NEBRASKA NATURAL RESOURCES COMMISSION

Water Sustainability Fund

Application for Funding

Section A.

ADMINISTRATIVE

PROJECT NAME: Eastern Nebraska Aquifer Framework Mapping

PRIMARY CONTACT INFORMATION

Entity Name: Lower Platte South Natural Resources District on behalf of the Eastern Nebraska Water Resources Assessment (ENWRA)

Contact Name: Katie Cameron, ENWRA Coordinator

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Partners / Co-sponsors, if any: 1) ENWRA Co-sponsors: Lewis and Clark, Lower Elkhorn, Lower Platte North, Lower Platte South, Nemaha, and Papio-Missouri River NRDs 2) ENWRA Partners: University of Nebraska Conservation and Survey Division (UNL-CSD), United States Geological Survey (USGS), Nebraska Department of Environmental Quality (NDEQ), and Nebraska Department of Natural Resources (NeDNR)

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

   Grant amount requested. $ 1,968,000.00

   Loan amount requested. $ NA

   If Loan, how many years repayment period? Click here to enter text.

   If Loan, supply a complete year-by-year repayment schedule.
   Click here to enter text.

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

Nebraska Game & Parks Commission (G&P) consultation on Threatened and Endangered Species and their Habitat	N/A☒	Obtained: YES☐	NO☐
Surface Water Right	N/A☒	Obtained: YES☐	NO☐
USACE (e.g., 404 Permit)	N/A☒	Obtained: YES☐	NO☐
Cultural Resources Evaluation	N/A☒	Obtained: YES☐	NO☐
Other (provide explanation below)	N/A☒	Obtained: YES☐	NO☐

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

   YES☐ NO☒

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

   YES☐ NO☒

   If yes attach a copy to your application. Click here to enter text.

   If yes what is the population served by your project? Click here to enter text.

   If yes provide a demonstration of need. Click here to enter text.

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

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

   N/A☐ YES☒ NO☐

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

   YES☐ NO☒

   If yes, have any changes been made to the application in comparison to the previously submitted application? Click here to enter text.

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

Click here to enter text.

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

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

As of the date of submittal of this application, what is the Total Net Local Share of Expenses incurred for which you are asking cost share assistance from this fund? $ 0.00

Attach all substantiating documentation such as invoices, cancelled checks etc. along with an itemized statement for these expenses. N/A

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

The Consultant requires payment of 30% of the total contract/Project costs at the time of signing for the initial flight planning and coordination. These upfront costs are estimated at $984,000 (30% of the $3,280,000 Total Project Costs or $393,600 Local & $590,400 from WSF). Depending on award timing and contractor scheduling, all or part of the $984,000 down payment costs are anticipated after the potential Project award notice, sometime between March 1, 2018 and June 30, 2018. The remaining anticipated Project costs expected after July 1, 2018 are $2,296,000 ($918,400 Local and $1,377,600 WSF).

Section B.

DNR DIRECTOR'S FINDINGS

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

YES☐ NO☒

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

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

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

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

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

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

Required geologic investigation (004.01 E 1); Click here to enter text.

Required hydrologic data (004.01 E 2); Click here to enter text.

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

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

A discussion of the plan of development (004.02 A);

The specific plan developed for this Project is based on previous Airborne Electromagnetic (AEM) geophysical surveys flown by the 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 for a history of airborne applications in this glaciated region

of Nebraska. Please also refer to the following Attachments relative to the plan of development: **Attachment 1** for a Project Map depicting the flight lines planned for each NRD, **Attachment 2** for a Consultant proposal letter and example contract, **Attachment 3** for NRD sponsor commitments, **Attachment 4** for ENWRA's Long Range Plan LRP Mapping Objectives, and **Attachment 5** for examples of previous AEM project results.

If funded, the ENWRA NRDs would use a geophysical contractor in a manner as previously used (please refer to http://enwra.org/ website for history of airborne applications and **Attachments 1 through 5**) for the following services:

1) Review the flight line locations and adjust them as needed to minimize interference (from power lines and other infrastructure)
2) Choose the appropriate AEM method/equipment/subcontractors/schedule
3) Oversee the survey activities
4) Collect and quality check the airborne data
5) Process the data
6) Gather/georeference all existing data near the flight lines
7) Interpret the data in a final report taking into account the reconnaissance framework (2014-2015 ENWRA AEM flights) and previous results (2007-2016 flights) specific to each NRD (http://enwra.org/).

