NEBRASKA NATURAL RESOURCES COMMISSION

Water Sustainability Fund

Application for Funding

Section A.

ADMINISTRATIVE

PROJECT NAME: Examining the effects of fertilizer application practices on nitrate movement and leaching in Lower Loup, Central Platte, and Upper Big Blue NRDs

SPONSOR'S *PRIMARY CONTACT INFORMATION* **(Not Consultant's)**

Sponsor Business Name: Lower Loup NRD

Sponsor Contact's Name: Russell Callan

Sponsor Contact's Address: 2620 Airport Dr. Ord NE 68862

Sponsor Contact's Phone: 308-728-3221

Sponsor Contact's Email: rcallan@llnrd.org

1. **Funding** amount requested from the Water Sustainability Fund:

   Grant amount requested. $ 631,200

   - If requesting less than 60% cost share, what %? Click here to enter text.

   If a loan is requested amount requested. $ NA

   - How many years repayment period? NA
   - Supply a complete year-by-year repayment schedule. NA

2. **Neb. Rev. Stat. § 2-1507 (2)**

   Are you applying for a **combined sewer overflow 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☒
- Attach a copy to your application. NA
- What is the population served by your project? NA
- Provide a demonstration of need. NA
- **Do not complete the remainder of the application.**

3. **Permits Required/Obtained** Attach a copy of each that has been obtained. For those needed, but not yet obtained (box **"NO"** checked), 1.) State when you will apply for the permit, 2.) When you anticipate receiving the permit, and 3.) Your estimated cost to obtain the permit.

(N/A = Not applicable/not asking for cost share to obtain)
(Yes = See attached)
(No = Might need, don't have & are asking for 60% cost share to obtain)

G&P - T&E consultation (required)	N/A☐	Obtained: YES☐	NO☒
DNR Surface Water Right	N/A☐	Obtained: YES☐	NO☒
USACE (e.g., 404/other Permit)	N/A☐	Obtained: YES☐	NO☒
FEMA (CLOMR)	N/A☐	Obtained: YES☐	NO☒
Local Zoning/Construction	N/A☐	Obtained: YES☐	NO☒
Cultural Resources Evaluation	N/A☐	Obtained: YES☐	NO☒
Other (provide explanation below)	N/A☐	Obtained: YES☐	NO☒

4. **Partnerships**

List each Partner / Co-sponsor, attach documentation of agreement:
Co-sponsors - Central Platte NRD (CPNRD), Upper Big Blue NRD (UBBNRD), Lower Loup NRD (LLNRD)
Partners – United States Geological Survey (USGS), University of Nebraska (UNL)

Identify the roles and responsibilities of each Partner / Co-sponsor involved in the proposed project regardless of whether each is an additional funding source.

The identified partners will contribute to the implementation and oversite of the project. The Co-sponsor will oversee the project activities like site communication with producers on access, timelines of farming activities and plant growth stages. The Co-sponsors will manage any agreements with contractors to perform the sampling and data collection. The Co-sponsors and USGS will work with sampling personnel on proper sampling, storage, and transport protocols. The USGS will be responsible for data processing, statistics, and reporting both annual and final. The University of Nebraska will act as a technical, and informational partner assisting with the analysis and interpretation of field data and will communicate related ongoing research to co-sponsors and stakeholders.

5. **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.

The total cost of the proposed project is $1,316,000. Additionally, the USGS is providing $264,000 in cooperative matching funds to offset some of their planned costs. The LLNRD, CPNRD, and UBBNRD are providing a total of $420,800 for 40% local match. The remaining 60% ($631,200) would be funded through this grant application by the WSF. Please refer to the budget table below and letters of support (Appendix A) for reference. The LLNRD, CPNRD, UBBNRD, and the USGS have indicated firm support for the project and have set aside the dollar amounts indicated below in their operating budgets.

	FY26	FY27	FY28	FY29	TOTAL
TOTAL					$1,316,000
WSF	$72,192	$163,620	$163,620	$231,768	$631,200
LLNRD	$24,064	$54,540	$54,540	$77,256	$210,400
CPNRD	$12,032	$27,270	$27,270	$38,628	$105,200
UBBNRD	$12,032	$27,270	$27,270	$38,628	$105,200
USGS match	$31,680	$68,640	$68,640	$95,040	$264,000

6. **Overview**

In 1,000 words *or less*, provide a brief description of your project including the nature/purpose of the project and its objectives. Do not exceed one page!

Nebraska's multibillion-dollar rural economy is heavily dependent on the production of corn and soybeans, which often require the use of nitrogen fertilizer to sustain yields. The project Co-sponsors (LLNRD, CPNRD, and UBBNRD) are actively managing groundwater quality to reduce the amount of nitrate entering the groundwater system. Specifically, the Co-sponsors would like to determine the loss of nitrogen to leaching from three different fertilizer application practices including traditional fall fertilizer application, fall manure application (or other application practice), and side-dress fertilizer application. This important research examines how current agricultural practices affect Nebraska's water quality and seeks to improve understanding of nitrogen movement in the LLNRD, CPNRD, and UBBNRD, which together encompass approximately 3.5 million irrigated acres - over one-third of the state's total irrigated land. The proposed project will include four different study areas across the 3 NRDs. Each study area will have 9 fields, with 3 fields for each of the fertilizer application practices (fall anhydrous, fall manure or other application practice, and side-dress). The methods for the proposed project are given below with a more detailed explanation is given in Part B 1.B.2 of this grant application. The project approach includes 1) soil core collection and laboratory analysis; 2) bromide tracer tests; and 3) collection of continuous soil moisture and other supporting data. Soil coring collection and laboratory analysis will involve collecting soil cores 8 times per year during key crop growth stages. Cores will be collected to a depth of 30 ft when fields will be accessible outside of the growing season and to 8 ft with a portable gas-powered coring set up during growing season. Soil cores will be subdivided into 1-ft increments to a depth of 8 ft and 2 ft increments to depths of up to 30-ft for laboratory analyses. The soil samples will be analyzed for nitrate (NO_3^-), ammonium (NH_4^+), and total nitrogen. Soil samples collected to a depth of 2 ft will include analyses of nutrients, cations, and organic matter. Soil sample data will be used to estimate nitrogen losses below the root zone and will be the primary data set for statistical comparisons of the different fertilizer application practices. The second part of this study will include bromide tracer tests which will estimate the travel time of solutes, such as nitrate, through the root zone for different soil types. Bromide is considered an ideal conservative tracer in that will not bind to soil particles or be incorporated into crop tissue. Both bromide and nitrate are negatively charged ions and will move through the soil at nearly identical rates. The maximum rate of nitrate movement will be determined through repeated soil coring during each growing season. Previous bromide tracer tests completed in 2024 in Platte, Boone, and Nance Counties indicated a maximum rate of water movement of nearly 1 inch per day during the growing season in deep loess-derived soils. The third major part of the project will include installation of soil moisture sensors in three fields for each of the four study areas (12 fields total). Soil moisture data will be collected at 9 depths to 3.3 ft below land surface. The continuous soil moisture data will be used to examine soil moisture changes in response to evapotranspiration, determine depth of the root zone, and identify wetting fronts from local precipitation and irrigation within the upper 3.3 ft of the soil. Soil moisture sensors will be particularly beneficial for tracking water movement following intense summer storm events or conversely when prolonged dry periods restrict the downward movement of nitrogen during the growing season. The data collected and major findings of this study will be published in a USGS Scientific Investigations Report. Availability of an online report helps disseminate the results of the investigations to a broad audience and enables water managers and users to gain access to this information in a timely manner after publication and into the future. All products will adhere to the USGS Fundamental Science Practices including peer review and to all other USGS standards for scientific integrity and quality.

