NEBRASKA NATURAL RESOURCES COMMISSION

Water Sustainability Fund

Application for Funding

Section A.

ADMINISTRATIVE

PROJECT NAME: Nemaha Natural Resources District (NNRD) Airborne Electromagnetic (AEM) Mapping

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

Sponsor Business Name: Nemaha Natural Resources District (NNRD)

Sponsor Contact's Name: Chuck Wingert

Sponsor Contact's Address: 62161 US Hwy 136 Tecumseh, NE 68450

Sponsor Contact's Phone: (402) 335-3325

Sponsor Contact's Email: cwingert@nemahanrd.org

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

   Grant amount requested. $ 190,020.00

   - If requesting less than 60% cost share, what %?

   If a loan is requested amount requested. $

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

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.
- What is the population served by your project?
- Provide a demonstration of need.
- **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:

The NNRD does not have Co-sponsors planned for this project.

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

This Project will be planned in accordance with other AEM projects planned in the region of Middle Republican (WSF #5315) to improve efficiency and gain economy of scale just as the NNRD's previous 2020 AEM flight project (WSF #5255) was coordinated with the Papio-Missouri River NRD (WSF #5238) and Middle Republican (WSF#5249) surveys which minimized mobilization/de-mobilization and logistical costs for the data collection and allowed for additional bonus flight lines for each NRD involved. The NNRD and ENWRA are aware of the neighboring Lower Big Blue NRD's AEM survey application to WSF. If both NRD projects were funded, the combined cost savings would benefit both survey projects with potential bonus line-miles as well as map potentially connected aquifer systems important to ENWRA's regional hydrogeologic assessment.

The NNRD is the lead agency for this proposed Project and this application to the WSF. The planning and coordination of all flights, data collection, processing, interpretation, and data products for this project will be done using a single geophysical consulting firm (please refer to Attachment 1 – Proposal Letter). The use of a single Consultant allows the NNRD to share the overhead costs of mobilization and de-mobilization of the data collection equipment, as well as creating efficiency and consistency in data processing and reporting. Please refer to Attachment 2 for the NNRD funding plans and Attachment 5 letter of support.

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 cost of the entire Project is estimated at $316,700.00 (see Attachment 1 Proposal Letter). NNRD is requesting $190,020.00 from the WSF and has budgeted for the required 40% local match funds ($126,680.00) through the NRD's annual budget process. The project will not be implemented as planned if the grant application is not awarded, however; the NNRD will continue to pursue additional AEM flights through ENWRA and any other funding opportunities that might arise. Please refer to Attachment 2 for the NNRD's planned funding (fiscal budget).

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!

Approximately 1,400 miles of airborne electromagnetic (AEM) geophysical data have been collected throughout the NNRD since 2007. The multiple surveys were conducted with

three different AEM systems and different entities performing the data interpretations including the CSD, USGS, XRI Geophysics, and AGF with oversight from the NNRD and coordination through the Eastern Nebraska Water Resources Assessment (ENWRA). The most recent 2020 AEM surveys (WSF #5255) extended the existing 1-mile AEM survey grid coverage from 2018 (WSF #5189) toward the west completing the mapping coverage for a large portion of the paleovalley aquifer system which is a major groundwater resource for the NNRD. However, several potential areas with coarse aquifer material beyond the current survey footprints were identified that require additional mapping. Areas identified in the 2020 AEM mapping (WSF # 5255) work performed by consultants for the NNRD and work from CSD have indicated a potential for additional aquifers in the unmapped areas of the NNRD. The existing 1-mile grid will be filled in generally south and east of Tecumseh and extended eastward to connect the 2018 flight grid with the 2018 Shubert block survey. Additional separate half to 1-mile spaced flight paths are also planned along the Little Nemaha River. The highly channelized deposits in the area require detailed mapping due to the limited spatial extent of the aquifer materials. The AEM mapping proposed under this project will total approximately 312 line miles of survey work and will include data processing and reporting using supplemental available borehole data similar to the 2018 and 2020 previous survey project scopes. However, the final report deliverables will include more comprehensive datasets bringing all the information from previous years together into one seamless package using the same parameters. This will provide additional information of the geographic distribution of groundwater in storage, recharge areas, susceptibility to groundwater contamination, and hydrologic connection to the streams in the newly mapped areas and complete the coverage of important aquifer areas of the NNRD with AEM. This Project seeks funding to collect additional AEM data in the NNRD and interpret the results into a comprehensive three-dimensional framework with datasets made available on the Nebraska GeoCloud (WSF#4164). Detailed information collected from AEM combined with traditional hydrogeologic information that is incorporated into an aquifer framework provides a better understanding of the physical extents and potential interactions of the local and regional aquifers and surface waters. The collection of hydrogeologic data, and assembly of that data into an overall aquifer framework, provides the information necessary to help determine recharge characteristics, aquifer extents, volume of available groundwater, interconnection with other aquifers, and stream-aquifer interactions. AEM, along with interpretation of the collected data, provides highly detailed information about the materials within the aquifer as well as the materials above, below, and adjacent to the aquifer.

7. **Project Tasks and Timeline**

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

- What activities (Tasks) are to be completed.
- An estimate of each Tasks expenditures/cost per year.
- Activities in years 4 through project completion under a single column.

Funding Sources	FY23 (30% by March 1, 2023)	FY24 (Next 50% after July 1, 2023)	FY24 or FY25 (Last 20% around one year after flights)	Total
NNRD NRD (40%)	$38,004.00	$63,340.00	$25,336.00	$126,680.00
WSF reimbursements (60%)	$57,006.00	$95,010.00	$38,004.00	$190,020.00
Total Project Cost	**$95,010.00**	**$158,350.00**	**$63,340.00**	**$316,700.00**

The Project will map flight transects and grids across the portions of the NNRD producing approximately 312 miles of Airborne Electromagnetic (AEM) survey to extend and supplement the hydrogeologic framework previously developed:

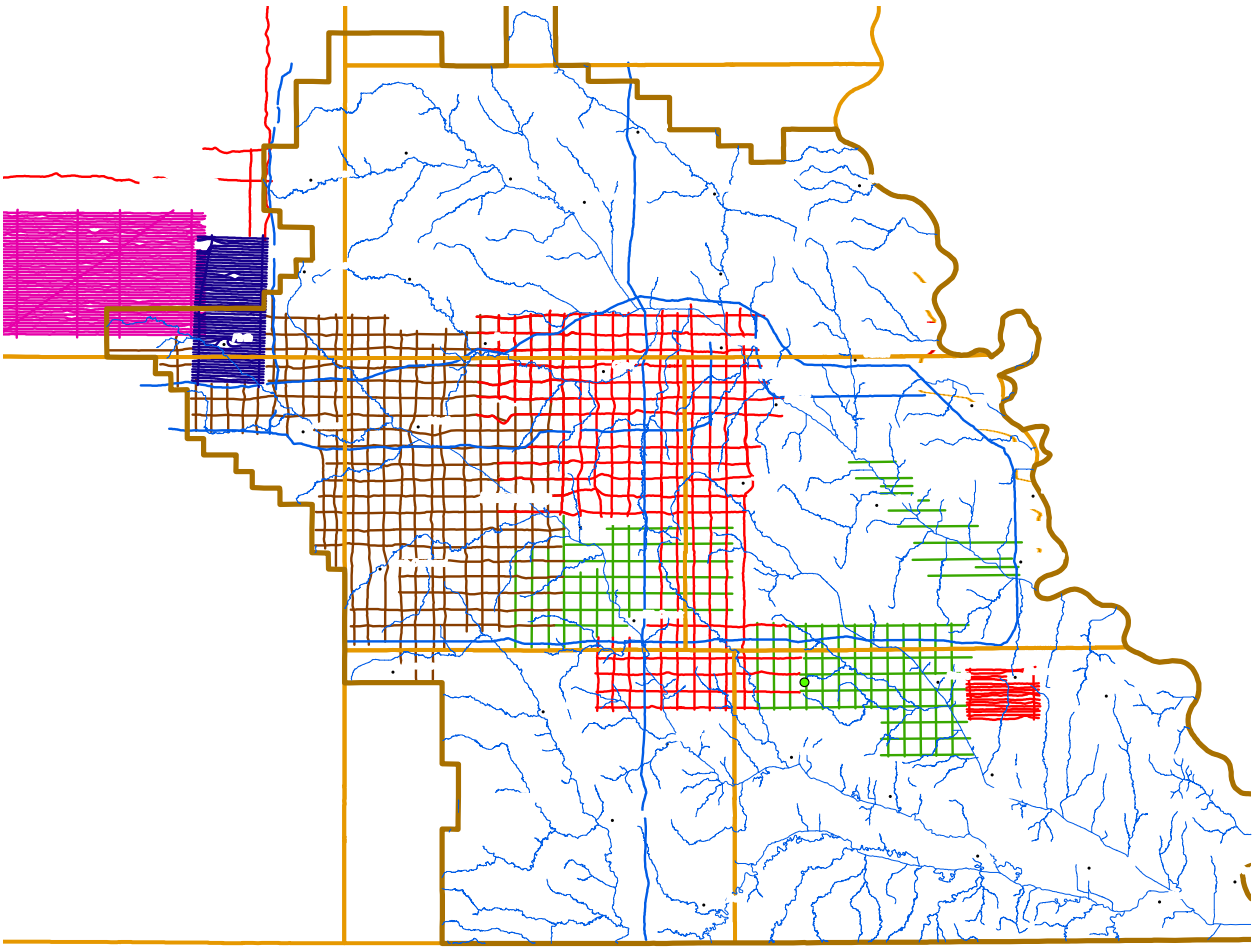

Figure Map of the NNRD and the previous and proposed AEM flight lines: 2007 Dark Blue; 2009 Pink; 2015 Blue; 2018 Red; 2020 Brown; and proposed 2023 Green.