The resulting datasets will be used by the NRDs for insight on groundwater management concerns specific to their District, such as: potential re-evaluation of management area boundaries/rules, positioning network monitoring 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 (Water Sustainability Fund [WSF] Award #4164), University of Nebraska Conservation and Survey Division (UNL-CSD), United States Geological Survey (USGS), Nebraska Department of Environmental Quality (NDEQ), Nebraska Department of Natural Resources (NeDNR) and the general public for collaboration and shared use of the best available comprehensive hydrogeologic framework data for the area.

It is important to note that Project work related to 80% of the $1,968,000 total asking from WSF for this Project will be completed by the end of the flight campaign ($1,574,400 in state dollars spent by summer 2018 time frame). The Project will provide: District wide completion for LENRD's 3-mile hydrogeologic framework, most of LCNRD's adjacent District wide 3-mile grid framework, LPSNRD's western District framework and Well-head Protection Area (WHPA) coverage, P-MRNRD's diverse aquifer framework north and west of the Omaha metro area, many of NNRD's high priority public WHPA frameworks, and map in detail most of the restricted development areas in LPNNRD. Please refer to **Attachment 1** for a map of the approximate 4,000 miles of anticipated flights with a breakdown of individual AEM line-miles planned for each NRD.

Accomplishment of this Project will fill in the majority of grid gaps left for LCNRD, LENRD, LPNNRD, and LPSNRD as well as provide understanding for the majority of the remaining

poorly understood WHPAs in eastern Nebraska. Most of the major high-dollar, regional-scale ENWRA NRD framework needs will be satisfied with this Project effort. The accomplishment of this Project will impact the management and sustainability of groundwater resources for six NRDs representing 65% of the state's 1.9 million population.

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

ENWRA started research activities in 2007 with three pilot study sites: Oakland, Ashland and Firth employing a variety of assessment tools including AEM - the first of its kind to be used in Nebraska (please refer to http://enwra.org/ website for history of airborne applications and results). AEM has been proven over the past 10 years to be crucial in non-invasively acquiring large amounts of detailed hydrogeologic information in a relatively short amount of time and in a cost-effective manner for the area covered. Additionally, Nebraska has become one of the international leaders in coordinated use of AEM for groundwater management purposes with over 15,000 line miles flown in approximately 15 of Nebraska's 23 NRDs (please refer to 2007-2016 flights found at http://enwra.org/ and AEM related 2015 to 2016 WSF awards: #4132, 4133, 4134, 4140, 4141, 4142, 4143, 4144 and 4164). The map included as **Attachment 1** depicts ENWRA NRD's 2007 to 2016 flights (green lines) and approximately 4,000 miles of planned AEM flights for this Project (blue lines).

> A description of the necessary water and/or land rights, if applicable (004.02 C);

No water or land rights are required to complete this Project. No trespass on private property or human health issues result from data collection. All data is collected under Federal Aviation Administration rules and procedures. Following evaluation of the Project results against existing UNL-CSD test holes and NRD well sampling networks, additional test holes and associated monitoring wells may be advanced in select locations for detailed geology/downhole geophysics and/or to address groundwater quantity and quality concerns. Planning, securing access and implementation of those activities will be conducted separately, subsequent to the Project approval by NRDs and ENWRA.

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

The AEM results provided by the contractor include Google Earth layer deliverables with information dots every 250 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 (please refer to **Attachment 5** and/or http://enwra.org/ LENRD 2014, 2015 AEM, 2016 AEM website tabs for interactive examples). This publically 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 ENWRA regarding AEM results on their property and are provided specific printouts of the available information to understand the potential resource under their land (see example **Attachment 6**). Private landowners can use the new understandings to identify suitable areas to construct a domestic, stock, 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 NRDs can, and have used, the survey data to evaluate subsurface characteristics in time of groundwater well interference to better understand the impacted formations. Surveys have been used by UNL-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 ENWRA NRDs are flying over their local communities' WHPAs, potentially leading to future adjustments to the boundaries, new public wells in better locations/depths, ability to better evaluate potential development of rural water systems, and/or target areas most susceptible to water quality impairments (for example, potential pathways from surface water to groundwater or confining units separating/protecting aquifers become apparent). The data will also be used to help landowners and the NRDs to narrow down areas where irrigation development is appropriate, and help avoid well interference issues. Using the data will also allow for selection of areas within the NRDs' for managed aquifer recharge to assist with increased groundwater supplies and associated surface water objectives.