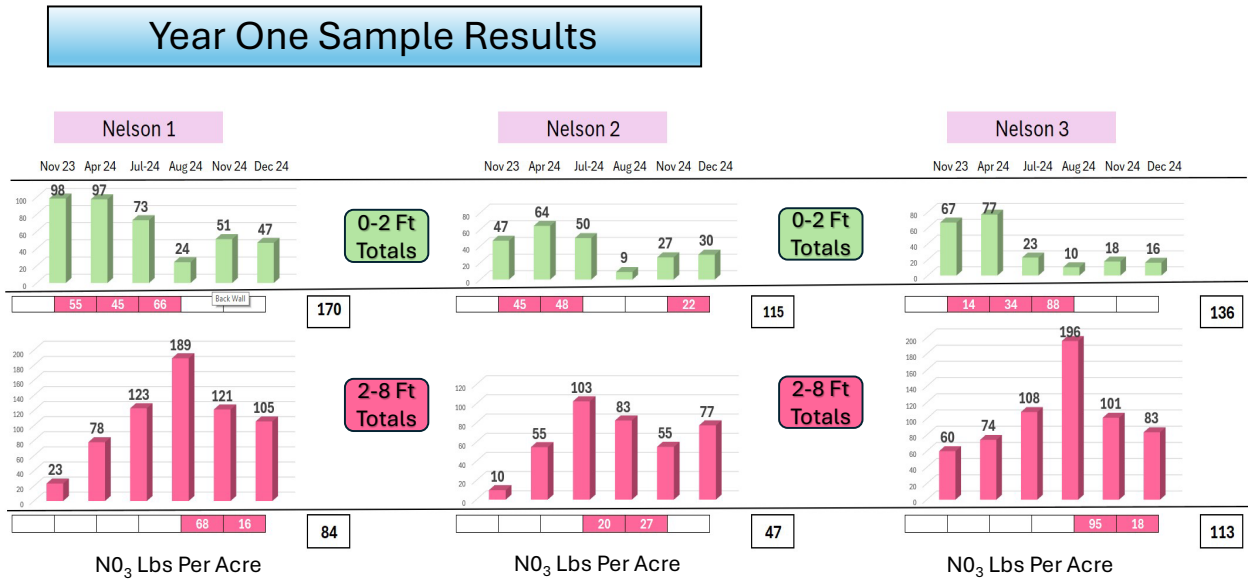


Figure 1. Example results showing repeated soil coring and calculated nitrate losses in pounds per acre for a side-dress fertilizer application field.

7. Project Tasks and Timeline

Identify what activities will be conducted to complete the project, and the anticipated completion date. Correspondence

For multiyear projects please list (using the following example): **Project timeline**

	2025	2026				2027				2028				2029
Activity	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept	Oct-Dec	Jan-Mar
Site selection	X													
Equipment installation		X	X											
Soil sampling	X		X	X	X		X	X	X		X	X	X	
Producer Correspondence	X	X												
Data review and analysis		X		X	X	X		X	X	X		X	X	
Yearly Annual Report						X				X				X
Report writing and production					X				X			X	X	X

One Study Area is 9 fields with 3 fertilizer application replications and 3 boreholes per field.

Activity	Year 1$	Year 2$	Year 3$	Year 4$	Total
Site selection	$1,500				
Monitoring Equipment	$30,000	$20,000	$20,000	$10,000	$80,000
Soil sampling/bromide work	$5,000	$28,835	$28,835	$28,830	$91,500
Producer Correspondence	$1,500	$10,000	$10,000	$15,000	$36,500
Data review and analysis		$15,000	$15,000	$30,000	$60,000
Yearly Annual Report		$11,500	$11,500	$11,500	$34,500

Report writing and production				$25,000	
Total	$38,000	$85,335	$85,335	$120,330	$329,000
minus USGS contribution	-$7,920	-$17,160	-$17,160	-$23,760	-$66,000
sub totals (one Study Area)	$30,080	$68,175	$68,175	$96,570	$263,000
Total # of Study Areas				4	$1,052,000

Total Project Cost		$1,316,000		
USGS Contribution		-$264,000		
Remaining		$1,052,000		
Water Sustainability Grant			60%	$631,200
NRD Match			40%	$420,800
Total				$1,052,000

Click here to enter text.

8. **IMP**

Do you have an **Integrated Management Plan** in place, or have you initiated one? YES☒ NO☐ Sponsor is not an NRD☐

Section B.

DNR DIRECTOR'S FINDINGS

Prove Engineering & Technical Feasibility

(Applicant must demonstrate compliance with Title 261, CH 2 - 004)

1. Does your project include physical construction (defined as moving dirt, directing water, physically constructing something, or installing equipment)?
YES☐ NO☒

If you answered "YES" you must answer all questions in section 1.A.
If you answer "NO" you must answer all questions in section 1.B.

If "YES", it is considered mostly structural, so answer the following:

1.A.1 Insert a feasibility report to comply with Title 261, Chapter 2, including engineering and technical data; NA

1.A.2 Describe the plan of development (004.01 A); NA

1.A.3 Include a description of all field investigations made to substantiate the feasibility report (004.01 B); NA

1.A.4 Provide maps, drawings, charts, tables, etc., used as a basis for the feasibility report (004.01 C); NA

1.A.5 Describe any necessary water and/or land rights including pertinent water supply and water quality information (004.01 D); NA

1.A.6 Discuss each component of the final plan (004.01 E); NA

1.A.7 When applicable include the geologic investigation required for the project (004.01 E 1); NA

1.A.8 When applicable include the hydrologic data investigation required for the project (004.01 E 2); NA

1.A.9 When applicable include the criteria for final design including, but not limited to, soil mechanics, hydraulic, hydrologic, structural, embankments and foundation criteria (004.01 E 3). NA

If "NO", it is considered mostly non-structural, so answer the following:

1.B.1 Insert data necessary to establish technical feasibility (004.02);

The LLNRD, CPNRD, and UBBNRD are pursuing an effort to collect on-farm data to demonstrate the effect fertilizer application practices, application timing, and irrigation/rainwater has on nitrate leaching. The soil data collected will be needed to access the amount of nitrate that is lost to leaching below the root zone. Data collected include the nitrate concentration in the soil in parts per million and lbs. per acre, bromide concentrations, soil moisture content, irrigation water applied, precipitation, crop growth stages, groundwater nitrate concentration, weather parameters, fertilizer application timing and amounts, and other agronomy soil analysis. Statistical comparisons of traditional fall fertilizer applications, side-dress fertilizer applications, manure applications or other will be completed which can be used to evaluate differences between the application practices. Other statistical approaches will be examined throughout the study. A key component of this project is demonstrating and communicating the results to local producers and stakeholders. To ensure a science-based approach USGS staff will meet regularly with the Co-sponsors' staff and Board members throughout the study to discuss initial results and findings. This proposed study will focus on determining the loss of nitrogen due to leaching from different soil types and fertilizer application practices including traditional fall fertilizer application, side-dress fertilizer application, fall manure application or other application practices in the LLNRD, CPNRD, and UBBNRD. The University of Nebraska will be part of the data review process and provide technical expertise when dealing with crop stages, plant nutrient uptake and overall crop agronomy. The project includes multiple soil properties analysis that will provide data that can help explain chemical and biological interactions that occur below the crop roots in the vadose zone.

