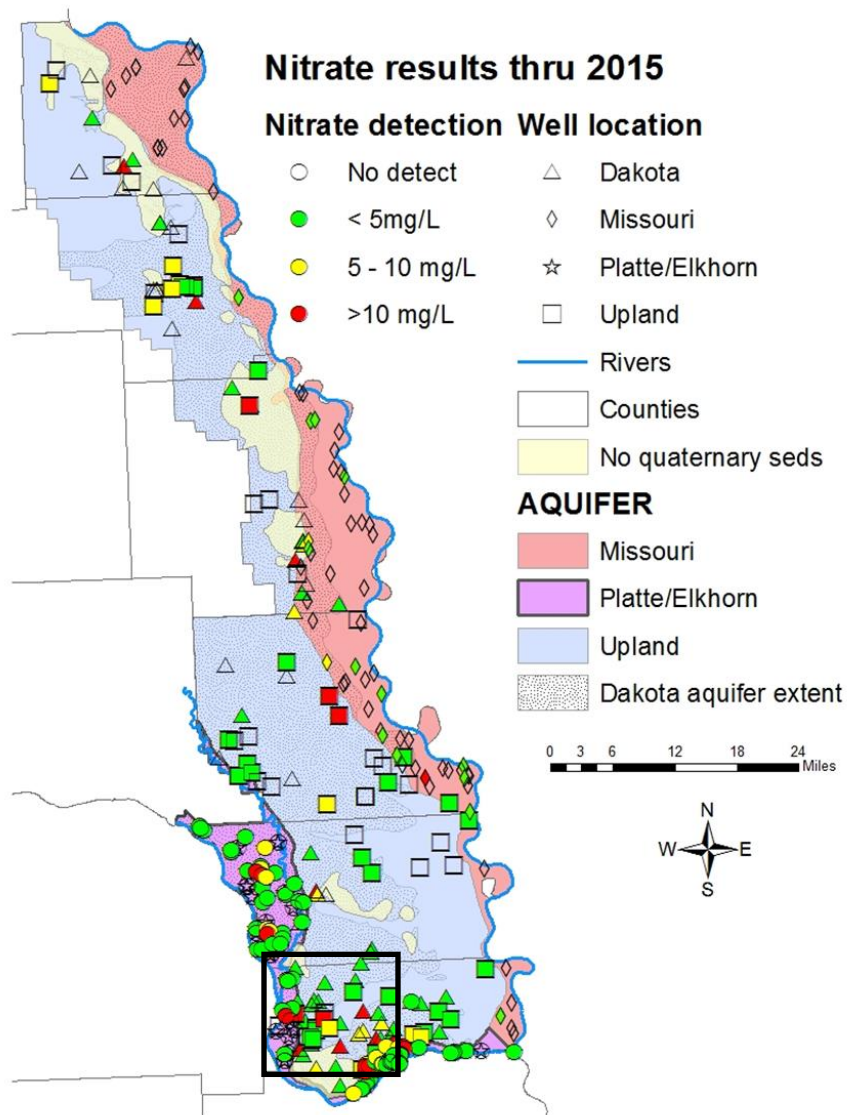


FIGURE C9-1. A. Flynn (2015) USGS - Papio-Missouri River NRD Groundwater Quality Monitoring Results

*Elevated nitrate levels have been found in Sarpy County as seen in Figure C9-1, particularly in shallow groundwater within the study area. This contamination of the groundwater supplies is concerning as it is unknown if the contamination is spreading or may get worse. The total population receiving drinking water from this area's aquifers is approximately 12,000. The GeoScene 3D modeling project can be used to map the impaired areas of the aquifer, to allow managers to visualize where the contamination is occurring and see the connections of the contamination to other water resources (groundwater discharge to streams) and aquitards. This information can be used to inform the managers on their sampling plan, and guide them in understanding where additional monitoring needs to occur. This study will utilize Airborne Electromagnetic (AEM) survey and other existing data to better understand the system to design a cost effective solution/management plan. This type of information can be used to aid stakeholders in determining the best course of development of the resource, for instance, should homeowners continue to drill wells, or should the development areas invest in a public water system to service the area. Alternative solutions would be to utilize the existing data and combine it (ie aquifer top and bottom, well screen depth, local water quality results, and adjacent well use) on an as needed basis. However, having this data already compiled and organized is expected to greatly enhance and inform decisions for the public and area as a whole.*