The Project activities managed by the Consultant will consist of the planning of flight lines, contracting with a geophysical equipment vendor, collection of AEM data along the flight lines, processing and quality assurance/quality control of the raw AEM data, interpretation

of the processed data, and reporting of the overall results for the NNRD. The deliverables will include a digital Adobe pdf report with color appendices depicting individual flight lines in profile view, maps of the aquifer(s), and maps of potential recharge areas for the NNRD. Digital datasets and metadata files produced/incorporated into the survey will also be provided for upload to the Nebraska GeoCloud (WSF Award #4164). Upon notice of award of the WSF grant, the NNRD will contract with the Consultant to refine the proposed flight lines (see Attachment 1 – Proposal Letter). Payment of $95,010.00 or 30% of the total contract amount will be due at the time of contract signing (anticipated around January 1, 2023). The Consultant, working with NNRD, will develop the final flight lines, maximizing the coverage area while avoiding infrastructure (powerlines, pipelines, etc.) that creates ground interference. Data collection and processing will occur in the NNRD fiscal year 2023 (between July 1, 2023 and December 31, 2023). Payment of $158,350.00 (50% of the total contract amount) will come due on or around the last day of the flight campaign. The report will be completed and will be available in approximately one year from the end of the data collection event (NNRD FY2024 or 2025, depending on the NNRD's approved fiscal budgeting plans). The remaining 20% of the total contract amount, or $63,340.00, will be paid out to the Consultant as the individual deliverable and associated digital datasets are completed. Review and use of the data will continue in future years beyond the Project timeline by CSD, United States Geological Survey (USGS), Nebraska Department of Environment and Energy Quality (NDEE), ENWRA, Nebraska Department of Natural Resources (NDNR) and the NNRD.

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;

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

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

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

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

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

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

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

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).

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

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

Airborne Electromagnetics (AEM) utilizes a helicopter to carry transmitting and receiving geophysical equipment along a predetermined flight path. AEM systems remotely and inductively sense the electrical resistivity of the subsurface geologic materials which is then used to interpret the types of subsurface materials that are in place such as clay, silt, sand, or gravel. Electrical resistivity is a measure of how well or poorly the subsurface materials resist the flow of an electrical current. Electrical resistivity when used in conjunction with borehole information can be correlated with the type of subsurface materials such as gravel, sand, silt, and clay at specific depths below land surface. Resistive materials are typically sand and gravel where less resistive materials typically are silt and clay. This provides a nearly continuous set of subsurface information along the flight lines producing a virtual borehole approximately every 50-75 feet. Due to the aquifer depths and variability of overlying material, Time-Domain Electromagnetics (TDEM) AEM has become the standard for large scale remote sensing of aquifer characteristics in Nebraska. TDEM AEM has been successfully implemented in much of Nebraska with extensive flights across the eastern portion of the state (over 25,000 miles). ENWRA, NDNR, and CSD assisted the local Natural Resources Districts (NRDs) with the funding, data collection, and interpretation as well as test hole drilling to ground truth the interpretations. The results of the AEM projects have also been used by the ENWRA NRDs, CSD and others to better plan and site new test hole and well locations in more specific, targeted aquifer units saving costs associated with blind drilling in less useful locations.

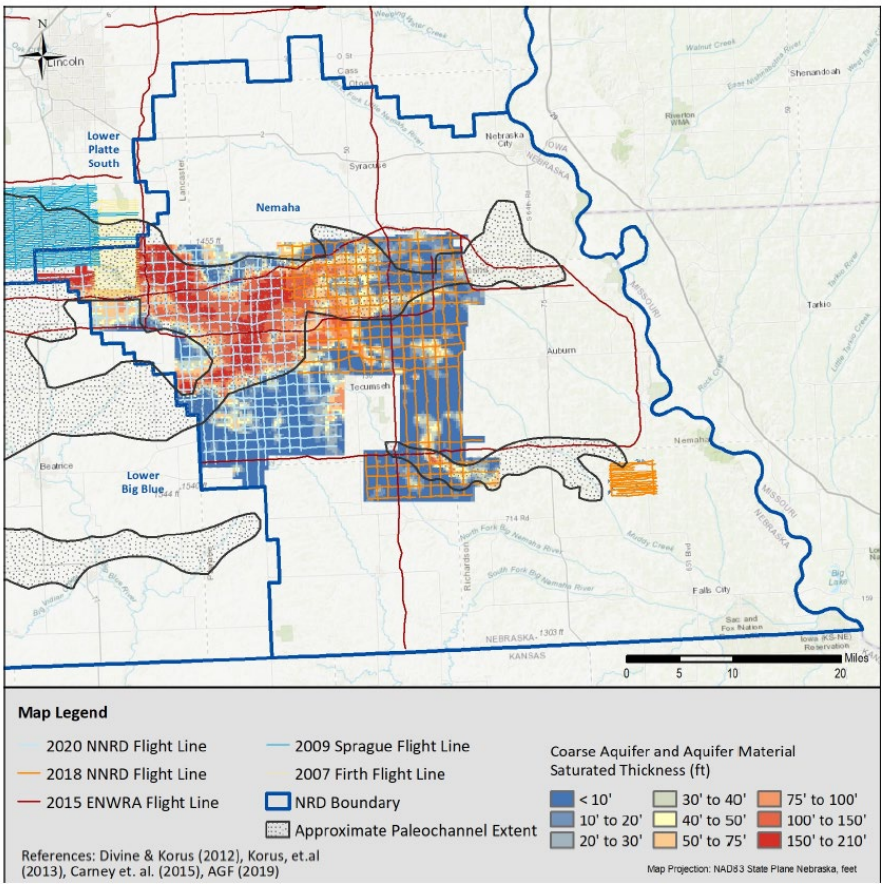

Figure ES-1 (left). Map of the historical AEM data collected in the NNRD with the saturated 2020 and 2018 Coarse Aquifer and Aquifer Material thickness.

Concerns over groundwater quantity in areas of the NNRD not previously flown requires additional data collection and interpretation of AEM flights (Project). The NNRD AEM data was instrumental in the identification and ranking of locations that would provide the greatest groundwater supply. The previous work and work done as part of this Project will be utilized by the NNRD to update the District's Groundwater Management Plan (GWMP) rules and regulations and IMP.

Please refer to http://enwra.org/ website tabs: "about", "projects", "media downloads", and "AEM" (several tabs) for background on the technology and methods the NRDs have expended to get to the level of this Project request.

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

The specific plan developed for this Project is based on previous Airborne Electromagnetic (AEM) geophysical surveys flown by the NNRD and Eastern Nebraska Water Resources Assessment (ENWRA) group, a coalition of six Natural Resources Districts (NRDs) partnered with federal, state and local agencies and experts to develop a three-dimensional geologic framework and water budget for eastern Nebraska. Please refer to the http://enwra.org/ website **2020 AEM** tab for the most recent survey results for the NNRD and a history of airborne applications in this glaciated region of Nebraska. Please also refer to the following Attachments relative to the plan of development specific to this Project: Attachment 1 - Consultant proposal letter, Attachment 3 - Map depicting the planned flight lines, Attachment 4 - ENWRA's Long Range Plan (LRP) Mapping Objectives for regional context.