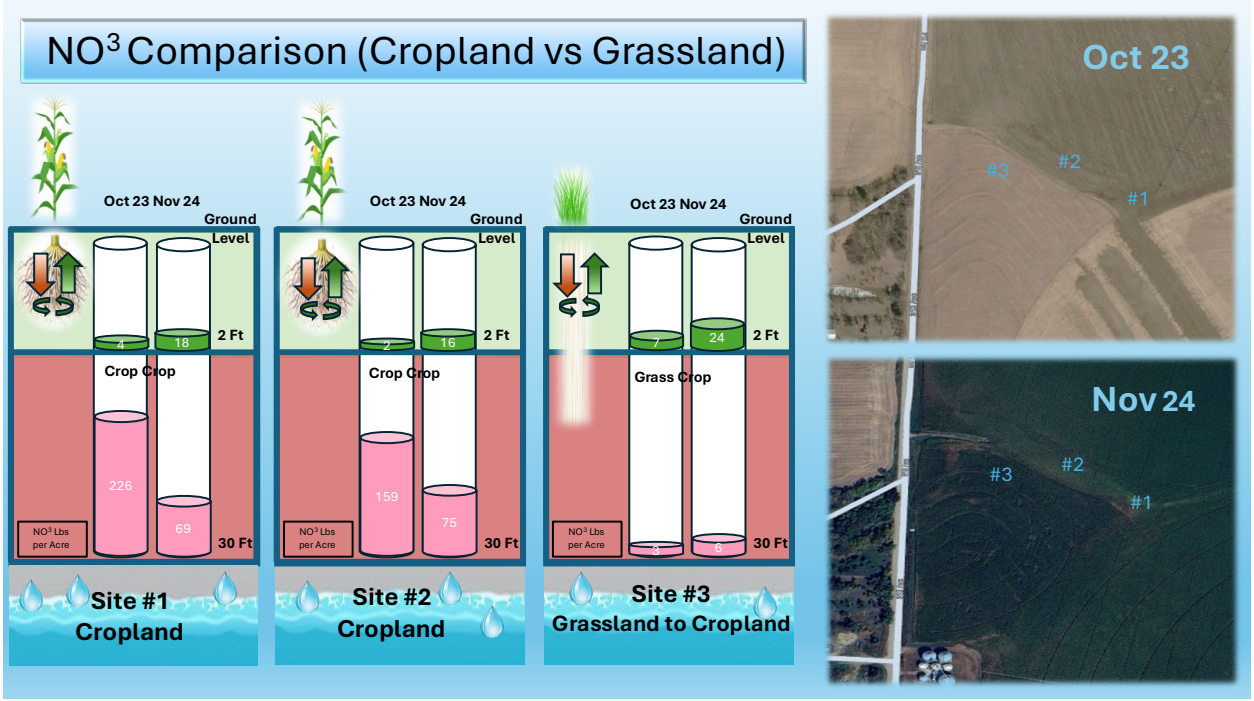


Figure 2. Vadose zone NO_3 Comparison of Cropland vs Grassland

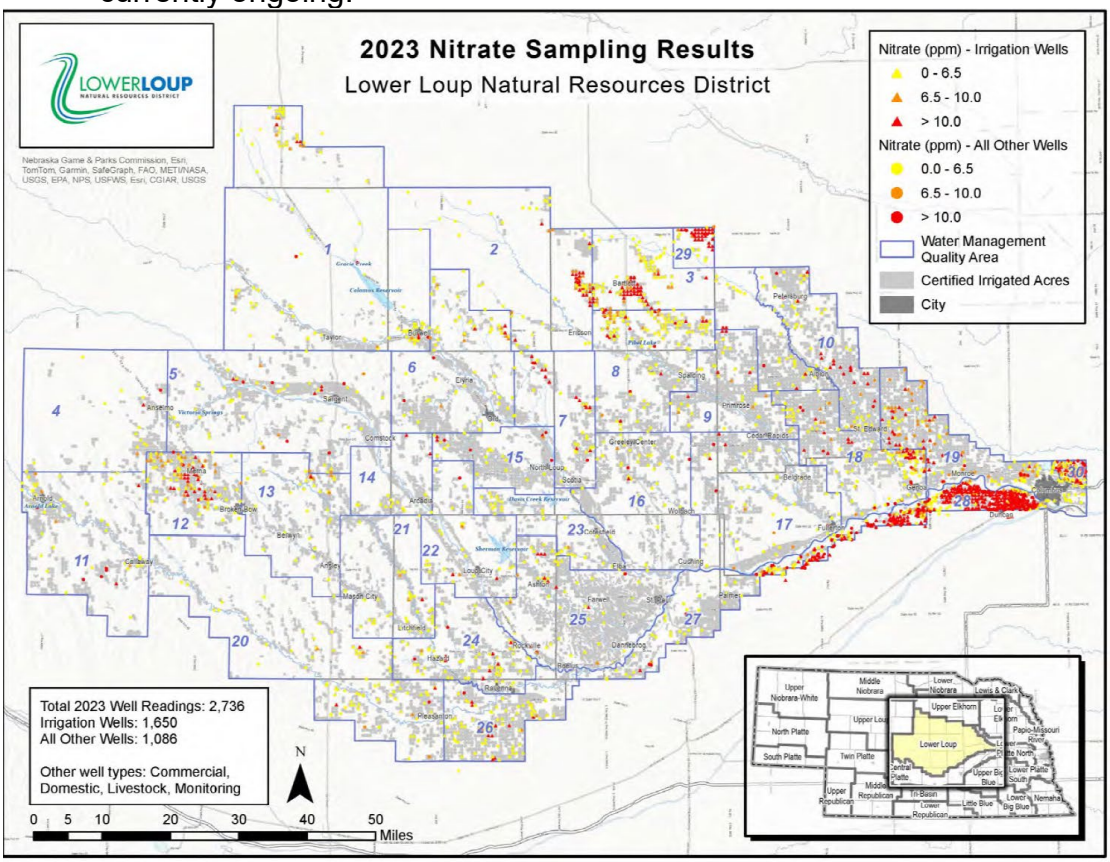
1.B.2 Discuss the plan of development (004.02 A);

The plan was conceived following regulation discussion that occurred following a public hearing where producers expressed disapproval of the LLNRD restricting fall fertilizer application. Following that a Public Hearing a vadose zone (area below the root zone above the aquifer) sampling project was started to look at nitrate losses below the root zone and to measure the speed that nitrate moves through the crop root zone to determine leaching potential of different fertilizer application practices. This project proposal is to add additional study areas to look at different soil types and weather effects within the LLNRD, CPNRD and UBBNRD. Because all field data are to be collected on active working farms, the co-sponsors need to work directly with producers' current farming practices to limit interruptions to normal farming operations. The Operation Plan is designed to access different fertilizer application practices including traditional fall anhydrous, fall manure (or other application practice), and in-season side-dress fertilizer application. The Operation Plan is designed to test and support the University of Nebraska's promotion of in-season fertilizer application based on NebGuide G2365 In-Season Nitrogen Management for Irrigated Corn (Ferguson and others, 2024). The focus of this study is to estimate the amount of nitrogen lost to leaching in selected areas of the LLNRD, CPNRD and UBBNRD. The Project is based on 4 Study Areas, each with 9 fields with 3 fertilizer application replications with 3 coring locations per field. Specific study area objectives are listed below: 1. Co-sponsors staff will coordinate the collection of soil nitrate samples. Summary of approach: At a minimum of three locations for each of the different land use practices being evaluated; traditional fall fertilizer application, side-dress fertilizer application, manure application (or other application practice). Co-sponsors/contractor will collect and send soil samples to a local agricultural testing laboratory for analysis. Quality assurance procedures will include the collection of a minimum of 10 percent duplicate environmental samples. USGS staff will help Co-sponsors determine the best locations for sampling. 2. Determine the total mass of nitrate leaving the root zone for land use practice. Summary of approach: Changes in the total mass of nitrogen will be calculated from soil samples collected at specified sampling periods described in the Approach section below. Statistical comparisons of N losses from traditional fall fertilizer applications, side-dress fertilizer applications, manure application (or other application practice) will be completed which can be used to evaluate differences between the application practices. Other statistical approaches will be examined throughout the study. A key component of this project is demonstrating and communicating the results to local producers and stakeholders. USGS staff will meet regularly with the Co-sponsors staff and Board members throughout the study to discuss initial results and findings. This proposed study will focus on determining the loss of nitrogen leaching from different soil types and fertilizer application practices including traditional fall fertilizer application, side-dress fertilizer application, fall manure application or other in the LLNRD, CPNRD, and UBBNRD. Soil samples will be collected at a