*Previous studies in the area include a groundwater quality reconnaissance study, performed in 1992 (Verstraeten and others, 1995) and a comprehensive study of the groundwater quality results collected from 1992 through 2009 (McGuire and others, 2012). These studies were commissioned to directly benefit the P-MRNRD's groundwater sampling plan. The current monitoring plan was developed as a direct result of these studies. Currently, the P-MRNRD monitors all contaminants regulated by Nebraska Title 118 that were previously detected at 30% or greater of the maximum contaminant level. The most widespread of these contaminants is nitrate. This proposed project will aid in understanding the distribution of the nitrate throughout the aquifer. With this information, the managers can determine where the nitrate is within the aquifer, and determine preferential flow paths of the groundwater to determine what wells could be impacted by nitrate in the future. This information will also benefit municipalities in understanding the placement of future wells, so they are not impacted by nitrates or other contaminants. As previously stated, municipal well installation is costly, as is nitrate remediation efforts on municipal supplies. Understanding the hydrogeology of the area is a cost-saving measure for municipalities and individuals alike. This information can also be used by the P-MRNRD to designate certain areas as groundwater management areas, restricting well installations in those areas impacted by contaminants and requiring best management practices.*

10. Has utilized all available funding resources of the local jurisdiction to support the program, project, or activity;

- Identify the local jurisdiction that supports the project.
- List current property tax levy, valuations, or other sources of revenue for the sponsoring entity.
- List other funding sources for the project.

*Previous funding support from the P-MRNRD and the Water Sustainability Fund has helped develop the AEM and other existing data necessary to create this 3D model. The P-MRMRD has allocated funds specifically for the study of the hydrogeology and groundwater resources and are planning to use those for this study. The P-MRNRD's FY 2018 budget includes proposed property tax revenue of approximately \$23.6 million. The USGS is providing \$77,700 in cooperative water dollar funds to put towards this work and their letter of support is attached. Other funding sources have not been envisioned for the project. However, this information can be utilized by municipalities within the study area to develop their own wellhead protection area plan at their own cost.*

11. Has a local jurisdiction with plans in place that support sustainable water use;

- List the local jurisdiction and identify specific plans being referenced that are in place to support sustainable water use.
- Provide the history of work completed to achieve the goals of these plans.
- List which goals and objectives this project will provide benefits for and how this project supports or contributes to those plans.
- Describe and quantify how the project supports sustainable water use, what is the target area, what is the population or acreage receiving benefits, what is the usage of the water: residential, industrial, agriculture or recreational.
- List all stakeholders involved in project.
- Identify who benefits from this project.

*This project specifically addresses the sustainable water use concerns of the P-MRNRD by providing a better understanding of aquifers and the quality and quantity of groundwater that could be available for use. The P-MRNRD Groundwater Management Plan (GWMP) states that groundwater quantity and quality within the District will be maintained at existing conditions in perpetuity. This project specifically addresses the GWMP recommendations to monitor groundwater quantity and manage it for the use and safety of the residents and as necessary to identify, manage and establish goals concerning groundwater quality [Nebraska Revised Statute Chapter 46, Article 6, Section 73.13].*

*This area is also included as part of the contributing drainage area to the Platte River and therefore part of the P-MRNRD's Integrated Management Plan. The IMP includes both water inventory and water supply management goals relating to sustainability. This project addresses objectives outlined in Goal 1 and 2 of the P-MRNRD IMP including developing/maintaining a water supply and use inventory based on the best available*

*data and developing/implementing policies and practices that contribute to the protection of existing groundwater uses while allowing for future water development.*

*The P-MRNRD is working on numerous revisions to its GWMP to organize and evaluate all historic hydrogeologic and groundwater quality information in an effort to determine if more specific management areas, goals, and actions are warranted. This project's study area in Western Sarpy County will be given special consideration due to its increased use as a public drinking water supply and indications of high nitrate levels.*

*At the same time, a large future development planning effort is underway for these Platte River watersheds in Sarpy County with issues relating to wastewater treatment, transportation, and surface water/flooding. The synthesis of all available data for domestic water supplies in the area will greatly aid this regional planning effort. The current population which receives drinking water from this area is approximately 12,000 and will likely grow quickly over the next several years. The stakeholders of this planning area and beneficiaries of this project include the Cities of Gretna and Springfield as well as Sarpy County, Bellevue and Papillion.*

12. Addresses a statewide problem or issue;

- List the issues or problems addressed by the project and why they should be considered statewide.
- Describe how the project will address each issue and/or problem.
- Describe the total number of people and/or total number of acres that would receive benefits.
- Identify the benefit, to the state, this project would provide.