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 are inferred, usually over distances of at least several miles. The aquifer materials and their properties may change dramatically in as little as a few tens of feet from the individual test hole. Individual points of information, like test holes, 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 on the order of $945,000 ($15 per foot of drilling, not accounting for geologist time) to produce a typical cross section along a 10-mile line using approximately 210 test holes spaced every 250 feet (drilled to typical depths around 300 feet). Drilling 210 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 data lumped every 250 feet to depths around 400 to 500 feet. The $945,000 required for traditional test hole drilling and logging can be compared to a 10 mile AEM flight line at approximately $8,050 ($804.672/mile) as planned with this Project, 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 4,076 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. Additionally, there is no UNL-CSD staff/equipment available to dedicate to completing this scale of work for the region. 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 a few 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.

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

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

The Project costs are for hydrogeologic data collection and visualization – i.e. mapping aquifers, recharge areas, and groundwater surface water interaction pathways (see Section D #4 and cost/benefit table of this Section, Section B #3, bullet 3).

   - Only primary tangible benefits may be counted in providing the monetary benefit information and shall be displayed by year for the project life. In a multi-purpose project, estimate benefits for each purpose, by year, for the life of the project. Describe any intangible or secondary benefits separately. In a case where there is no generally accepted method for calculation of primary tangible benefits describe how the project will increase water sustainability, such that the economic feasibility of the project can be approved by the Director and the Commission (005.02).

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 test hole datasets, AEM work done prior to this Project, and continually advancing visualization programs and interpretation methods putting the picture together as a whole rather than individual point locations. The resulting framework can be used in addressing any future hydrogeologic problem or project, and will allow all partners, other resources entities, and the general public to be more efficient and effective in directing future groundwater-related activities.

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

Cost Activity	**30% Down Mar. 1, 2018**	**Cost after July 1, 2018**	**Cost after July 1, 2019**	**Cost TOTAL**	**Benefits -** potential cost of drilling 84,000 300ft test holes at $15/ft and processing the data to produce aquifer boundary maps (250 ft hole spacing along 4,000 mi of planned flight lines)
WSF Grant	$590k	$984k	$394k	**$1.968M**	Test hole drilling $378,000,000 plus incalculable CSD/ENWRA time
Local Match	$394k	$656k	$262k	**$1.312M**	
UNL-CSD				**In-kind**	
ENWRA				**In-kind**	
TOTALS				**$3.280M**	**>$378,000,000***

*UNL-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 about 2,000 years for two full time employees to complete the test hole processing/cross-section work (annual salaries of $75k, totaling about $302 Million).

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

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 2017 funding levies listed below for each ENWRA NRD will provide sufficient funds to provide the cash contribution necessary to complete this Project. Additionally, each NRD has planned to budget matching funds for this Project in their annual fiscal year (FY) FY2018/2019/2020 budgets (finalized after July 1 each year). Commitments to ENWRA from each NRD are outlined in the Letters of Support in **Attachment 3**. Potential grant contracting and financial handling will be conducted under ENWRA's existing interlocal agreement (refer to ENWRA budget and interlocal agreement renewal in **Attachment 7**).

Local Sponsors	Cents per $100 Assessed Valuation	2017 Property Tax Revenue	2017 Total Budget
Lewis and Clark NRD ($500,000 project)	2.12	$933,580	$2,947,331
Lower Elkhorn NRD ($650,000 project)	2.20	$4,076,006	$7,669,250
Lower Platte North NRD ($750,000 project)	3.83	$3,480,715	$6,632,439
Lower Platte South NRD ($850,000 project)	3.35	$9,257,353	$21,887,468
Nemaha NRD ($300,000 project)	3.06	$2,189,521	$4,860,036
Papio-Missouri R. NRD ($230,000 project)	3.80	$22,828,011	$70,510,023

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

The extended cost to operate and maintain the work achieved is covered in the annual dues paid to ENWRA by the associated NRDs (**Attachment 7**). UNL-CSD and the USGS have teamed with ENWRA to create the Nebraska GeoCloud to house all the AEM data statewide and provide long-term data visualization, management, and sharing capabilities (WSF award contract #4164). Because the Project is primarily data collection, there is no cost associated with equipment replacement, just annual Nebraska GeoCloud costs which are currently local match-funded under a 10-NRD interlocal agreement (eastern and western Nebraska NRDs). Additionally, anticipated annual costs of $25,000 or less per year to maintain the Nebraska GeoCloud are within ENWRA's (or other statewide entity as appropriate) long range plan budget for data management (**Attachment 4**).