minimum of three fields for each fertilizer application practice by Co-sponsors/contractor's staff. A minimum of three soil cores will be taken for each field and collection will be timed to assess changes in soil nitrogen at the crop growth stages including: 1) 30-foot sample immediately after harvest, before any fall application of fertilizer of any type; collected around October. 2) 30-foot sample pre-planting. 3) 8-foot sample planting at pre-emergence. 4) 8-foot sample V5 to V6 corn is about 16 inches tall. 5) 8-foot sample V8 corn is about 24inches tall. 6) 8-foot sample at pollination/silk R1. 7) 30-foot sample immediately after harvest, before any fall application of fertilizer of any type. 8) A 30-foot sample after fall application of fertilizer if applicable collected around October. Soil samples collected pre-planting (1) and after harvest (7 and 8) will be collected to a depth of 30-ft with a soil coring rig. To prevent crop damage, soil samples collected within the growing season (2 through 6) will preclude the use of a soil coring rig. A gas-powered/handheld soil sampler will be used to collect samples to a depth of 8-ft to fully characterize the nitrogen within and below the crop root zone. Both 8-foot and 30-foot core samples will be divided into increments of the first 8 ft will be 1-foot samples and below that 2-foot samples. The soil sampling will be repeated for 3 growing seasons to assess differences in precipitation patterns on nitrate movement. They will be sent to a local agricultural testing laboratory for analysis. Soil samples will be analyzed for the S-5 test, which include nutrients, selected cations, organic matter (Ward Laboratories, 2023) and ammonium (NH_4^+) for the 0 to 1 ft and 1 to 2 ft samples. Deeper samples (past 2 ft below land surface) will be analyzed for nitrate (NO_3) and ammonium (NH_4^+) only. Although the primary focus of this project is on soil sampling and subsequent statistical comparisons, other sources of information will be critical in fully assessing and understanding the results. Bromide which is commonly used as a conservative tracer will be applied to one coring location per field per year to allow for estimation of time of travel for nitrate and shall be sampled and analyzed alone within normal sampling timelines. The nitrate concentration of irrigation water applied through the growing season will be sampled annually for nitrate by the Co-sponsor's staff. Precipitation will be measured at or near each field with a tipping bucket rain gage. Ideally, each rain gage could measure the total precipitation and irrigation water applied to each field being sampled. In cases where a rain gage cannot be used to measure local precipitation and applied irrigation water, flow meter readings will be used to estimate the amount of groundwater applied. Soil moisture sensors will be installed at selected fields to examine soil moisture changes in response to evapotranspiration, determine depth of the root zone, and identify wetting fronts from local precipitation and irrigation within the upper 3 ft of the soil. Soil moisture sensors will be particularly beneficial for tracking water movement following intense summer storm events or conversely when prolonged dry periods restrict the downward movement of nitrogen during the growing season. Additional equipment including soil moisture sensors (Campbell Scientific, 2025), tipping bucket rain gage, dataloggers, and cellular modem will be purchased for real-time monitoring.

1.B.3 Describe field or research investigations utilized to substantiate the project conception (004.02 B);

The growing groundwater nitrate contamination concern in the state of Nebraska continues to be monitored by the NRDs. The water quality reports from the NRDs, Nebraska Department of Environment and Energy, Nebraska Department of Health and Human Services, and others highlight the issues. NRDs assist producers daily to work on nutrient management and irrigation management. The districts require producers to take soil samples, measure water applied, regulate application timings, and potentially nitrogen inhibitors all to support best management practices that reduce the chances of nitrate leaching into the groundwater supply. This project is using on-farm, year-round measurements to support changes needed to reduce the nitrate infiltration effects associated with out of season application practices. The recent and ongoing USGS and LLNRD "Examining the effects of fertilizer application practices on nitrate movement and leaching in Platte, Nance, and Boone Counties, Nebraska" indicates that shallower root depths also add to the effect of nitrate leaching. Recent research has supported this finding suggesting that corn root depths have decreased for most commercially grown varieties (Rinehart and others, 2024). This project is proposed as a way to replicate and expand the USGS, LLNRD study that is currently ongoing.



1.B.4 Describe any necessary water and/or land rights (004.02 C); NA

1.B.5 Discuss 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). The project will help inform nutrient management decisions needed to improve groundwater quality by effects of specific fertilizer application practices on nitrate leaching and groundwater quality. The anticipated findings from this proposed project will hopefully reduce the possibility of reverse osmosis water treatment systems for well owners, which may cost $35 to $60 per month per user. For a municipality, the cost of a reverse osmosis system is likely to cost $2 to 3 million, plus maintenance costs (Lower Elkhorn Natural Resources District, 2023).

Prove Economic Feasibility

(Applicant must demonstrate compliance with Title 261, CH 2 - 005)

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 ground truthing concept of this project provides valuable on-farm in-season data that cannot be obtained any other way. The current alternatives include Nitrate Mobility Modeling that is being developed and has promising applications. However, the data obtained by this study will be an asset to supporting the calibration processes needed to field truth these models. Furthermore, the insight and information gained from this project will help foster best management practices to preserve groundwater quality from further degradation and improve the efficient use of fertilizers which are needed to sustain agricultural production. The next best alternative is to enact overly stringent nutrient management strategies, which may adversely affect crop production and negatively impacting the income of local producers. Conversely, if the necessary steps are not taken, and nitrate concentrations in groundwater continue to increase, local well owners may need to install reverse osmosis systems in their homes, which may cost $35 to $60 per month per user. For a municipality, the cost of a reverse osmosis system is likely to cost $2 to 3 million, plus maintenance costs (Lower Elkhorn Natural Resources District, 2023). The additional water treatment is particularly important because of recent research that suggests a linkage between nitrate in groundwater and certain types of pediatric cancer (Ouattara, 2022).

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 is the project life. (Title 261, CH 2 - 005). The total cost of the proposed project is $1,316,000 of which the LLNRD, CPNRD, and UBBNRD are requesting $631,200 in funds from the Water Sustainability Fund. From the perspective of an individual NRD, the funding from

the USGS and this grant would provide a nine-fold return on their initial investment. The benefits of this project are to provide the needed background information to develop cost-effective solutions to better manage fertilizer use and reduce nitrate concentrations in groundwater. The LLNRD, CPNRD, and UBBNRD want to base their future management decisions using the best available science. Water managers want to avoid enacting overly stringent nutrient management strategies, which may adversely affect crop production and negatively impacting the income of local producers. Conversely, if the necessary steps are not taken, and nitrate concentrations in groundwater continue to increase, local well owners may need to install reverse osmosis systems in their homes, which may cost $35 to $60 per month per user. For a municipality, the cost of a reverse osmosis system is likely to cost $2 to 3 million, plus maintenance costs (Lower Elkhorn Natural Resources District, 2023). The additional water treatment is particularly important because of recent research that suggests a linkage between nitrate in groundwater and certain types of pediatric cancer (Ouattara, 2022).).

3.A 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).

The estimated cost of the project comes from work that is already preceding with the current USGS, LLNRD study. The budget includes man hours needed to complete the labor-intensive process of obtaining soil samples to 8ft throughout the growing season. The equipment that is needed to gather the samples includes a gas-powered sampling tube pounder, sampling tubes jack to retrieve the tubes, weather station and soil moisture monitoring probes, and a soil coring machine to collect 30ft off season vadose zone cores. The estimated cost of this equipment and installation is included in the proposed budget. The data collected and major findings of this study will be published in a USGS Scientific Investigations Report. Availability of an online report helps disseminate the results of the investigations to a broad audience and enables water managers and users to gain access to this information in a timely manner after publication and into the future. All products will adhere to the USGS Fundamental Science Practices including peer review and to all other USGS standards for scientific integrity and quality. USGS will maintain the data collected and the resulting report as part of their national data management that will not include any maintenance costs to the project. There will be no annual operation, inspection, or replacement costs with this project. The estimated project life of this research project is difficult to determine at this time but would likely result in improvements in nitrogen application efficiency and improvements to groundwater quality. Upon completion of this project, the 3 involved NRDs and USGS should have a better understanding of the impacts of different fertilizer application methods, and provide recommendations for each of the impacted areas for optimum economic

return while minimizing leaching potential. This research could be repeated in other areas of the state and have benefits to any area where row-cropped irrigated ground has a vulnerability to nitrate leaching.