*A primary objective for the P-MRNRD's groundwater quality and quantity management (statutory obligations/histories/plans described in detail in Section C question #2) is the need for improvements to the groundwater data inventory, especially related to sustainability which this project addresses. This need for enhanced groundwater data is common to all 23 NRDs statewide as they all have groundwater management plans/regulations in-place and are in various stages of integrated water management and building their local water data inventories.*

*Many parts of the state have collected AEM data to better understand the groundwater resources, but few areas have integrated the data into a 3D model. This project would be a pilot area for the use of this data. If other parts of the state used this study concept, it could translate to enhanced knowledge for the entire state.*

*The estimated population of the 101,000 acre study area is approximately 12,000 residents. The common issue/concern from a statewide perspective is the management of nitrate impaired groundwater. The results from this 3D modeling will provide very accurate information needed to protect existing groundwater uses from further contamination or degradation and to safely allow for future groundwater wells planned for the area. The potential success of this project to avoid contaminants or shortages in groundwater supply may serve as a potential model for other areas of the state.*

13. Contributes to the state’s ability to leverage state dollars with local or federal government partners or other partners to maximize the use of its resources;

- List other funding sources or other partners, and the amount each will contribute, in a funding matrix.
- Describe how each source of funding is made available if the project is funded. • Provide a copy or evidence of each commitment, for each separate source, of match dollars and funding partners.
- Describe how you will proceed if other funding sources do not come through.

*The PMRNRD has allocated \$80,000 of its funds towards this project. The USGS has \$77,700 Cooperative Water Program fund dollars available for this project. If funded, the project will have state, local and federal funding sources contributing to (and partnering on) the effort resulting in mutual and individual benefits for each. Please see attached letters of support pledging the associated funding amounts. The project will not be initiated at this time if grant funding is not obtained.*

<b>Activity</b>	<b>Cost TOTAL</b>
WSF Grant funding (state)	\$120,000
USGS (federal)	\$77,700
PMRNRD (local)	\$80,000
<b>TOTALS</b>	<b>\$277,700</b>

14. Contributes to watershed health and function;

- Describe how the project will contribute to watershed health and function in detail and list all of the watersheds affected.

*Sustainable groundwater development is a significant component of watershed system health and function. The work proposed for this project will provide a better understanding of the amount of groundwater available from aquifers in Sarpy County. The increased understanding of the highly variable, diverse aquifers will allow for more informed management which in turn protects the areas with the greatest sustainability and quality concerns and helps maintain the overall watershed’s function.*



15. Uses objectives described in the annual report and plan of work for the state water planning and review process issued by the department.

- Identify the date of the Annual Report utilized.
- List any and all objectives of the Annual Report intended to be met by the project
- Explain how the project meets each objective.

*Utilizing past Water Sustainability Funds, the PMRNRD has completed an assessment of the geology in Sarpy County using airborne geophysical methods as stated in the NDNR's 2015 annual report. This project uses the data obtained from that effort (resulting GIS bedrock surfaces) to create contours of the vertical extents of aquifers in Sarpy County. The NDNR annual report to the legislature dated September 2015 also outlines interagency coordination, integrated management, and prioritization of data collection and analysis capabilities to support state and local planning efforts which this project demonstrates through partner teaming and hydrogeologic reconnaissance efforts. Results from this study will support integrated management and enhance groundwater modeling efforts for the Lower Platte River and Missouri River tributaries.*

16. Federal Mandate Bonus. If you believe that your project is designed to meet the requirements of a federal mandate which furthers the goals of the WSF, then:

- Describe the federal mandate.
- Provide documentary evidence of the federal mandate.
- Describe how the project meets the requirements of the federal mandate.
- Describe the relationship between the federal mandate and how the project furthers the goals of water sustainability.

*No federal mandates are addressed as a result of this project.*

## Section D.

### PROJECT DESCRIPTION

#### 1. Overview

In 1,000 characters or less, provide a brief description of your project including the nature and purpose of the project and objectives of the project.

*The P-MRNRD needs to better understand the aquifer extents and thicknesses in Western Sarpy County to determine what future level of management is necessary, both for quality and quantity. As part of this study, geologic data will be compiled and interpreted to obtain a three-dimensional depiction of aquifer extents, well depths, and nitrate contamination. This will allow NRD managers, well drillers, community officials, etc. to visualize the aquifers, the placement of wells within the aquifers, and the connections of the aquifers with the land surface and to each other for a better understanding of groundwater availability and the extent of groundwater quality concerns.*

#### 2. Project Tasks and Timeline

Identify what activities will be conducted by the project. For multiyear projects please list what activities are to be completed each year.

- 1) *Collect geologic data from DNR well classification, Existing ENWRA wells, and unregistered well logs (2018).*
- 2) *Build GeoScene model (2018-2019).*
- 3) *Create isopach map of Dakota Aquifer (2019).*
- 4) *Produce USGS Open File Report (2019).*
- 5) *Produce USGS Scientific Investigations Map (2019).*

#### 3. Partnerships

Identify the roles and responsibilities of agencies and groups involved in the proposed project regardless of whether each is an additional funding source. List any other sources of funding that have been approached for project support and that have officially turned you down. Attach the rejection letter.