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

NA

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

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 holes.

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

NRDs are responsible for maintaining groundwater quality and quantity for municipal, domestic, and agricultural uses (*Nebraska State Statute Chapter 2 Article 32 and Nebraska Groundwater Protection Act Chapter 46 Article 7)*. The NRD staff members have local knowledge of the area and groundwater resources. The ENWRA staff and technical advisors/partner agencies (USGS, UNL-CSD, NeDNR, NDEQ) have the expertise and/or regulatory background in hydrogeology and the Project aligns with their core missions.

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

Each of the eastern Nebraska NRDs have been using ENWRA as a vehicle to understand both groundwater and hydrologically connected water, and thus ENWRA's Long Range Plan (LRP) includes AEM mapping and other assessment goals and plans specific to each NRD. Identifying the location and volume of aquifers (**Attachment 4**, LRP Objective 2) focuses the refinement of the geologic framework to areas in which there are economic and ecologic returns on the investment. The specific locations listed represent areas in which competition for groundwater is occurring and scientific data to support management decisions is lacking. ENWRA anticipates working on multiple small to mid-sized projects at any given time and the projects will likely have variable scales of resolution, use a variety of geologic and geophysical techniques, and have multiple funding sources. The purpose of the ENWRA LRP is to enhance the cost effectiveness and timeliness of these potential projects through coordination and collaboration. In addition, the ENWRA LRP addresses eight other objectives relating to understandings gained from the AEM that are applicable for each of the NRDs, such as, estimating recharge, assessing groundwater surface water connections, calculating water budgets, and characterizing natural and anthropogenic groundwater concerns. Further, the ENWRA coordinator, as stated in the ENWRA LRP, will provide coordination services for secondary projects (NRD-specific projects like this one and the associated Nebraska GeoCloud WSF#4164) as long as they further the overall ENWRA goals and objectives.

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. Each of the ENWRA NRDs 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 their Districts, and to preserve and conserve groundwater quality and quality.

Further, each of the ENWRA NRDs has an Integrated Management Plan (IMP) in place, or has initiated one. Additional AEM data will provide valuable information as those individual plans continue to be implemented. The status of NRD IMPs is as follows:

- LCNRD developed an IMP http://www.lcnrd.org/news/20160808_IMPfinal.pdf with goals to "develop and maintain a district-wide water inventory" and "refine delineations of hydrologically connected areas

- LENRD voluntarily entered into the IMP development process to take a proactive approach to the protection of the interconnected water resources
- LPNNRD is working on a voluntary IMP for the hydrologically connected surface water and groundwater
- LPSNRD has a voluntary IMP in place for the entire District (adopted May 5, 2014 http://www.lpsnrd.org/Programs/gwIntMgtPlan.pdf)
- NNRD has initiated the IMP process with NeDNR this year (NNRD took action on March 9, 2017 to begin the development of a voluntary IMP).
- P-MRNRD has a voluntary IMP for the hydrologically connected surface water and groundwater (https://dnr.nebraska.gov/sites/dnr.nebraska.gov/files/doc/water-planning/lower-platte/papio-missouri-NRD/PMRNRD_IMP_20140801.pdf)

Each District's existing groundwater data will be combined by the staff and management with the information collected during this Project. Each of the ENWRA NRD Boards will utilize the full set of information regarding the groundwater resources obtained from AEM to inform the IMP development process and future decisions about the management and protection of the groundwater resources. ENWRA will work through the Nebraska GeoCloud (WSF Award #4164) and continue to coordinate eastern Nebraska hydrogeological assessment work for the NRDs (http://enwra.org/).

The data collected by the Project will also be submitted to the NeDNR as the "best available" information for use in the Annual Evaluation of Availability of Hydrologically Connected Water Supplies, hereafter referred to as the FAB Report. The FAB Report is a statutory requirement of the NeDNR which evaluates the long-term availability of the hydrologically connected water supplies of the state. The previous collection of AEM data completed by ENWRA was partially funded by the NeDNR for use in modeling efforts to determine the impacts of groundwater use on surface water availability in hydrologically connected reaches. The results of those modeling efforts (Lower Platte and Missouri River Tributaries ([LPMRT] Assessment), when complete, will be incorporated into the FAB Report which determines if a basin is fully appropriated or not. The Project will update the overall hydrogeologic framework and improve upon the previous AEM work that supports the FAB Report.