If funded, the NNRD would hire a geophysical Consultant for the following services:

1) Review the proposed flight line locations and adjust them as needed to minimize interference from power lines and other infrastructure. Preliminary flight line locations, spacing and distances have been estimated for the Project area. (see Attachment 3 – AEM Flight Paths.)
2) Selection of the appropriate AEM method, equipment, subcontractors and schedule and contract with the appropriate geophysical vendor
3) Oversee and coordinate the survey activities
4) Collect and quality check the airborne data
5) Process, analyze and interpret the data
6) Gather and georeference all existing geologic data near the flight lines
7) Interpret the data into a final report including the integration of the 2007-2020 AEM flights (http://enwra.org/) in the NNRD. Included with the final report are Google Earth files that can be readily shared with interested parties to assist landowners, well drillers, and local agencies with decisions regarding groundwater resources.
8) Final data will be uploaded to the Nebraska GeoCloud

The resulting datasets will be used by the NNRD for insight on groundwater management concerns specific to their District, such as: potential re-evaluation of

management area boundaries/rules, positioning network monitoring/observation well locations and/or screen intervals, evaluation of recharge areas, updates and/or refinements to areas of hydrologically connected groundwater and surface water, and groundwater modeling projects in progress/planned. Additionally, results will be provided to ENWRA, the Nebraska GeoCloud Project, CSD, USGS, NDEE, NDNR and the general public for collaboration and shared use of the best available comprehensive hydrogeologic framework data for the area. The AEM data is considered long term "legacy" data such as borehole records are in the NDNR and CSD databases. It can be used well into the future due to its unique nature and validation of its metadata including the following datasets: raw data, inversion data and interpretation.

It is important to note that Project work related to 80% of the $190,020 total asking from WSF for this Project will be completed by the end of the flight campaign ($152,016 in state dollars spent by fall 2023-time frame). The Project will provide the extension of the one mile hydrogeologic framework grid in the District and coverage of several potential areas with coarse aquifer material beyond the current AEM survey footprints as well as areas within the Little Nemaha River valley (Section 4.2 https://www.nemahanrd.org/sites/default/files/may2022_nnrd_final_imp.pdf) which includes the municipal wellfield of Nemaha, as well as the drinking water supply wells of Rural Water District #1 and City Auburn (https://water.unl.edu/article/drinking-water-wells/proactive-drinking-water-management-unique-water-system) Please refer to Attachment 3 – Proposed Flight Lines for a map of the approximate 312 miles of anticipated flights.

Accomplishment of this Project will fill in most grid gaps left for the NNRD as well as provide a greater understanding for re-delineating several public water supplier's Wellhead Protection Areas (WHPAs). The accomplishment of this Project will greatly enhance the management and sustainability of groundwater resources for the Nemaha basin.

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

NNRD started research activities through its participation with ENWRA in 2007 with three pilot study sites: Oakland, Ashland and Firth (the southern half of the Firth block is in the NNRD) employing a variety of assessment tools including AEM. This was the first of its kind to be used in Nebraska (see http://enwra.org/ website for the history of airborne applications and results). AEM has been proven over the past 15 years to be a crucial, non-invasive method in acquiring large amounts of detailed hydrogeologic information in a relatively short amount of time and in a cost-effective manner for the amount of area covered. Additionally, Nebraska has become one of the leaders in coordinated use of AEM for groundwater management purposes with over 25,000 line miles flown in approximately 15 of Nebraska's 23 NRDs (see 2007-2020 flights found at http://enwra.org/ and AEM related WSF awards: #4132, 4133, 4134, 4140, 4141, 4142, 4143, 4144, 4164, 5189, 5193, 5206, 5238, 5243, 5249, 5255, 5303, 5311, 5312, 5313, and 5315). The map included as Figure Map on page 5 Section A #7 depicts 1,400 line

miles of NNRD's 2007 to 2020 flights and approximately 312 line miles of planned AEM flights for this Project.

Please refer to http://enwra.org/ website tabs: "about", "projects", "media downloads", and "AEM" (several tabs) for background on the technology and methods the NRDs have expended to get to the level of this Project request.

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

Not applicable.

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 AEM results provided by the contractor include Google Earth layer deliverables with information dots approximately every 50-75 feet along each flight line. The dots are linked to corresponding interpreted profile image files broken into approximate 5 to 10-mile sections with legal description track maps shown at the top (see http://enwra.org/ 2020 AEM website tab for interactive NNRD flight examples). This publicly available dataset can influence future well siting for any well type for any beneficial use. As with past surveys, many private landowners have inquired to NNRD regarding AEM results on their property and are provided specific printouts of the available information to the potential resource under their land. Private landowners can use the new information to identify suitable areas to construct a domestic, livestock, or irrigation well, especially in areas where water resources are highly variable and/or limited, saving time and money in test hole drilling and other development costs. The NNRD will, and have used, the survey data to evaluate subsurface characteristics in times of groundwater well interference to better understand the impacted formations. Surveys have been used by CSD and NRDs to work with communities with public supply wells under Administrative Order (AO) from the Nebraska Department of Health and Human Services (DHHS) to evaluate siting potential for new wells. Additionally, many of the proposed flights are over local communities' WHPAs, potentially leading to future adjustments to the boundaries, siting of new public wells in better locations/depths and/or target areas most susceptible to water quality impairments. The data will also be used to help landowners and the NRD to narrow down areas where irrigation development is appropriate and help avoid well interference issues. Use of the data will also allow for selection of areas within the NRD for managed aquifer recharge projects to increase groundwater supplies and associated surface water objectives.

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.

Traditional methods of collecting hydrogeologic information are through the drilling of test holes and logging of the geologic materials found. Individual test holes provide a single point of information about the area's hydrogeology and the materials between test holes, typically over several miles, are inferred. The aquifer materials and their properties may change dramatically in as little as a few tens of feet from the individual test hole and provide limited information about the broader aquifer characteristics. While limited, test holes have been the best available method for assessing aquifer materials until the recent employment of AEM. AEM essentially provides virtual test holes along a flight path, thereby collecting a nearly continuous cross-section of the aquifer materials. This type of seamless cross-section cannot feasibly be collected through any other known method. As a generic example, it would cost around $990,000 ($10 per foot of drilling, not accounting for geologist time) to produce a typical cross section along a 10-mile line using approximately 330 test holes spaced every 160 feet (drilled to typical depths of around 300 feet). Drilling 330 test holes would certainly require months if not years of intensive effort. The AEM proposed herein will provide virtual borehole soundings about every 20 feet with x, y, z axis data lumped every 70 feet to depths around 500 feet. The $990,000 required for traditional test hole drilling and logging can be compared to a 10-mile AEM flight line at approximately $9,620 ($962/mile) as planned with this Project (based on $300,000 in survey costs without report, Attachment 1), or less than 1% of the cost of traditional methods.

In addition, the raw data for such a 10-mile AEM flight line can be collected in a matter of hours, and the processing of that data can be accomplished in a few days. For the entire proposed Project area, it would likely take decades to complete the 312 miles of cross sections through the use of test hole drilling and logging of geologic materials, compared to two years anticipated for the proposed AEM flights and reporting. In summary, using this example, the traditional test hole boring method would cost over $48 million compared with the $316,700 cost of collecting AEM 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 is the project life, up to fifty (50) years; *or*, with prior approval of the Director up to one hundred (100) years, (Title 261, CH 2 - 005).

Relevant costs will include mobilization of the geophysical equipment and helicopter, flight line planning, data collection and interpretation and the Consultant fee to produce the final report. The cost to collect the remote sensed geophysical data from a helicopter is approximately $962 per mile and the estimated life of the Project is two years. Data collection using traditional methods through test hole drilling and logging would amount to approximately $99,000 per mile and take several decades to complete 312 equivalent miles of data.

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).

Relevant costs will include mobilization of the geophysical equipment and helicopter, flight line planning, data collection and interpretation and the Consultant fee to produce the final report. Two years is the estimated life of the Project.

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 cost of the Project is $316,700 and involves desktop work and coordination with NRDs that will benefit/improve water sustainability datasets for eastern Nebraska through filling in areas within the NNRD. The Project does not include construction activities or construction-related costs (see cost/benefit table in the next Section, Section B #3.C). The primary tangible benefits of the AEM are generally the same as for test holes, i.e. data obtained is a record of what geologic materials are present below ground at different depths. However, the outcomes for this Project are enhanced by the existing CSD test holes, NDNR registered well datasets and AEM work done prior to this Project. Advancements in visualization software programs and interpretation methods are combining individual point location data together to produce highly detailed cross-sections and three-dimensional geologic frameworks. The resulting framework can be used in addressing any future hydrogeologic problem or project, and will allow all partners and the general public to be more efficient and effective in directing future groundwater-related activities and decisions.

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).