3.B 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 intangible or secondary benefits (if any) 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, in a way that justifies economic feasibility of the project such that the finding can be approved by the Director and the Commission (005.02). The benefits of this project are to provide the background information needed to develop cost-effective solutions using sound data representative of soil conditions that reflect current fertilizer application practices. Use of assumed or dated data and a less than thorough understanding of different fertilizer application practices and its influence on drinking water quality may lead to uninformed groundwater management decisions that could have negative economic implications or conversely could further impair groundwater quality.

3.C Present all cost and benefit data in a table to indicate the annual cash flow for the life of the project (005.03). Given below is a cost table of the proposed project. Exact tangible benefits cannot be described for the research project.

	FY26	FY27	FY28	FY29	TOTAL
TOTAL					$1,316,000
WSF	$72,192	$163,620	$163,620	$231,768	$631,200
LLNRD	$24,064	$54,540	$54,540	$77,256	$210,400
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USGS match	$31,680	$68,640	$68,640	$95,040	$264,000

3.D 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, demonstrate the economic feasibility of such proposal by such method as the Director and the Commission deem appropriate (005.04). (For example, show costs of and describe the next best alternative.) There is no generally accepted method for calculation of primary tangible benefits of the proposed research project. This research will support water sustainability because the information gained will assist the LLNRD, CPNRD, and UBBNRD in making future water management decisions to meet the water needs of approximately 268,383 Nebraskans. The purpose of this project is to help

determine the influence of fertilizer applications practices on groundwater quality. This insight and information from this project will help foster best management practices to preserve groundwater quality from further degradation and for the efficient use of fertilizers which are needed to sustain agricultural production. The next best alternative is to enact overly stringent nutrient management strategies, which may adversely affect crop production and negatively impacting the income of local producers. Conversely, if the necessary steps are not taken, and nitrate concentrations in groundwater continue to increase, local well owners may need to install reverse osmosis systems in their homes, which may cost $35 to $60 per month per user. For a municipality, the cost of a reverse osmosis system is likely to cost $2 to 3 million, plus maintenance costs (Lower Elkhorn Natural Resources District, 2023). The additional water treatment is particularly important because of recent research that suggests a linkage between nitrate in groundwater and certain types of pediatric cancer (Ouattara, 2022).

Prove Financial Feasibility

(Applicant must demonstrate compliance with Title 261, CH 2 - 006)

4. Provide evidence that sufficient funds are available to complete the proposal. The LLNRD, CPNRD, and UBBNRD have allocated funds for this study. Letters of support from the supporting jurisdictions are provided in Appendix A. The table below lists the 2023-2024 property tax levies, valuations, and sources of revenue for the LLNRD, CPNRD, and UBBNRD (Nebraska Auditor of Public Accounts https://www.nebraska.gov/auditor/reports/index.cgi?budget=1- accessed March 6, 2025). The USGS is providing $264,000 in cooperative matching funds contributed to this project.

Natural Resources District	Tax Levy (per $100 valuation)*	Valuation 2023-24	Total Resources Available*	Local match for proposed project
Central Platte	2.338	$ 20,642,169,013	$ 26,829,482	$105,200
Lower Loup	3.6169	$ 18,067,263,121	$19,886,527	$210,400
Upper Big Blue	2.1098	$ 16,524,839,091	$9,195,844	$105,200

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

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

7. Describe how the plan of development minimizes impacts on the natural environment (i.e. timing vs nesting/migration, etc.). The proposed project has minimal impacts on the natural environment because the field activities are limited existing croplands. The soil sampling and other field activities will result in no adverse or detrimental impact to the environment.

8. Explain how you are qualified, responsible and legally capable of carrying out the project for which you are seeking funds. The LLNRD, CPNRD, and UBBNRD have the authority under the Nebraska Groundwater Management and Protection Act, Chapter 46 Article 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. Nebraska State Statute Chapter 2 Article 32 gives the LLNRD, CPNRD, and UBBNRD authority to carry out projects related to the development, management, utilization and conservation of groundwater and surface water. The NRD staff members have local knowledge of the area and wish to collaborate with the USGS on this project. NRD staff also require key employees to maintain their NRD groundwater technician license from the Nebraska Well Driller's Licensing Board which require continuing education hours ensuring staff are up to date with current and relevant water-resource issues. The USGS has a major role in studying the Nations water resources and serves as the lead earth science agency of the Federal Government. The Central Plains Water Science Center employs approximately 98 employees whose mission is to deliver timely, accurate, and relevant information on water resources for Nebraska and Kansas.

9. Explain how your project considers plans and programs of the state and resources development plans of the political subdivisions of the state. The proposed project will support the goals and objectives of management plans for the LLNRD, CPNRD, and UBBNRD aimed at sustaining groundwater quality and availability. This project would provide supporting data and background on the influence of fertilizer application practices have on groundwater quality for the current iteration of the LLNRD Groundwater Management Plan and will supplement annual water-quality reports (example Lower Loup Natural Resources District, 2021). Similarly, the proposed project will provide valuable supporting information to the CPNRD in its Groundwater Management Plan (Central Platte Natural Resources District, 2023) and the UBBNRD Water Quality Management Plan (2020) triggers and management actions aimed at reducing nitrate concentrations in groundwater. The proposed project will provide critical information that will be communicated to NRD Directors, area producers, and residents. The proposed project also supports other groundwater management plans that are administered by other state agencies. The Nebraska Ground Water Management and Protection Act which allows for the protection and conservation of groundwater which are essential to economic prosperity and

future well-being. The proposed project is intended to provide the necessary information to protect drinking water for approximately 268,383 Nebraskans. The proposed project also supports the Nebraska Department of Environment and Energy's Title 130 because the findings will have direct impacts on when and how much manure can be applied to fields as well as locating and permitting Confined Animal Feeding Operations. Furthermore, the proposed project will also support the Wellhead Protection Areas for the cities of Broken Bow, Lexington, and York with improved management and regulation of non-point source groundwater pollution.

10. Are land rights necessary to complete your project? YES☐ NO☒

If yes:

10.A Provide a complete listing of all lands involved in the project. Click here to enter text.

10.B Attach proof of ownership for each easements, rights-of-way and fee title currently held. Click here to enter text.

10.C Provide assurance that you can hold or can acquire title to all lands not currently held. Click here to enter text.

11. Identify how you possess all necessary authority to undertake or participate in the project. The participating NRDs have 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 NRDs' 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 consequences (environmental and ecological) that may result if the project is or is not completed. The proposed project will help determine the effects of different fertilizer application processes on nitrate leaching and groundwater quality. The information gathered from this project will help foster best management practices to preserve groundwater quality from further degradation and for the efficient use of fertilizers which are needed to sustain agricultural production. If this project is not completed the LLNRD, CPNRD, and UBBNRD will make future groundwater management decisions without the needed scientific information. This may result in enacting overly stringent nutrient management strategies, which may adversely affect crop production and negatively impact the income of local producers. Conversely, if the necessary management steps are not taken, and nitrate concentrations in

groundwater continue to increase, local well owners may need to install reverse osmosis systems in their homes, which may cost $35 to $60 per month per user. For a municipality, the cost of a reverse osmosis system is likely to cost $2 to 3 million, plus maintenance costs (Lower Elkhorn Natural Resources District, 2023). The additional water treatment is particularly important because of recent research that suggests a linkage between nitrate in groundwater and certain types of pediatric cancer (Ouattara, 2022).

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 to 6 for items (1) - (9); and 0 to 3 for items (10) - (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 72 possible points, plus two bonus points. The potential number of points awarded for each criteria are noted above. 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.