There are also multiple rural community water supplies, sanitary improvement districts, and municipal WHPAs in the Project area (around 60 will be flown over to some degree: 3 in LCNRD, 25 in LENRD, 11 in P-MRNRD, 6 in LPNNRD, 8 in LPSNRD, 9 in NNRD). WHPAs are delineated by the NDEQ based upon estimated 20-year time-of-travel zones. Each of the water systems being flown with tight spaced lines (for example, LPSNRD and NNRD are proposing to collect data at a high resolution spacing of approximately 750 feet across WHPAs and LPNNRD is proposing to collect data at a spacing of 1/3 mile in restricted development areas) will benefit from potential new understandings on aquifer boundary/pathway conditions and NRD assistance with well-head protection planning needs using the more detailed 3-dimensional information.

10. Are land rights necessary to complete your project?

YES☐ NO☒

If yes, provide a complete listing of all lands involved in the project.
Click here to enter text.

If yes, attach proof of ownership for each easements, rights-of-way and fee title currently held.
Click here to enter text.

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

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

The NRDs, as political subdivisions, have 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 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 environmental and ecological consequences that may result as the result of the project.

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, geometry, and volume of specific 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. 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 in parenthesis. Once points are assigned, they will be added to determine a final score. The scores will determine ranking.

- The Commission recommends providing the requested information and the requests are not intended to limit the information an applicant may provide. An applicant should include additional information that is believed will assist the Commission in understanding a proposal so that it can be awarded the points to which it is entitled.

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

1. Remediates or mitigates threats to drinking water;

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

INTRODUCTION: Please refer to Section D of this application for scope overview, specific tasks, timeline, and costs associated with this Eastern Nebraska Water Resources

Assessment (ENWRA) Project. Each of the six ENWRA Natural Resources Districts (NRDs): Lewis and Clark (LCNRD), Lower Elkhorn (LENRD), Lower Platte North (LPNNRD), Lower Platte South (LPSNRD), Nemaha (NNRD), and Papio-Missouri River (P-MRNRD) have slightly different approaches to the Airborne Electromagnetic (AEM) surveys (transects, grids, block areas) depending on their District-specific goals. However, all of the AEM survey work is designed to improve the understanding of the subsurface hydrogeology in highly diverse geologic settings by providing 2-dimensional (2D) cross sections and 3-dimensional (3D) visualizations in a comprehensive report (paper and digital examples are included in **Attachment 5** and available at http://enwra.org/).

ENWRA NRDs work closely with the University of Nebraska Conservation and Survey Division (UNL-CSD) and United States Geological Survey (USGS) who serve as technical advisors on much of the AEM data interpretations (includes work under Nebraska GeoCloud WSF award #4164). The gathered existing subsurface information (latest test holes, registered wells) and new interpreted subsurface information (AEM) will be readily usable by groundwater managers by the end of the Project to evaluate both quantity and quality threats to drinking water. The ability to show these risks to the public in a tangible format and the ability to have a visual of where these risks exist is essential to reaching the target audiences, primarily, community board members and the general public. The complexity of hydrogeology, its importance to the community, and the need to protect the groundwater resource from depletion and contamination threats is difficult to express to the general public. The products produced by this Project will facilitate understanding of the concepts and provide a platform for discussion with the communities and landowners at risk (**Attachment 6**).

DRINKING WATER USERS:

The NRDs in ENWRA represent 65% of the state's 1.9 million residents and have a diverse group of drinking water users: large municipalities, small and mid-size communities and towns, rural water systems, and high densities of rural domestic users compared to other areas of the state (http://enwra.org/, **Attachments 8 and 9**).

In the LCNRD (http://www.lcnrd.org/), Cedar County's population is approximately 5,700 (full County is around 8,850) and Knox County is approximately 5,820 (full County is around 8,700), based on 2010 census data. Approximately 73% of those residents rely on groundwater as a drinking water source. The northern portions Cedar and Knox Counties experience, in general, water quantity issues, while the southern portions of those Counties experience primarily water quality issues. However, because of limited quantity and/or quality groundwater resources, many residents and businesses of the area rely on treated surface water from the Lewis and Clark Lake produced by the Cedar-Knox Rural Water Project (CKRWP). The CKRWP, serves four communities and more than 880 rural customers, and is nearing production capacity. Sediment in Lewis and Clark Lake is advancing and threatens the CKRWP intake (**Attachment 9**). There is abundant Missouri River Alluvium along the northern border of the District; however, it is generally not suitable for drinking. The Santee Sioux Nation is located within the northern portion of the LCNRD boundaries and experiences issues with the drinking water supply.