*The USGS will be responsible for all data collection, analyses, and report preparation. Their letter of support is attached.*

#### 4. Other Sources of Funding

Identify the costs of the entire project, what costs each other source of funding will be applied to, and whether each of these other sources of funding is confirmed. If not, please identify those entities and list the date when confirmation is expected. Explain how you will implement the project if these sources are not obtained.

*PMRNRD has proposed \$80,000 in direct funding towards this proposal to be included in their Fiscal Year 2018/2019 and 2019/2020 budgets. The USGS has \$77,700 Cooperative Water Program fund dollars available for this project. Please see attached letter of support from USGS as a contributing financial partner. If funded, the project will have state, local and federal funding sources contributing to (and partnering on) the effort resulting in mutual and individual benefit for each. The project will not be initiated at this time if grant funding is not obtained.*

	PMRNRD FY 19(July 2018-June 2019)	PMRNRD FY 20 (July 2019-June 2020)	Totals
WSF	\$72,000	\$48,000	\$120,000
PMRNRD	\$48,000	\$32,000	\$80,000
USGS	\$66,000	\$11,700	\$77,700
Totals	\$186,000	\$91,700	\$277,700

#### 5. Support/Opposition

Discuss both support and opposition to the project, including the group or interest each represents.

*Reference letters of support from the project sponsors are attached. A letter of support is included from the City of Springfield and the U.S. Geological Survey. There is no known/anticipated opposition to the project.*



## United States Department of the Interior

U.S. GEOLOGICAL SURVEY  
Water Resources Discipline  
Nebraska Water Science Center  
5231 South 19<sup>th</sup> Street  
Lincoln, NE 68512-1271

July 27, 2017

Mr. Jeff Fassett  
Director  
Nebraska Natural Resources Commission  
Nebraska Department of Natural Resources  
301 Centennial Mall South  
Lincoln, NE 68509

Dear Mr. Fassett,

On behalf of the U.S. Geological Survey (USGS) Nebraska Water Science Center (NEWSC), we appreciate how the Water Sustainability Fund (WSF) has significantly enhanced water science and water-resources monitoring across the state.

The USGS NEWSC has the ability, through its Federal-State Cooperative Matching Funds Program, to match funds with State and local cooperators for water resources investigations that advance water-science information that is in the national interest. The USGS NEWSC has been a partner with the Papio-Missouri Natural Resources District (PMRNRD) for several decades. The identification and protection of sustainable groundwater resources for eastern Nebraska communities, businesses, and environmental needs is a high priority. The PMRNRD and USGS NEWSC are proposing the development of a GeoScene 3D model of western Sarpy County.

This project will incorporate all geologic data available in the area, including the recently collected AEM data, to generate a 3D visualization of the area to better understand the connectivity of the aquifers to each other and to the surface; and to better understand the quantity of water available in the individual aquifer reservoirs. Once imbedded in the GeoScene viewer this information will be easily accessible to PMRNRD staff, state agencies, and the public. The USGS NEWSC believes this type of open access data presentation is essential for management and education and has the expertise and connections other USGS offices to develop this type of scientific hydrologic product.

The USGS NEWSC will also provide \$77,700 in funding that will be put towards the project. This information, combined with the interpreted geologic data will provide greater understanding of the quantity and quality of the groundwater resources within the District.

Sincerely,

Robert B. Swanson

Director, USGS Nebraska Water Science Center



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July 8, 2016

Mr. Jeff Fassett and Members of the Nebraska Natural Resources Commission  
Nebraska Department of Natural Resources  
301 Centennial Mall South  
Lincoln, Nebraska 68509-4676

Re: P-MRNRD Water Sustainability Fund Application for 3D Aquifer Characterization of  
Western Sarpy County

Dear Director and Reviewers:

The purpose of this letter is to support the Papio-Missouri River NRD's (P-MRNRD) Water Sustainability Fund (WSF) Grant application for the 3D Aquifer Characterization of Western Sarpy County. Our community and surrounding rural land owners rely on this potentially isolated Dakota sandstone aquifer in Western Sarpy County to supply our drinking water, meet industrial needs, and allow for future development. The limitations and potential water quality risks of this aquifer must be better understood to protect existing water supplies and plan for future community needs.

We support the approval of this application as a tool to protect the water resources our community depends on and to compliment ongoing community planning efforts within the P-MRNRD.

If you or members of the Commission have any questions regarding our support or how this project will benefit our community, please feel free to contact me at 402-253-2204.

Sincerely,

A handwritten signature in black ink that reads "Robert Roseland".

Robert Roseland  
Mayor