Cost Activity	**30% Down Mar. 1, 2023**	**Cost after July 1, 2023**	**Report Costs March 1, 2024**	**Cost TOTAL**	**Benefits -** potential cost of drilling 10,296 test holes 300ft deep at $10/ft and processing the data to produce aquifer boundary maps (160 ft hole spacing along 312 mi of planned flight lines)
Local Match	$38,004	$63,340	$25,336	$126,680	Test hole drilling $30,888,000.00 plus incalculable CSD/NNRD time
WSF Grant	$57,006	$95,010	$38,004	$190,020	
CSD				**In-kind**	
NNRD				**In-kind**	
TOTALS	**$95,010**	**$158,350**	**$63,340**	**$316,700**	**>$67,888,000***

*CSD commonly uses $6 per foot as an in-kind value for one geologist's time (expertise rate commonly used in grant applications additional to drilling costs) it would take over 250 years for two full time employees to complete the test hole processing/cross-section work (annual salaries of $75k, totaling over $37 Million).

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.)

This Project will collect information necessary to assist the NNRD Board with decisions regarding the conservation and protection of the groundwater resources. Those decisions may result in the establishment of elevated regulations through Groundwater Management Areas for either quantity or quality, the prioritization of Wellhead Protection Plans and other programs sponsored by the NNRD for aquifer protection. Since the program, project, or action that may result from the information is not yet known, there is not currently a method for calculating the primary tangible benefits of the Project in a quantitative way. While quantifying the benefits from the Project is not a possibility, there is an ability to discuss the overall benefits from a qualitative standpoint. The purpose of the mapping through AEM is to identify and define the relationship of the aquifer systems to one another as well as to the land surface and the surface water systems. The water available for use from an aquifer system is dependent upon the relationships among overall use, recharge, and discharge. The Project will improve the overall identification of confining layers between aquifers thereby improving the understanding of the interrelationships of use, recharge, discharge, and potential contamination threats. This improved understanding will be used to drive management decisions regarding the quantity available of various groundwater demands in the area. The conservation of the groundwater resources would be accomplished with management actions that prioritize use and limit total groundwater withdrawals as and where needed. Relationships among

groundwater use, recharge, and discharge also informs potential actions related to groundwater quality. Tailoring the locations of groundwater use decreases the potential need for expensive treatment and improves the longevity of capital investments related to water supply. Additionally, the understanding of where the groundwater resources are most susceptible from surface contaminants can be used to tailor the approaches to groundwater management activities. This greater understanding of the groundwater/surface water interaction reduces the need for additional, expensive test hole drilling by those looking to utilize the resource as well as preventing undue regulation resulting from a lack of knowledge of the resource. The Project improves the NNRDs ability to provide tailored approaches to management to ensure the long-term conservation and protection of the water resources. These tailored approaches can assist the users of the water resources with understanding their capacity for continued development and protect existing and future development. One form of benefit from this Project could be realized by the ability to avoid constructing replacement of wells impacted by the migration of high nitrates. Mapping through the AEM process will also give the NNRD a better understanding of potential cross contamination threats of multiple aquifers. Further benefits are realized from the public use of the data and enhanced management of the quality and quantity of groundwater.

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.

Natural Resources Districts (NRDs) are granted the authority to impose property tax levies to generate revenue for operational needs. The funding levies for the Nemaha NRD (NNRD) will provide sufficient funds to provide the cash contribution necessary to complete this Project (July 1, 2021 through June 30, 2022 example table listed below).

Local Sponsors	Tax Levy Cents per $100 Assessed Valuation	2021 Property Tax Revenue	2021 Valuation
Nemaha NRD ($316,700 Project)	2.7	$2,268,453.94	$7,681,237,723

(*Nebraska Auditor of Public Accounts https://www.nebraska.gov/auditor/reports/index.cgi?budget=1 accessed June 13, 2022):

Additionally, the NNRD has planned to budget matching funds for this Project in their annual fiscal year (FY) FY2023 and 2024 budgets (finalized after July 1 each year but not approved until the September board meeting). See Attachment #2 for Budget & Board Authorization.

2022-2023 (FY23) Fiscal Year Budget (Proposed)	Amount
44810 - AEM Flights	$317,000*

** Remaining FY23 funds will be deferred to FY24 to complete the proposed project*

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

The Fiscal Year 2023 Budget for NNRD displays the NRD AEM Flights account has $317,000, enough to cover the Project costs: See Attachment #2 for Budget & Board Authorization.

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

Not Applicable.

7. Describe how the plan of development minimizes impacts on the natural environment (i.e. timing vs nesting/migration, etc.).

There is no construction associated with proposed Project. The AEM survey is conducted in and out of local airports without trespass on private land beneath the flight lines, and is

conducted according to current FAA rules which minimize disturbance to property owners. The number of holes and observation wells required to define aquifer systems is decreased significantly by the AEM mapping process, thus lowering the degree of impact on the natural environment from drilling rigs and support vehicles. The areas of impact to the natural environment will be narrowed to those most beneficial for the public and the NRD rather than used as reconnaissance.

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

The NRDs have the authority 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. 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. The NRD staff members have 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.

All NRDs are statutorily required to have a completed Groundwater Management Plan (GMP) which includes information about the aquifers of the NRD, supplemental supplies, integrated and coordinated use, and the boundaries of management areas. The NNRD has an adopted GMP and results of this Project specifically meet the objectives of the GMPs to increase the NRDs' general knowledge of the hydrogeologic characteristics of the District, and to preserve and conserve groundwater quality and quality.

The NNRD also has a Voluntary Integrated Management Plan (IMP) effective May 20, 2022. The NRD staff members have local knowledge of the area and groundwater resources and access to the ENWRA advisors/partner agencies: U.S. Geological Survey (USGS), University of Nebraska School of Natural Resources Conservation and Survey Division (CSD [state geological survey]), Nebraska Department of Natural Resources (NDNR), Nebraska Department of Environment and Energy (NDEE) who have the expertise in hydrogeology and/or regulatory backgrounds. The Project aligns with the partners core missions and fills out grid coverage of the southern aquifers in the Eastern Nebraska Water Resources Assessment (ENWRA) Project region.

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.

10.B Attach proof of ownership for each easements, rights-of-way and fee title currently held.

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

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

The NNRD, as a political subdivision, has the authority to undertake the Project because the purpose of the Project relates directly to the development, management, utilization, and conservation of groundwater and surface water as designated in Nebraska State Statute Chapter 2 Article 32. Further authority of the NRDs are defined under the Nebraska Groundwater Management and Protection Act Chapter 46 Article 7, to enter into contracts or agreement, 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.

There are several positive environmental/ecological impacts provided by an improved understanding of the groundwater resources of the region. The knowledge will lead to improved management of the resources for water quality and quantity. Identifying areas of ground and surface water connection and better defining the presence, extent and volume of specific paleovalley aquifers (where the line spacing provides sufficient resolution) will likely alter the current management methods in those areas, thus promoting more sustainable, wiser use of the resources. Since all the data will be collected by air flights, no damage will occur to the ecosystems such as wetlands, nesting habitat, forest areas etc. Collecting data by traditional on ground methods like drilling can result in some impacts to the ecosystem because of equipment and vehicle use. Airborne Electromagnetic survey (AEM) dataset coverage can reduce the number of test holes required with exploratory drilling, making the Project more of an environmental/ecological benefit than a consequence.

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 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.

The District's groundwater resources are complex, complicated by past glaciation and associated till deposits. Reliable groundwater sources are difficult to obtain and are often localized small formations that provide minimal yields. The principal stream valleys

containing alluvial deposits and the bedrock valleys buried under glacial till deposits are filled with sand, gravel, and finer-grained alluvial sediments and provide moderate yields. Locally, specific layers of bedrock may also be a source of water in discrete locations, but water quality is often poor.

Past studies conducted by the Auburn Board of Public Works indicate a hydraulic connection between the alluvial aquifer where Auburn's primary municipal wells are located and the Little Nemaha River. This hydraulic connection with the alluvial aquifer appears to extend downstream within the Little Nemaha River valley and includes the municipal wellfield of the Village of Nemaha, as well as the drinking water supply wells of Nemaha County Rural Water District #1 (https://water.unl.edu/article/drinking-water-wells/proactive-drinking-water-management-unique-water-system). Unlike the High Plains Aquifer of western Nebraska where the aquifer thickness can exceed 1,000 feet, the alluvial aquifer in the Little Nemaha River valley is typically less than 50 feet thick – amplifying the alluvial aquifer's dependence on Little Nemaha River flows for maintaining a reliable groundwater supply.