The Santee Sioux area, including the Village of Santee, cannot economically be serviced by the CKRWP due to current treatment plant capacity and the geographic setting relative to the CKRWP system (higher elevation ridge between the two). Niobrara Bedrock, a secondary groundwater aquifer present in the area, has been fractured and due to the weathering it can store and yield water, however positioning successful wells is difficult. The much deeper buried Dakota Formation also provides a source for agricultural and drinking water uses; however, the quality of the water can be such that it is not desirable for drinking and, due to its' depth, well construction is expensive.

In the LENRD (http://www.lenrd.org/, the proposed Project area includes 719 domestic wells and encompasses 25 Well-Head Protection Areas (WHPAs) serving a combined population of more than 26,000. Water quality sampling in the Project area has indicated that there are elevated levels of nitrate ranging from 5 to over 10 parts per million (ppm) in several areas. The City of Stanton, Village of Pender, Village of Dodge, Village of Rosalie, and the Cuming County Rural Water District 1 have received violations in the past due to nitrate/nitrite levels.

In the LPNNRD (http://lpnnrd.org/, The proposed Project area includes approximately 350 domestic drinking water wells and encompasses six WHPAs serving a combined population of approximately 2,000 (**Attachment 9**). Water level measurements since 1985 in the Project area have indicated that the aquifers in several of the restricted development areas are confined and experience large pressure fluctuations due to excessive high capacity well pumping. The Project area covers three risk areas of the District representing approximately 97% of the identified risk areas.

In LPSNRD (http://www.lpsnrd.org/, the Project area includes an estimated 1,500-2,000 registered, active domestic wells and encompasses eight WHPAs for the communities of Ceresco, Davey, Denton, Emerald, Garland, Malcolm, Pleasant Dale, and Raymond (**Attachment 9**). The current population of the communities noted above is approximately 2,500 people; assuming that each registered domestic well serves three people on average, those wells would serve an additional 4,500-6,000 people. In addition, there are undoubtedly some unregistered domestic wells serving an unknown number of people in the Project area, and it's likely that these wells serve an additional few thousand people. Therefore, LPSNRD estimates that approximately 8,000-10,000 people rely on the combination of domestic wells and small municipal supplies in the Project area for their primary drinking water source (City of Lincoln and the population supplied by its water system are not included in these population estimates).

In the NNRD (www.nemahanrd.org) around 75% of the total population is served by a public water supplier. This includes both community and rural water systems. 1,150 registered domestic wells and 33 WHPAs are located within the NNRD serving a population of approximately 32,000. Approximately 11 WHPAs (four rural water suppliers and seven communities) are located within the Project area. Quantity and quality threats to drinking water are especially important for NNRD because of the controlling hydrogeology. Groundwater resource aquifers are thin sand and gravel deposits predominately located in limited paleochannel features cut into bedrock (although readily

recharged in some areas, there is less groundwater storage capacity compared to other areas of the state). A large portion of the surface and groundwater resource drains out into the Missouri River. Once in the Missouri it is essentially lost to Nebraska for beneficial use and the NNRD is the last Basin before the resource leaves the state.

In the P-MRNRD (www.papiond.org), the proposed Project area includes an estimated 3,000 active domestic wells (including registered and unregistered wells) and 15 active WHPAs (**Attachment 9**) serving a combined population of approximately 660,000 within the P-MRNRD (not including Lincoln and Fremont). Water quality sampling since 1992 in the Project area has indicated that there are elevated levels of nitrate ranging from 5 to over 10 parts per million (ppm) in the alluvial systems associated with the Elkhorn River drainage. The P-MRNRD Groundwater Management Plan (GMP) sets 5 ppm (half of the drinking water limit of 10 ppm) as a trigger level for further study and with the potential for actions to address the nitrate contamination. Nitrate above the safe drinking water standard of 10 ppm needs to be addressed through some form of treatment or filtration.