Nitrate contamination is a documented threat in Nebraska's ground water supply. 85% of Nebraska's get their drinking water from groundwater. This includes municipal supplies and private drinking water wells. The project will address groundwater nitrate

and groundwater sustainability. Groundwater is an important drinking water source for the 268,383 people within LLNRD, CPNRD, and UBBNRD where nitrate concentrations can exceed the Environmental Protection Agency Maximum Contaminant Level of 10 milligrams per liter (U.S. Environmental Protection Agency, 2018). The NRDs have rules and regulations in place to encourage producers to reduce nitrogen applications by requiring reporting processes and mandating that producers use the nitrogen calculator that the University of Nebraska promotes (Ferguson and others, 2024). This process is used to educate producers by requiring them to look at the nitrogen budget they use in their farming practices. The project proposed will examine and compare nitrogen losses from three different fertilizer application practices including: 1) fall anhydrous 2) fall manure (or other application practice) and 3) in-season side-dress fertilizer applications. The project will examine nitrogen movement throughout three growing seasons to examine the effects different precipitation patterns on nitrate leaching from each of the three fertilizer application practices. The overarching goal of the proposed project is to encourage producers to adopt nitrogen budgeting and encourage best management practices that reduce leaching by applying nitrogen in the growing season as recommended by the University of Nebraska (Ferguson and others, 2024). In-season application of fertilizer is not a new concept; however, producers are reluctant to switch to it because of the lack of information that looks at nitrogen losses associated with fall or pre-season application and the potential increased workload and labor during the growing season. If the issue is not resolved, nitrate concentrations in Nebraska's drinking water will likely continue to get worse. For groundwater quality to improve, fertilizer application will need to be better managed, and producers will need to apply fertilizer at the time the crop needs it to support plant growth. In much of the state, nitrate levels in groundwater are rising and public health outcomes associated with drinking high nitrate groundwater will continue to increase.

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.

   The 3 NRDs involved with this project have active Groundwater Management Plans (GWMP) and approved Integrated Management Plans. This project focuses on water quality; however, it looks at leaching impacts to nitrates which is also caused by the overapplication of groundwater which reduces streamflow in many hydrologically connected areas. The LLNRD, CPNRD, and UBBNRD have been proactive in managing their groundwater resources; in terms of both water availability and water quality through water sampling efforts, education programs with rural and urban citizens, water quality and quantity Best Management Practices cost share programs, stream augmentation projects, groundwater recharge, static water-level measurements, and hydrologic

modeling. Each of the three co-sponsoring NRDs have goals to reduce nitrate concentrations in groundwater written within their GWMPs. The primary goal of the LLNRD's GWMP is to maintain the quality of groundwater in the groundwater reservoir to within maximum contaminant levels for all chemicals and compounds established by the Nebraska Department of Environment and Energy and the Department of Health and Human Services. Objective 1 – Recognize that the major threat to nonpoint pollution of groundwater within their jurisdiction will be in the form of nitrate pollution and that the major sources of nitrate pollution are from agriculture, urban and industrial sewage treatment, septic systems, and from background sources. The CPNRD's GWMA objectives are to : Extract the nitrates in the groundwater by utilizing them for the nitrogen needs of the crop; Fully utilize the residual nitrates in the soil profile for the nitrogen needs of the crop; Reduce fertilizer applications to account for nitrogen available in the soil and irrigation water; reduce the "opportunity time for fertilizer to leach below the root zone; Encourage farm practices, techniques and installation of equipment that have proven to be helpful in reducing groundwater nitrate levels and leaching; Research new equipment and techniques that have potential for reducing groundwater nitrates. The primary goal of the Upper Big Blue Natural Resources District is successful long-term water management, for both quantity and quality. The district strives to provide an adequate supply of acceptable quality groundwater to fulfill the reasonable groundwater demands within the district for domestic, agricultural, manufacturing or industrial, and other uses deemed beneficial by the Board of Directors. The project will address groundwater nitrate and groundwater sustainability. Groundwater is an important drinking water source for the 268,383 people within LLNRD, CPNRD, and UBBNRD where nitrate concentrations can exceed the Environmental Protection Agency Maximum Contaminant Level of 10 milligrams per liter (U.S. Environmental Protection Agency, 2018). The NRDs have rules and regulations in place to encourage producers to reduce nitrogen applications by requiring reporting processes and mandating that producers use the nitrogen calculator that the University of Nebraska promotes. This process is used to educate producers by requiring them to look at the nitrogen budget they use in their farming practices. The project proposed will examine and compare nitrogen losses from three different fertilizer application practices including: 1) fall anhydrous 2) fall manure (or other application practice) and 3) in-season side-dress fertilizer applications. The project will examine nitrogen movement throughout three growing seasons to examine the effects different precipitation patterns on nitrate leaching from each of the three fertilizer application practices. The overarching goal of the proposed project is to encourage producers to adopt nitrogen budgeting and encourage best management practices that reduce leaching by applying nitrogen in the growing season as recommended by the University of Nebraska (Ferguson and others, 2024).

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.

The primary objective of this project is to examine how fertilizer application practices affect nitrate leaching across the LLNRD, CPNRD, and the UBBNRD. Although the focus is on water-quality the proposed project supports the goals approved IMPs for the LLNRD, CPNRD, and the UBBNRD which are aimed at maintaining streamflow within the Loup River, Platte River, and Big Blue River basins. One of the biggest threats to groundwater quality is the overapplication of groundwater to irrigate crops. Over irrigating causes nitrate leaching past the root zone and negatively impacts groundwater availability and streamflow. The IMPs of all three NRDS involved with this project expressed the need for irrigation water management to prevent the over application of groundwater and reduce impacts to streamflow and groundwater levels. Demonstrating the negative effects of overapplication of groundwater that increases nitrate leaching and potential groundwater contamination will provide water managers with necessary information to promote best management practices needed to improve groundwater quality and in turn will result in cross-basin benefits by increasing streamflow and groundwater availability.

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.

This project focuses on the conservation and preservation of groundwater as a drinking water source for 268,383 Nebraskans. Furthermore, this important research examines how current agricultural practices affect Nebraska's water quality and seeks to improve understanding of nitrogen movement in these NRDs, which together encompass approximately 3.5 million irrigated acres - over one-third of the state's total irrigated land. The information provided by this project will enable water resource managers to examine the influence of specific fertilizer practices on nitrate leaching, communicate to local producers how fertilizer application practices can affect groundwater quality, and develop a study template that could be transferred to other areas within the LLNRD, CPNRD, UBBNRD, or the state of Nebraska experiencing the same water-resource

issues. The primary goal of this project is to identify fertilizer application practices that reduce nitrate leaching, which is a direct benefit to Nebraska's water supply. This project is designed to look at the nitrate leaching throughout the growing season across three different NRDs with unique soil types, precipitation patterns, and farming practices. The proposed project will assist producers and the LLNRD, CPNRD, UBBNRD to manage fertilizer applications to prevent unnecessary nitrogen losses to the groundwater. Nitrate contamination continues to threaten groundwater water quality for municipal and domestic water uses. We expect the benefits of the proposed project will last for decades as it will enable water managers from the LLNRD, CPNRD, UBBNRD make sound water management decisions based on the best-available science. If we continue on the current path, the LLNRD, CPNRD, UBBNRD will make future groundwater management decisions without the needed scientific information. This may result in enacting overly stringent nutrient management strategies, which may adversely affect crop production and negatively impacting the income of local producers. Conversely, if the necessary management steps are not taken, and nitrate concentrations in groundwater continue to increase, local well owners may need to install reverse osmosis systems in their homes, which may cost $35 to $60 per month per user. For a municipality, the cost of a reverse osmosis system is likely to cost $2 to 3 million, plus maintenance costs (Lower Elkhorn Natural Resources District, 2023).

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.