The proposed Project AEM survey area includes parts of Johnson, Nemaha and Richardson Counties, including the Little Nemaha River valley near Auburn (refer to proposed AEM survey Figure in Section 1.B.2). The NNRD has monitored groundwater quantity and quality in the Project area for the past several decades as part of its current GWMP. The NDNR water well registration database indicates there are 110 irrigation wells, 100 domestic wells and 48 public water supply wells from seven communities and four rural water Districts serving over 20,000 residents within the project area. Over 11,000 in population served are listed for the Public and Rural Water Drinking Water Systems in the area footprints of the planned Project (Auburn, Elk Creek, Humboldt, Nemaha, Stella, Tecumseh, Verdon, Johnson Co RWD#1, Nemaha Co. RWD #1 &2, Richardson Co RWD#1). Annual water quality sampling of domestic and irrigation wells indicates some areas with low nitrate-nitrogen concentrations and other areas with nitrate-nitrogen concentrations at or above the Environmental Protection Agencies (EPA) maximum contaminant level (MCL) of 10 parts per million (ppm). Several of the community wells indicate routine sample results of nitrate-nitrogen in the 2 to 9 mg/L range. Potential mitigating actions which may occur as a result of the mapping study include: well head protection area boundary adjustments, deeper domestic well construction, future well construction locations or modifications, enhanced groundwater recharge information and management, and improved water quality monitoring.

Detailed information collected from AEM combined with traditional hydrogeologic information that is incorporated into an aquifer framework provides a better understanding of the physical extents and potential interactions of the local and regional aquifers and surface waters. A hydrogeologic framework includes not only the depth to the top of the aquifer and extents of the aquifer materials but also the depth to the bottom of the aquifer. An aquifer's susceptibility to surface contaminants is partially determined by the type of overlying materials and the materials percolation rate to recharge the aquifer or not. Sandier materials above an aquifer with limited clay content allow more rapid recharge, whereas thick sections of clay reduce the rate of percolation and recharge. This

information will be a product of the data collected along the flight lines. Additional sources of information about the overlying materials, such as soils maps, only include the very near surface materials. The standard soil mapping practices typically only sample the soil every 2.5 acres versus the data rich sampling done with the virtual boreholes of AEM. AEM provides information about the full sequence of material that overlays an aquifer. Greater understanding of the extents of materials that limit or transmit percolating water can provide NNRD with the ability to tailor management activities intended to protect drinking water quality. Typically, contamination from the land surface tends to remain in the uppermost portion of the aquifer system versus mixing more deeply in the aquifer. Nitrate is a good example as it tends to stratify in the upper aquifer. The mapping of shallow clay zones through AEM helps delineate zones along the flight lines protected from contaminate transport from the surface. Locating future domestic and municipal drinking water supplies in areas where these protected aquifer units exist can help with wellhead protection and limit the impacts of the downward migration of contaminants. Historically, domestic well construction occurred in the uppermost portion of the aquifer once the driller has encountered enough water bearing sands, the drilling was stopped, and the well was completed. Drilling deeper was considered an unnecessary expense however can provide a domestic well with greater longevity and reduced impact from surface contaminants. A deeper drinking water well also reduces the potential interference from nearby wells as the aquifer is drawn down during peak use periods and times of drought.

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 NNRD began development of a voluntary Integrated Management Plan (IMP) with the NDNR in 2017 and each entity adopted the finalized plan in April 2022 (https://www.nemahanrd.org/sites/default/files/may2022_nnrd_final_imp.pdf effective May 2022). The overall goals of the NNRD voluntary IMP are to attain and maintain a desired balance between uses and supplies of both surface water and groundwater sources so economic viability, as well as social and environmental health, safety, and welfare, can be achieved and maintained in the District for both the near-term and long-term, while considering effects on existing surface water appropriators and groundwater users.

This Project will address objectives and action items related to these goals by: (1) utilizing the best available data and analysis tools to understand the District's water supplies for the project areas (define hydrologically connected areas, distinct sub areas, and connections with municipal supplies), (2) use the new understandings to prevent or mitigate water-related conflicts within the District, (3) inform the public of the District's

water resources in the mapped areas in context of the remaining areas already mapped and provide data in support of a district regional numerical model.

Chapter 9 of the voluntary IMP describes the proposed controls for groundwater management and proposed controls for surface water management which apply to the entire geographic area of the Nemaha NRD, maps of which are provided in Chapter 8. The groundwater controls to be implemented by the NRD are: 1. Required metering devices on all new high-capacity (pumping greater than 50 gallons per minute) wells and/or modified irrigation wells and/or irrigation systems, commercial, industrial, or municipal water supply systems. The proposed surface water controls to be implemented by NDNR are: 1. Required measuring devices on any new high-capacity surface water irrigators; and 2. Continued enforcement of the administration of surface water controls.

In addition to developing the voluntary IMP, the NNRD has an adopted GWMP, last revised in December of 2014 (NNRD GWMP 1985). Results of this project meet the objectives of the GWMP to address specific problems of groundwater quality by identifying aquifer locations, geometries and surface water/groundwater connections supporting regulation and management decisions. Groundwater quality monitoring conducted by NNRD staff has shown the northwest portion of Richardson County and area north of Humboldt to have elevated levels of nitrates. This area has been designated a Phase II Groundwater Management Area (GWMA) for groundwater quality and requires the NNRD to conduct annual sampling of wells. Areas around Auburn and Elk Creek in the proposed project footprint are in current Phase II designations as well (Appendix A of rules and regs: https://www.nemahanrd.org/sites/default/files/groundwaterrules.pdf). The NNRD also provides cost-share incentives to landowners for closing abandoned wells, soil sampling and fertilizer control systems. The NNRD also has a hazard mitigation plan which includes Drought susceptibility assessment and maps. The areas in the project footprint are also identified in the top half of the higher vulnerability scale (https://jeo.com/sites/default/files/inline-files/13_Appendix%20E.pdf : Figure 5 and Figure 1of NNRD PWS 1:24K INSET FIGURES). This projects survey results would provide more understanding to support the quantity and quality vulnerability analyses for the project areas mapped within the district.

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.

A large portion of the surface and groundwater resource in the NNRD Project area drains directly into the Missouri River. Once in the Missouri River, it is essentially lost to

Nebraska for beneficial use. In most areas of the state, water leaving a basin still has the opportunity to be used in the next basin (https://dnr.nebraska.gov/water-planning/what-statewide-water-planning), but this is not the case for the NNRD. Cross basin benefits for the NNRD include improving the ability of groundwater professionals/agencies to delineate aquifer boundaries that may cross the Missouri-River Tributaries basin, Lower Platte River basin and/or NRD watershed boundaries. One of the primary goals/purposes of the 2014/2015 AEM recon lines was to provide a grid-like data set to compare with NDNR's numerical groundwater model work for the Lower Platte and Missouri River Tributaries (LPMRT) Assessment in eastern Nebraska. The LPMRT Assessment is one of NDNR's current Integrated Management projects and covers the surface area of Nebraska tributaries that drain into the Missouri and Lower Platte Rivers. The Eastern Nebraska NRDs are currently coordinating with the NDNR to use the AEM with the LPMRT model (LENRD WSF#5243, PMRNRD and LPNNRD #5303, LPSNRD WSF #5311). Following the completion of the LPMRT numerical model, the NDNR plans to produce another numerical model specific to the Nemaha River basin. The proposed project will fill in gaps from previous AEM surveys and add transects near Auburn, the new coverage along with existing data that has been collected (recon level transects in 2015, one-mile grid flights for the paleochannel aquifer systems in 2018 and 2020, and block level flights for Firth in 2007 and Shubert in 2018), will provide the NNRD and NDNR with additional aquifer thickness and vulnerability information within the Nemaha River basin. This more comprehensive grid and transect coverage would allow for additional model input comparison purposes, thus assisting in the NDNR's annual evaluation of basin water supplies.