THREATS/LONG RANGE IMPACTS: Issues with groundwater quantity were experienced throughout eastern Nebraska during the drought of 2012 and, to a lesser extent, 2013. Many domestic wells experienced groundwater shortages due to pumping interference with other wells. Many public water suppliers, including City of Lincoln and Omaha's Metropolitan Utilities District, also encountered shortage concerns. The drought of 2012 pointed to the need for Nebraska to make conserving water resource quantities a priority for the ENWRA NRDs. The AEM data collected for the Project will greatly help the ENWRA NRDs determine and further evaluate areas susceptible to a repetition of those problems previously experienced. Based on historic indications - (and state level discussions for Nebraska Water Sustainability), drought is certain to occur again in the future for the region. The availability of consumable drinking water in the next century is uncertain without first understanding the hydrogeologic framework (where the water is, where it is vulnerable, and how it is used and replenished). The Project will greatly inform the development and employment of the LENRD Drought Mitigation Plan, the Lower Platte River Drought Contingency Plan (WSF award #4151 involving LPSNRD, LPNNRD, P-MRNRD), the LPNNRD Restricted Development area evaluation, and other NRD drought management efforts.

Drinking water quality problems are often correlated to human-related activities at or near the land surface and/or the presence of deposits naturally containing heavy metals such as arsenic, selenium and uranium. High levels of nitrogen, such as nitrate from widespread historical ag-related activities in the region or identified point source locations, can be harmful to young infants or young livestock when consumed. Excessive nitrate can result in restriction of oxygen transport in the bloodstream. Infants under the age of 4 months lack an enzyme necessary to correct the restricted oxygen transport resulting in what is known as "blue baby syndrome". The long-term impacts from not fully understanding the sources of nitrate and other contaminants and the susceptibility of the aquifer system to contamination can potentially put human health at great risk. The detailed knowledge gained from AEM data will prove invaluable to Districts, communities, and individuals wishing to locate and maintain safe, sustainable groundwater supplies.

ENWRA partners plan to use knowledge from this Project to manage the resource over the long term in conjunction with ENWRA (**Attachment 4** - LRP goals and objectives table) thus ensuring the sustainability and quality of life for the region's current and future residents.

HISTORY/MITIGATION: AEM provides a far more complete and widespread coordinated understanding of the physical extents and potential interactions of the local and regional aquifers and surface waters compared to inferring between drilled borings and surface water/outcrop locations. Historically, problems are encountered and reacted to with conducting assessments (mostly compartmentalized like chemical point source investigations or drilling recon test holes for more water wells or going deeper with well screens). This Project informs each of those historical types of mitigation methods and provides a comprehensive picture for decision making. For example, the AEM data identifies areas susceptible to contaminant migration (e.g. sandy materials present between the surface and the top of the aquifer or thin overburden above aquifer). Additionally, evaluation of the AEM data helps water resource managers visualize and understand why some areas experienced groundwater shortages due to pumping interference with other wells (several of the NRDs experienced these conditions in the 2012 drought, and to a lesser extent during 2013).

Potential mitigating actions which may occur as a result of this Project include: deeper domestic well construction, new or refined water use rules/best management practices, enhanced groundwater recharge information and management (siting reservoirs, aquifer protection), and improved water quality monitoring (using AEM to target optimal well locations and screening intervals). Each of the NRDs have monitored groundwater quality networks which are part their GMPs in the Project area (several of the NRDs have each updated their GMPs and positioned monitoring wells using AEM data in recent years). Groundwater quality monitoring wells provide highly reliable groundwater level and quality information from targeted sections of the aquifers (**Attachment 11**). With the networks, the NRDs can track their mitigation efforts over time or adjust their management using the network data in conjunction with the hydrogeologic framework created with this Project.

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 (GMP).
   - 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 **LCNRD** GMP was adopted in 1986. The plan was amended in 1995 to address water quality concerns and an attachment was added in 2014 detailing water quantity concerns.

The LCNRD and NeDNR have just wrapped up drafting an Integrated Management Plan (IMP). The plan (http://www.lcnrd.org/news/20160808_IMPfinal.pdf) was adopted by the LCNRD board on July 28, 2016, and following NeDNR adoption, became effective on September 5, 2016. The proposed Project meets goals and objectives identified in the plan Goal 1, to "develop and maintain a district-wide water inventory", and Objective 1.3 to "improve delineations of hydrologically connected areal extents". AEM technology is an identified method to develop the water inventory and to identify areas of hydrologic connection. The data collection and map products also support other components of the IMP, including Objective 2.3, identify management strategies to improve water resource sustainability. This will be achieved through the understanding of aquifer systems and ground and surface water interactions. For example, the Coleridge WHPA with complex hydrogeology and quantity and quality concerns was mapped with tightly spaced AEM flight lines in 2016 (WSF award #4143). The AEM data indicated an aquifer boundary that was not previously understood (**Attachment 10**) and demonstrated possible nitrate movement pathways corresponding to known impacted wells.