   Nebraska continues to see an increase in nitrate contamination in the groundwater. This project is to focus on the fertilizer timing and application practices used to grow crops in the state. The study looks at nitrate movement through the root zone that is headed to the groundwater supply that 85% of Nebraska's residents get their drinking water from. The study also looks at fertilizer application timing which would be a benefit to Nebraska's producers to indicate more efficient application methods that get the nitrate to the crop when it needs it and less loss to the environment. The agriculture industry will benefit from the lessons learned from this project on the efficient application of nitrogen and the reduced harm to drinking water supplies. Water managers will benefit from this work because they will be able to apply the best available science to support future management decisions. Water managers want to avoid enacting overly stringent nutrient management strategies, which may adversely affect crop production and negatively impacting the income of local producers. Conversely, if the necessary steps are not taken, and nitrate concentrations in groundwater continue to increase, local well owners may need to install reverse osmosis

systems in their homes, which may cost $35 to $60 per month per user. For a municipality, the cost of a reverse osmosis system is likely to cost $2 to 3 million, plus maintenance costs (Lower Elkhorn Natural Resources District, 2023). The additional water treatment is particularly important because of recent research that suggests a linkage between nitrate in groundwater and certain types of pediatric cancer (Ouattara, 2022). This project will benefit the 268,383 area residents of the LLNRD, CPNRD, and UBBNRD who rely on safe, clean drinking water to meet their everyday needs.

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 total cost of the proposed project is $1,316,000 of which the LLNRD, CPNRD, and UBBNRD are requesting $631,200 in funds from the Water Sustainability Fund. From the perspective of an individual NRD, the funding from the USGS and this grant would provide a nine-fold return on their initial investment. The collaboration of multiple agencies provides the most benefit to financial investment. There are no construction, O/M, or land/water acquisition costs. This important research examines how current agricultural practices affect Nebraska's water quality and seeks to improve understanding of nitrogen movement in these NRDs, which together encompass approximately 3.5 million irrigated acres - over one-third of the state's total irrigated land. The benefits of this project are to provide the needed background information to develop cost-effective solutions to manage fertilizer use and help reduce nitrate concentrations in groundwater. The LLNRD, CPNRD, and UBBNRD want to base their future management decisions using the best available science. Water managers want to avoid enacting overly stringent nutrient management strategies, which may adversely affect crop production and negatively impacting the income of local producers. Conversely, if the necessary steps are not taken, and nitrate concentrations in groundwater continue to increase, local well owners may need to install reverse osmosis systems in their homes, which may cost $35 to $60 per month per user. For a municipality, the cost of a reverse osmosis system is likely to cost $2 to 3 million, plus maintenance costs (Lower Elkhorn Natural Resources District, 2023). The additional water treatment is particularly important because of recent research that suggests a linkage between nitrate in groundwater and certain types of pediatric cancer (Ouattara, 2022). This project will benefit the 268,383 area residents who rely on safe, clean drinking water to meet their everyday needs.

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.

The proposed project will assist the LLNRD, CPNRD, and UBBNRD in managing their groundwater supplies for sustainable domestic, agricultural, municipal, and industrial uses. The responsibility for ensuring safe drinking water is divided among the U.S. EPA, states, tribes, water systems, and the public. Additionally, we interpret the Nebraska Title 118 policy as applicable to "interstate compacts, decrees, or other state contracts or agreements or federal law." As stated in Nebraska Title 118-Ground Water Quality Standards and Use Classifications, "It is the public policy of the State of Nebraska to protect and improve the quality of ground water for human consumption; agriculture, industry and other productive, beneficial uses…". Nebraska Title 118 also defines the maximum contaminant levels for specific constituents in drinking water supplies. Additionally, NRDs monitor nitrate and other contaminants in groundwater within their districts to determine the impact of agriculture on groundwater quality. NRDs have the authority to regulate fertilizer application when nitrate concentrations exceed set thresholds to drinking water quality. Nitrate concentrations in groundwater in Water Quality Management areas of the LLNRD, CPNRD, and UBBNRD often exceed the Environmental Protection Agency Maximum Contaminant Level of 10 milligrams per liter (U.S. Environmental Protection Agency, 2018). The LLNRD, CPNRD, and UBBNRD have management objectives and nitrate thresholds in place through their Groundwater Management Plans; however, the LLNRD, CPNRD, and UBBNRD do not have enough information on how different fertilizer application practices affect groundwater quality to support any potential future regulations. The proposed project will seek to reduce this deficiency through repeated soil coring across multiple growing seasons to estimate the loss of nitrate below the root zone for different fertilizer application practices. The lessons learned from this project will guide future management decisions aimed at reducing nitrate concentrations in groundwater.

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.

Water security and public health and safety for Nebraskans is directly tied to clean and sustainable groundwater resources. About 85% of the state's population uses groundwater as drinking water. However, decades of crop production have allowed fertilizers and some agricultural chemicals to reach groundwater. The proposed project will benefit public security, health, and safety by informing water managers the effects of different fertilizer application practices on groundwater quality. Traditionally, many producers would apply commercial anhydrous ammonia fertilizer or animal manure to crop fields in late fall for the following growing season. Applying fertilizer the previous fall can be advantageous to a lot of producers as it would ensure adequate time for nitrification or mineralization of nitrogen and commercial fertilizers are often less expensive in the fall. The downside to this practice is that the nitrogen is on cropland for 6 months prior to when the crop needs it for plant growth. Over this 6-month window the nitrogen is subject to potential leaching below the root zone, adversely affecting groundwater quality. Critical infrastructure for public water supply systems in many areas of the LLNRD, CPNRD, and UBBNRD are threatened by elevated nitrate concentrations in groundwater. Wise water management decisions which protect drinking water supplies will preclude the need for more costly water treatment. If nitrate concentrations in groundwater continue to increase, local well owners may need to install reverse osmosis systems in their homes, which may cost $35 to $60 per month per user. For a municipality, the cost of a reverse osmosis system is likely to cost $2 to 3 million, plus maintenance costs (Lower Elkhorn Natural Resources District, 2023). The additional water treatment is particularly important because of recent research that suggests a linkage between nitrate in groundwater and certain types of pediatric cancer (Ouattara, 2022). Protecting this infrastructure is critical to Nebraska because the cost of installing reverse osmosis treatment systems is enormous and would likely incur significant financial burdens on small communities with limited tax base. In addition to local water treatment costs the Platte River is an important stream reach that provides nearly 100 percent of drinking-water supplies to Lincoln, Nebraska, 40 to 60 percent of drinking-water supplies to Omaha, Nebr. High-nitrate groundwater discharging into the Platte River can increase surface and groundwater nitrate concentrations downstream, potentially impacting these water supplies.

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.

Nebraska's multibillion-dollar rural economy is heavily dependent on the production of corn and soybeans, which often require the use of fertilizer to sustain yields. Fertilizer application rates that exceed in-season crop demands can result in leaching of nitrate into the shallow groundwater. This project focuses determining the groundwater quality effects of different fertilizer application practices. The LLNRD, CPNRD, and UBBNRD are actively managing groundwater quality to reduce the amount of nitrate entering the groundwater system. Specifically, the LLNRD, CPNRD, and UBBNRD are considering adopting rules that would prohibit fall application of fertilizer and encourage timing the application of fertilizer in the growing season when crops need additional nitrogen to support growth and improve yields. The in-season application of fertilizer is a best management practice referred to as side-dress fertilizer application and can improve nitrogen uptake efficiency and reduce the losses to leaching to the groundwater system. The LLNRD, CPNRD, and UBBNRD would like to determine the loss of nitrogen to leaching from three different fertilizer application practices including traditional fall fertilizer application, side-dress fertilizer application, and fall manure application (or other application practice). Determining the leaching losses for each land fertilizer application practice will provide the information needed to evaluate proposed regulations which are aimed at improving groundwater quality. The outcomes of this study will inform decisions made by the on groundwater-quality management areas in LLNRD, CPNRD, and UBBNRD. This area includes about 268,383 people who rely on a clean drinking water source. Groundwater within the study area discharges to the Platte River, its tributaries, or to the Big Blue River. Groundwater with high nitrate concentrations may adversely affect the water quality of the alluvial aquifer downstream where the Metropolitan Utility District (MUD) Platte West and City of Lincoln wellfields are located. The information gained from this project will help improve the water-quality for nearly 800,000 Nebraskans. Other solutions to this issue is to provide funds for local well owners to install reverse osmosis systems in their homes, which may cost $35 to $60 per month per user. Or for a municipality, the cost for a reverse osmosis system is likely to cost $2 to 3 million, plus maintenance costs (Lower Elkhorn Natural Resources District, 2023).