The collection of hydrogeologic data, and assembly of that data into an overall aquifer framework, provides the information necessary to help determine recharge characteristics, aquifer extents, volume of available groundwater, interconnection with other aquifers, and stream-aquifer interactions. AEM, along with interpretation of the collected data, provides highly detailed information about the materials within the aquifer as well as the materials above, below, and adjacent to the aquifer. Multiple examples of the type of aquifer delineation that AEM can provide is included in the 2020 AEM survey report:
https://www.dropbox.com/s/rbyhqd30fk8vvxu/NNRD_2020_AGF_AEM_Report_15Mar2

021_v1.pdf?dl=0 and depicted on the example Figure 5-21 shown here:

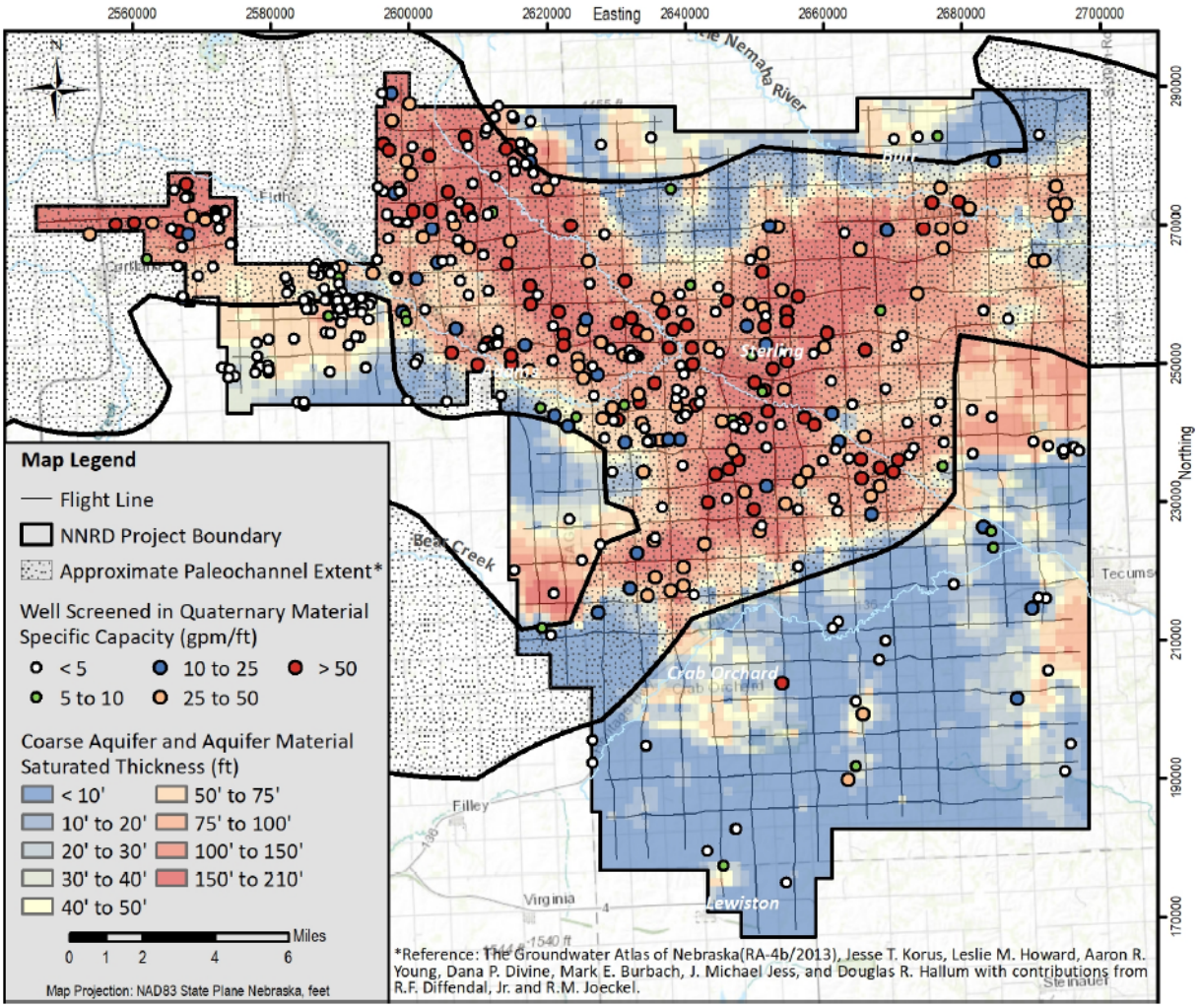

Figure 5-21. Map of the saturated thickness of Aquifer Material and Coarse Aquifer material within the 2020 NNRD AEM survey area with NE-DNR wells displaying estimated Specific Capacity. Flight lines are indicated by the black lines. The projection is NAD83 State Plane Nebraska (feet).

Aquifer recharge is determined by the water available from precipitation for deep percolation after taking into account runoff, evapotranspiration, soil characteristics, and other factors. Recharge is also impacted by the materials that overlay the aquifer which influence the way in which the deeply percolating water reaches the aquifer. Generally speaking, the sandier the materials that overlay the aquifer, the faster the recharge will be, while more clay rich materials will tend to slow the recharge. AEM can be utilized to improve the NNRD's understanding of recharge potential by delineating the layers of material types overlying an aquifer. Recharge potential can then be utilized by NRDs to better assess projects designed to increase recharge as well as inform NRDs' management of preferred development zones in areas where recharge is higher. Preferred development areas can be used to tailor development of additional uses of groundwater to those areas where recharge more readily replenishes withdrawals, where aquifer thickness is greatest, where effects from aquifer extents are reduced, or where

well impacts to streams are minimized. This Project will also benefit the combined efforts to map regional recharge (ENWRA WSF #5312) which includes the Dorchester Sterling Paleochannel system (outline on Fig 5-21, just north of the proposed flight lines but potentially in connection) as a focus area for both horizontal and vertical recharge study which extends west from the Nemaha basin into parts of the neighboring Lower Platte and Blue basins.

Management decisions for GWMAs would seek to balance the needs for groundwater development with the existing uses of groundwater in an area. A more complete framework of the hydrogeology will improve the NNRD's ability to make those management decisions and improve the sustainability of the overall water resources in the AEM project areas. Potential management decisions to utilize allocations, water use, rotation, limits on development, well spacing requirements, or other groundwater controls as part of a GWMP or IMP can be updated to protect existing users and promote sustainable use of the water resources with the project results for the proposed mapping 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.

Conservation and preservation of water resources for the beneficial use of the residents of the state requires detailed information about the aquifer characteristics and interactions of the groundwater and surface water resources. Sound strategies for conservation and preservation in this area, whether it be through management actions, programs, or projects, depends on that detailed information to understand the distribution of available groundwater and associated water quality. AEM data collection in the project area will not only benefit residents of southeast Nebraska in Johnson, Nemaha and Richardson Counties but also provide invaluable amount of data for current and future studies to better manage and conserve water resources. AEM surveys have greatly advanced groundwater management efforts by providing cost-effective, high-resolution subsurface information that has revolutionized aquifer mapping in Nebraska. In the last 15 years, taxpayers have invested over $10 million on 25,000 line-miles of AEM collected by different consultants and sponsors using different survey methods, software, and analytical approaches. The Nebraska GeoCloud, a state-wide internet storage network designed specifically for AEM data, in order to permit seamless data integration and sharing of results between collaborating organizations including the CSD who manages the Nebraska GeoCloud and whose mission aligns with NRD's groundwater management goals. The AEM data from the project will be added to the Nebraska GeoCloud, making the data readily available in a standardized format to water resource managers, scientists,

and planners across the state (new tools are continually being improved to make the data more accessible in the online portal, sponsorship by 10 NRDs has been extended through 2027).

Further, the report will also include integration of the historical roughly 1,400 line-miles of AEM acquired within the NNRD from 2007-2020, making the results of previous investments more comprehensive and improving geographic coverage of the mapping benefits. Infrastructure interferes with AEM survey method so getting areas mapped prior to increased development is important. Water managers will understand the resource areas in a timely manner with the project results and potentially save agricultural, domestic, municipal and industrial users in the project area exploratory drilling costs long term.

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.

The beneficial use of Nebraska's water resources is established and prioritized in the Nebraska State Statutes with domestic use being the highest priority and agricultural and industrial use following from there. Water is considered a natural want and a correlative resource of the State. The aquifer framework developed through this AEM collection project will further the District's understanding of the aquifer systems and will be shared with other NRDs as well as other agencies including NDNR, USGS and CSD. The primary impact to beneficial use from the proposed Project is to the protection of groundwater used as a drinking water source from potential contamination. The Project will also assist the NNRD in establishing the development capability of specific aquifers and the impact future groundwater development will have on streamflow. Understanding the capacities and susceptibility of the aquifer systems will allow the NNRD to tailor it's approaches to programs, projects, and actions by the NNRD Board to provide greater protection and full value of the water resources. The need for potential GWMA area boundary updates, along with best management practices for activities that may contribute surface contaminants to the groundwater, can be readily assessed and implemented.

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.