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.

The LLNRD, CPNRD, and UBBNRD have allocated funds for this study. Letters of support from the supporting jurisdictions are provided in Appendix A. The table below lists the 2023-2024 property tax levies, valuations, and sources of revenue for the LLNRD, CPNRD, and UBBNRD (Nebraska Auditor of Public Accounts https://www.nebraska.gov/auditor/reports/index.cgi?budget=1- accessed March 6, 2025). The USGS is providing $264,000 in cooperative matching funds contributed to this project.

Natural Resources District	Tax Levy (per $100 valuation)*	Valuation 2023-24	Total Resources Available*	Local match for proposed project
Central Platte	2.338	$ 20,642,169,013	$ 26,829,482	$105,200
Lower Loup	3.6169	$ 18,067,263,121	$19,886,527	$210,400
Upper Big Blue	2.1098	$ 16,524,839,091	$9,195,844	$105,200

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 addresses the concerns of the LLNRD, CPNRD, and UBBNRD with regards to groundwater sustainability and groundwater quality. The LLNRD, CPNRD, and UBBNRD have the authority under the Nebraska Groundwater Management and Protection Act, Chapter 46 Article 7 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. Nebraska State Statute Chapter 2 Article 32 gives the NRDs authority to carry out projects related to the development,

management, utilization and conservation of groundwater and surface water. About 85% of the state's population uses groundwater as a drinking water source and nitrate concentrations have continued to increase since the widespread use of commercially applied anhydrous fertilizer. Fertilizer application rates that exceed in-season crop demands can result in nitrate leaching which can adversely affect groundwater quality and human health. To support future management actions the LLNRD began a pilot project with the USGS in 2023 to examine how fertilizer application practices affect groundwater quality in Platte, Nance, and Boone Counties. Preliminary results from the first year of study indicated that traditional fall applied anhydrous fertilizer and fall applied manure resulted in more nitrate leaching compared to in-season fertilizer application. The study also indicated infiltration rates in upland soils that approached nearly 1 inch per day during the growing season. Water managers with the LLNRD, CPNRD, and UBBNRD wish to use a similar study approach to target specific areas to support potential future management decisions that are aimed at improving groundwater quality for approximately 268,383 area residents.

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.

The proposed project will address the statewide problem of high nitrate in groundwater in Nebraska, which is the drinking water source for approximately 85% of its residents. Similar to many areas across the state, the nitrate concentration of groundwater in groundwater-quality management areas within LLNRD, CPNRD, UBBNRD often exceed the Environmental Protection Agency Maximum Contaminant Level of 10 milligrams per liter (U.S. Environmental Protection Agency, 2018). The LLNRD, CPNRD, UBBNRD are actively managing groundwater quality to reduce the amount of nitrate entering the groundwater system for the 268,383 people within the study area. Specifically, the LLNRD, CPNRD, UBBNRD would like to determine the loss of nitrogen to leaching from three different fertilizer application practices including traditional fall fertilizer application, side-dress fertilizer application, and fall manure application (or other application practice). Determining the leaching losses for each land fertilizer application practice will provide the information needed to evaluate proposed management actions which are aimed at improving groundwater quality. This project will benefit the 268,383 residents who rely on safe, clean drinking water to meet their everyday needs. Nearly all 23 NRDs across the state have areas high nitrate areas they actively manage to improve groundwater quality. The methods used in this study may be applied to other areas of Nebraska experiencing similar groundwater quality problems. The results, data,

and lessons learned from this study will be shared with the Department of Environment and Energy, researchers at the University of Nebraska, other NRDs, and water managers at meetings and conferences.

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 total cost of the proposed project is $1,316,000. Additionally, the USGS is providing $264,000 in cooperative matching funds to offset some of their planned costs. The LLNRD, CPNRD, and UBBNRD are providing a total of $420,800 for 40% local match. The remaining 60% ($631,200) would be funded through this grant application by the WSF. Please refer to budget table below and letters of support (Appendix A) for reference. The LLNRD, CPNRD, UBBNRD, and the USGS have indicated firm support for the project and have set aside the dollar amounts indicated below in their operating budgets.

	FY26	FY27	FY28	FY29	TOTAL
TOTAL					$1,316,000
WSF	$72,192	$163,620	$163,620	$231,768	$631,200
LLNRD	$24,064	$54,540	$54,540	$77,256	$210,400
CPNRD	$12,032	$27,270	$27,270	$38,628	$105,200
UBBNRD	$12,032	$27,270	$27,270	$38,628	$105,200
USGS match	$31,680	$68,640	$68,640	$95,040	$264,000

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.

The project will provide information that can be used to analyze the effectiveness of modern nitrate management strategies and minimize future nitrate contamination of the aquifer. Sustainable groundwater is a significant component of watershed system health and function. The project will provide information that can be used to evaluated modern nitrate management strategies and potentially implement more effective strategies to maintain and improve the health of the

aquifer. Groundwater aquifer boundaries do not always align with surface water boundaries. The watersheds that the LLNRD, CPNRD, and UBBNRD help manage will be affected by this project as well as the potential for other watersheds that are impacted by the discharge of groundwater to a stream or spring downgradient of the recharge areas of the study area. The Platte River is an important stream reach that provides nearly 100 percent of drinking-water supplies to Lincoln, Nebraska, 40 to 60 percent of drinking-water supplies to Omaha, Nebr. Groundwater flow with high nitrate discharging into the Platte River can caused increased surface and groundwater nitrate concentrations downstream impacting these water supplies. Similarly, the Big Blue River and the surrounding alluvial aquifer are regionally important water sources for residents of Nebraska.

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.

This project addresses the needs stated in Goal 5 in the 2024 Nebraska DNR Annual Report (Nebraska Department of Natural Resources, 2025) which states "Protect existing water uses through collaborative investments in water resource projects, planning, administration and permitting of surface water rights, and the registration of groundwater wells". The managers from the LLNRD, CPNRD, and UBBNRD have identified a need for more information to make water-management decisions on the best available science to sustain drinking water supplies for the residents of the LLNRD, CPNRD, and UBBNRD. The project will protect existing water uses, in this case drinking water, by informing water managers the impact of different fertilizer application practices on groundwater quality. Determining the leaching losses for each land fertilizer application practice will provide the information needed to evaluate proposed management actions, which would be aimed at improving groundwater quality. The proposed project also supports Goal 1 which "Establish strong state leadership, involvement, and support for science-based decision making that is necessary to sustain state and local water management outcomes." The proposed project will provide water managers from the LLNRD, CPNRD, and UBBNRD with necessary information to support science-based decision making to ensure the residents of LLNRD, CPNRD, and UBBNRD have adequate drinking water supplies in the future.

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.

The Safe Drinking Water Act of 1947 (SDWA; Pub.L.93-523 88 Stat. 1660 42 U.S.C. §300) was created for the protection of groundwater resources from contaminants. The federal mandate also identifies and quantifies the acceptable levels of contaminants in public water supplies. Public water suppliers are required to provide drinking water that meets various federal standards or Maximum Contaminant Levels (MCLs), including nitrate. The SDWA also discusses the designation of a sole source aquifer (section 1427) and the establishment of wellhead protection areas (section 1428). The proposed project will enable managers from the LLNRD, CPNRD, and UBBNRD understand the influence of different fertilizer application practices on groundwater quality. Determining the leaching losses for each land fertilizer application practice will provide the information needed to evaluate management actions aimed at improving groundwater quality. The information gathered from this proposed project will help communities meet the standards established by the SDWA. The project would provide the LLNRD, CPNRD, and UBBNRD with additional information to promote agricultural best management practices in these areas to minimize the occurrence and likelihood of nitrate contamination of groundwater supplies.

Appendix A: Project Partner Support Letters

Appendix B: Supplemental information (project map and references cited)

STUDY AREA MAP(S)

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