There are no costs for construction, O/M, etc. for this Project. This project benefits from several other similar AEM related projects previously funded across the state allowing for consistency, accuracy, taking advantage of the most recent technical advancements and lessoned learned from the previous application and data sharing between entities, ultimately making the project very cost effective. Even though AEM surveys are expensive, the technology provides the equivalent of a detailed geologic cross section for every aerial line flown. Such a result can be obtained in rough form within a few hours, and after data analysis, inversion, etc., the detailed result is produced (along with three-dimensional [3D] versions, derived characteristics, etc.) within several months. Traditional methods of collecting hydrogeologic information are through the drilling of test holes and logging of the geologic materials found. Individual test holes provide a single point of information about the area's hydrogeology and the materials between test holes, typically over several miles, are inferred. The aquifer materials and their properties may change dramatically in as little as a few tens of feet from the individual test hole and provide limited information about the broader aquifer characteristics. While limited, test holes have been the best available method for assessing aquifer characteristics until the recent employment of AEM. AEM essentially provides virtual test holes along a flight path, thereby collecting a nearly continuous cross-section of the aquifer materials. This type of seamless cross-section cannot feasibly be collected through any other known method. As a generic example, it would cost around $990,000 ($10 per foot of drilling, not accounting for geologist time) to produce a typical cross section along a 10-mile line using approximately 330 test holes spaced every 160 feet (drilled to typical depths of around 300 feet). Drilling 330 test holes would certainly require months if not years of intensive effort. The AEM proposed herein will provide virtual borehole soundings about every 20 feet with x, y, z axis data lumped every 70 feet to depths around 300-500 feet. The $990,000 required for traditional test hole drilling and logging can be compared to a 10-mile AEM flight line at approximately $9,620 ($962/mile) as planned with this Project (based on $300,000 in survey costs without report, Attachment 1), or less than 1% of the cost of traditional methods. In addition, the raw data for such a 10-mile AEM flight line can be collected in a matter of hours, and the processing of that data can be accomplished in a few days. For the entire proposed Project area, it would likely take decades to complete the 312 miles of cross sections through the use of test hole drilling and logging of geologic materials, compared to two years anticipated for the proposed AEM flights and reporting. In summary, using this example, the traditional test hole boring method would cost over $30 million compared with the $316,700 cost of collecting AEM data. Additionally, there is no CSD staff/equipment available to dedicate to completing this scale of work for the region. For example, if you use a $12 per foot rate (10,296 holes about 300 feet deep) for two geologists' time (CSD commonly uses $6 per foot as an in-kind value for one geologist's time in grant applications) it would take over 250 years for two full time employees to complete the work (annual salaries of $75k, totaling about $37 Million). Further, the AEM electronic products and deliverables are conducive to incorporation into modern computing and modeling work and already include existing geologic data gathered along the flight lines as compared to manual test hole processing and conversion into electronic format for test holes. Given these points, it's apparent that collection of geologic and groundwater data through AEM will provide almost immediate payback as the data will be available in as little as two years and can be used for the

foreseeable future, while collection of such data via traditional methods would take generations, if it would even be possible at all.

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 Nemaha basin is part of the Missouri Tributaries Watershed and Federally endangered species exist within the NNRD basin which are susceptible to its health and function. By better understanding the aquifer resources, the Nemaha NRD can make responsible decisions that will reduce potential negative impacts to its local threatened and endangered species. Additionally, information gained from these surveys can benefit Nebraska's drinking water program which has 1,375 public water systems, serving most of its 1.7 million residents (Nebraska Health and Human Services [DHHS] website accessed March 2020). Water regulators and managers in compliance with the Safe Drinking Water Act, including the establishment of well-head protection areas, use CSD data for making their decisions. CSD has immediate plans to incorporate the AEM data (Ongoing County Atlas work, Recharge mapping, and Nebraska GeoCloud) into their survey and geologic data integration efforts. Also, the information provided by this Project would assist water managers/regulators with science-based information to comply with Nebraska Title 118-Ground Water Quality Standards and Use Classifications, which states "It is the public policy of the State of Nebraska to protect and improve the quality of groundwater for human consumption, agriculture, industry and other productive, beneficial uses."

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.

Information resulting from this Project will help protect critical infrastructure, primarily municipal and domestic drinking water wells which serve the communities of NNRD, with

an estimated population of 11,000 to 20,000. Public water supply systems in these areas are threatened by elevated nitrate concentrations in groundwater and water shortages due to periodic drought and aquifers with limited saturated thickness. The NDNR water well registration database indicates there are 110 irrigation wells, 100 domestic wells and 48 public water supply wells from seven communities and four rural water Districts serving the project area. Over 11,000 in population served are listed for the Public and Rural Water Drinking Water Systems in the area footprints of the planned Project (Auburn, Elk Creek, Humboldt, Nemaha, Stella, Tecumseh, Verdon, Johnson Co RWD#1, Nemaha Co. RWD #1 & 2, Richardson Co RWD#1, Drinking Water Branch (ne.gov)). Declining groundwater levels that impact wells often requires well owners to lower their pumps or drill new wells. This data can help protect these drinking water supplies by helping to protect future overuse of the aquifer and reducing the threat of groundwater contamination. Understanding the entire aquifer framework is essential to prevent future drinking water supply contamination and ensuring a reliable public water supply for the future development of this area. Cost savings resulting from the completion of this project are unknown currently however having to construct a new public water supply well due to contamination or depletion can cost hundreds of the thousands of dollars to a municipality or rural water district and their customers. For example, installing a municipal, irrigation, or domestic well in a poor aquifer location that would then later need to be replaced or modified can save an additional expenditure of $200,000 - $500,000, $40,000 - $80,000, or $900 - $8,750, respectively. Public health and safety concerns for the Project area also include water availability for emergency fire protection. The need for rural areas or municipalities to have water volumes on reserve will only increase over the long term as limited areas get more developed over time and potential impacts from future drought risks increase.

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.

Groundwater in many areas of Nebraska has been degraded due to non-point source contamination from agricultural fertilizers and pesticides. Nitrate contamination is elevated in parts of the Project area and drinking water users are susceptible to the same type of nitrate contamination to varying degrees depending upon the location and depth of the municipal or domestic wells relative to the impacted areas. Where drinking water supplies are impacted, and the owners of those wells are aware of the impacts, costly filtration systems are needed to remove the contamination. Creation of a hydrogeologic framework that delineates the extents, thickness, and interaction of the area aquifer systems along the flight lines allows the NNRD Board to make science-based decisions regarding the protection of the water resources. Large scale uses, such as agricultural

or industrial, have withdrawals that can potentially impact other users. The understanding of the extents and interaction of the aquifer system also allows for the conservation of the water resources for the long-term beneficial uses of the residents and businesses. While a primary benefit from the Project is an understanding of the water quantity available, the improvement of groundwater quality is also a concern. The NNRD would be able create programs or projects that directly impact water quality from further degradation and protect the health of the residents that are dependent upon the groundwater for their drinking water supply. An estimated 11,000 to 20,000 residents get their drinking water from groundwater supplies, municipal or domestic, in the Project area (Auburn, Elk Creek, Humboldt, Nemaha, Stella, Tecumseh, Verdon, Johnson Co RWD#1, Nemaha Co. RWD #1 &2, Richardson Co RWD#1 plus farmsteads). Nebraska's Wellhead Protection Program (WHPP) is a voluntary program which assists public water supply systems in preventing contamination of their water supplies through active planning and on the ground practices in conjunction with the Nebraska Department of Environmental & Energy (NDEE) and local NRD. The first step in a WHPP is to delineate a wellhead protection area (WHPA) around a system's wellfield based upon the local hydrogeology entered into a groundwater model. The WHPA model estimates the distance away from a supply well that contamination of the aquifer would take to reach a supply well over a twenty-year period. Typically, there is very little geologic data available for the model besides the geologic logs of the supply well(s) and a handful of other registered wells or CSD test holes. Public water systems are expected to review their WHPP every five years and incorporate any new data into the model. AEM data would greatly improve the input data to model, the accuracy of the groundwater model and the subsequent protection area.

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 NNRD devotes substantial time and resource to the assessment of the overall water quality of the groundwater resources of the district. This proposed Project was discussed and voted on by the NNRD Board of Directors during the June 9, 2022 meeting. The motion to pursue resources to proceed with this Project was strongly approved. Past financial input from the NNRD to support these types of projects include annual water quality and quantity monitoring, installation of monitoring and observation wells, past AEM studies, and partnerships with CSD, NDNR and other local NRDs to collect data of this sort. The total Project costs for this proposed AEM data collection, interpretation and reporting is $316,700.00. Of that total Project cost, the NNRD will use general funds to cover the required local match of 40%, or $126,680.00. The remaining $190,020.00 of funds needed for the Project are this grant request. Please refer to Attachment 2 for the NNRD's planned funding. The funding levies for the NNRD will provide sufficient funds to

provide the cash contribution necessary to complete this Project (July 1, 2021 through June 30, 2022 example table listed below).

Local Sponsors	Tax Levy Cents per $100 Assessed Valuation	2021 Property Tax Revenue	2021 Valuation
Nemaha NRD ($316,700 Project)	2.7	$2,268,453.94	$7,681,237,723

(*Nebraska Auditor of Public Accounts https://www.nebraska.gov/auditor/reports/index.cgi?budget=1 accessed June 13, 2022):

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.

NRDs have the authority 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. 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. The NNRD started development of a voluntary IMP with the NDNR in 2017, which establishes measurable goals and targets for managing the District's aquifers. The results of this project will support sustainable water use by creating an aquifer framework to better manage domestic, municipal, agricultural, and industrial water supplies and water quality. Benefits of the project will address the threat of nitrate contamination for an estimated population of around 11,000 to 20,000. Stakeholders involved in the project will include the Board and staff of the NNRD, NDNR, CSD, local municipalities, rural water providers and local landowners. The NNRD has an adopted GWMP, last revised in 2020. Results of this project specifically meet the objectives of the GWMP to address specific problems of groundwater quality. Groundwater quality monitoring by NNRD staff, as part of the GWMP, has shown parts of the Project area to have elevated levels of nitrates. Since May of 2013 the NNRD has applied the following management considerations for sustainable water use:

- Flowmeters have been required on all new or replacement wells that have approved permits for flowrates greater than 50 gpm
- Cost-share provided for flowmeters and soil moisture monitoring equipment
- Developed a well permit scoring system that requires a test hole be submitted along with the application which takes in account aquifer thickness and transmissivity. The density of registered wells within 6,000 feet of a proposed high capacity well is also considered in the permit scoring system.

AEM data helps support the NNRD's evaluation of the test hole data submitted, thickness of the aquifer, and the depth to bedrock. Additionally, the comprehensive dataset for this survey will include previous survey data and provide an easier integration for the future Nemaha basin model work with NDNR.

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.

Groundwater is the primary water supply source in Nebraska. The two primary issues addressed by this Project will be limited groundwater supplies (especially in drought conditions) and groundwater quality degradation due to nitrate-nitrogen and other potential contaminants. These problems are a statewide occurrence in Nebraska but are particularly magnified in the Project area due to the variable and limited nature of the aquifers occurring in the eastern glaciated portion of the state. The NNRD represents 2.44% of the state's 1.9 million residents and has a diverse group of drinking water users: municipalities, small and mid-size communities and towns, eight rural water systems, and high densities of rural domestic users. This Project will assist entities and individuals in maximizing current groundwater conservation and management efforts, as well as helping them identify potential new well locations should the need occur. https://jeo.com/sites/default/files/inline-files/13_Appendix%20E.pdf.

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 funding levies for the Nemaha NRD (NNRD) will provide sufficient funds to provide the cash contribution necessary to complete this Project (Attachment 2 for the NNRD funding plans). The primary leverage for this Project will be to benefit local public water suppliers and domestic well owners. As described, the detailed AEM results will be highly valuable to local suppliers in managing existing, limited groundwater supplies, as well as identifying new well locations should that become necessary. Public water suppliers make use of a variety of funding sources (for example, the State Revolving Fund and USDA Rural Development) when upgrading or installing new water or wastewater systems. The information on groundwater occurrence, as well as near surface geology, will prove highly valuable when evaluating new facility sites. The refined aquifer volume estimates will help facilitate required aquifer analysis for establishment of new groundwater-based drinking water systems.

The Project also builds on previous state dollar investments as it is considered a follow-up, expansion, fill-in of additional data piloted by NNRD and ENWRA's initial AEM efforts. Attachment 4 – ENWRA Long Range Plan Project Objectives outlines how this project fits into the coordinated efforts for the eastern Nebraska region. This project benefits from several other similar AEM related projects previously funded across the state allowing for consistency, accuracy, taking advantage of the most recent technical advancements and lessoned learned from the previous application and data sharing between entities, ultimately making the project very cost effective. NDNR was a funding partner on AEM data collection through ENWRA in 2007 with the ENWRA pilot projects (NDNR IWMPP Contracts #294 and #359) and reconnaissance flights in 2014 and 2015 (NDNR Contract #789), and is working on groundwater numerical models for eastern parts of Nebraska (LENRD WSF#5243, PMRNRD and LPNNRD #5303, LPSNRD WSF #5311) to evaluate comparisons of outputs using AEM results (LPMRT currently and Nemaha basin after). The Project provides further detailed datasets for CSD's and USGS's AEM evaluation efforts and pending internal mission plans (WSF Nebraska GeoCloud, ENWRA recharge mapping, CSD County Groundwater Atlas map creation, updated water level dataset creation/mapping, CSD test hole database). The project will not be implemented as planned if the grant application is not awarded, however; the NNRD will continue to pursue additional AEM flights through ENWRA and any other funding opportunities that might arise.

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.

Groundwater is a critical component of stream function and watershed health. The data resulting from this Project will benefit several watersheds and two major NDNR managed basins (Nemaha and Missouri Tributaries) and will be vital for making informed decisions regarding management within the watersheds/basins. AEM data will identify areas of groundwater recharge and can serve as the basis for various NRD projects which

enhance such recharge (e.g. recharge basins). In addition, this data will help further identify and refine areas of hydrologic connection between groundwater and surface water (stream/aquifer interactions). A more detailed knowledge of this connection will help the NRDs and state agencies like NDNR implement programs to manage the effect of groundwater pumping on streamflow as well as enhance recharge from streams into the shallow groundwater system. These actions, while supporting sustainable groundwater and surface water resources, will also benefit the many animal and plant species (some of them threatened or endangered) which depend on these ecosystems.

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.

The Annual Report to the Legislature Fiscal Year 2020-2021 (NDNR 2021) lists the following agency goals:

- Establish strong state leadership, involvement, and support for science-based decision making that is necessary to sustain state and local water management outcomes. (#1)
- Provide high quality products and services through the performance of our duties in the areas of floodplain management, flood mitigation planning, dam safety, and survey to promote the safety of all Nebraskans. (#2)
- Develop and implement customized and decentralized water management plans established through collaboration with local Natural Resource Districts and stakeholders that provide for long-term sustainability of the state's water resources (#3)
- Encourage strong public engagement with multiple constituents and stakeholder groups in planning and implementation activities to ensure that local and state needs are addressed. (#4)
- 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. (#5)
- Provide agency-wide services and support in the areas of information technology and transparent data sharing, business process improvement, public information, and administration of state-aid funds in conjunction with the NRC (#6)

The collection of AEM data and the incorporation of that data into an overall aquifer framework directly supplements goal #1 through improved data, information, and analysis capabilities. The data collected would be a collaborative investment (#5) that provides greater understanding of the extents, thickness, and interconnection of aquifer systems in the context of sustainability for the NRD and NDNR (#3, #4, #6). That greater

understanding directly informs analysis of streamflow in the hydrologically connected water resources of the State (#3).

Water uses and supplies are analyzed as part of the Fully Appropriated Basin (FAB) Report, done annually by the NDNR (December 13, 2021), through modeling of those hydrologically connected areas. The AEM data and the resulting interpretation and framework will be submitted to the NDNR as the best available data for use in the annual Reports. The Project directly supplements the staff and resources of the State for planning and management of the water resources of the state. The Project partners will utilize the data collected and the interpretation of that data to further their expertise in the local hydrogeologic framework. That expertise is utilized by the management and the NNRD Board of Directors to develop the appropriate plans, programs, and projects for the protection and conservation of the water resources. The NNRD partners with many agencies of the state including NDNR, NDEE, DHHS, the Nebraska Game and Parks Commission (NGPC), and others with an interest in the protection and conservation of the state's water resources. The Project partners represent local, regional, and state level interests, cooperatively studying the water resources of the state (#4, #5, #6). Additionally, the data collected is shared with other non-partner agencies and the general public to provide an overall greater understanding of the hydrogeologic framework. That understanding is fundamental to any program or project undertaken to protect and conserve the water resources.

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.

As described, a primary function of this Project will be to gain greater understanding of the aquifer occurrence and geometry within several WHPAs and complete and enhance aquifer framework coverages for the NNRD. Under the federal Safe Drinking Water Act, public water suppliers are required to provide drinking water that meets various federal standards or Maximum Contaminant Levels (MCLs), with the most applicable being the 10 parts per million MCL for nitrate-nitrogen. Understanding the limitations of the aquifers in this area, as well as possibly identifying aquifer volume and recharge/vulnerability areas within those WHPAs, will help those systems evaluate and manage possible threats to their groundwater supplies. In addition, it will provide NNRD with additional information to promote agricultural and fertilizer best management practices (BMPs) in those areas so as to minimize the occurrence and likelihood of nitrate contamination of groundwater supplies.