The **LENRD** has an adopted GMP, last revised in April 2017. Results of this Project increase our general knowledge of the hydrogeologic characteristics and assist LENRD to meet the following objectives in the GMP:

- Establish a baseline of data and monitor trends in groundwater quality and quantity
- Improve groundwater conservation practices
- Maintain and improve groundwater quality
- Cooperate with other agencies and organizations to develop and provide educational materials and programs to promote public support for and participation in management of groundwater resources
- Minimize pumping conflicts
- Protect municipal and domestic groundwater supplies
- Obtain Funding for Groundwater Management Activities

The **LPNNRD** is in the final processes of completing a Voluntary IMP. Current management strategies are being addressed under the GMP last updated in 1995. More specifically, Section B, Goal #2 - Management Systems Development, under the "Plan for Groundwater Management in LPNNRD" is being targeted. The overall objective of this goal is to provide a system of groundwater management to support the groundwater reservoir life goal, based upon an adequate technical foundation and public awareness of groundwater issues. Goal #2 has provided a framework for LPNNRD to implement several programs that have led to a greater understanding of the various aquifer systems throughout the District and the ways to address the issues realized through communication and data acquisition. LPNNRD has commissioned studies to map the aquifer characteristics on a macro scale to allow more specific controls on a localized level. It has also provided a network of monitoring wells and sample sites to monitor groundwater quantity and quality. Further work has been done to quantify water usage through the acre certification process which looks at the actual number of acres being irrigated throughout the District. Annual informational classes have been held to keep groundwater users updated on the most recent data gathered by the District as well as

any updates to the current management policies or LPNNRD Rules and Regulations. The AEM flights will continue the data acquisition objectives of the current GMP as well as future management strategies to be addressed under the IMP. The AEM flights will assist in the data sharing that is necessary between neighboring NRDs in order to retain consistency in general rules that help groundwater users and NRDs manage aquifers that cross political boundaries.

This Project will directly meet goals and objectives of both the **LPSNRD's** Ground Water Management Plan (GWMP, equivalent to GMP acronym) approved by NeDNR in 1995 and the NRD's voluntary IMP adopted May 5, 2014. For the GMP, the data provided by AEM flights will provide a more detailed and defensible understanding of the highly variable aquifer units in the western portion of the District. In addition, it will provide a much improved geologic framework for the designated WHPAs in that part of the LPSNRD. These WHPAs (referred to as Community Water Supply Protection Areas [CWSPAs] in the NRD's GMP) are designated areas of groundwater quality and quantity management. As of this writing, two WHPAs (Davey and Pleasant Dale) are Phase II management areas for nitrate-nitrogen. The voluntary IMP identifies three major Goal Areas: Water Inventory, Water Supply Management, and Water Use Management. The Project directly addresses the Water Inventory area by providing a much more detailed picture of the limited and variable aquifer units in the western portion of the NRD. This information will feed directly into the District's efforts at Water Supply Management, specifically including proper location of new water supply wells and evaluation of additions and improvements to the regional water systems in the area. Finally, the data provided by this Project will greatly enhance LPSNRD's efforts at Water Use Management, specifically helping identify priority areas for water conservation techniques as well as evaluation of new water uses and their effects on existing groundwater supplies.

The **NNRD** took action on March 9, 2017 to begin the development of a voluntary IMP. The NNRD has a history with addressing groundwater quantity/quality concerns demonstrated though the following specific District management actions:

- Updating their GMP Rules and Regulations
- Measures groundwater levels twice a year in over 130 wells
- Regularly collects samples from over 100 wells throughout the District
- Has a private water supply well sampling plan which ties directly to the groundwater sampling/sustainability data gathering scope of this Project
- Continues to promote and encourage routine private water well sampling and analysis
- Educates District residents on the health risks associated with groundwater contamination, on methods to treat the problem, and on actions to reduce or eliminate the reoccurrence
- Considers aquifer thickness and transmissivity when evaluating new well permits
- Looks for opportunities to expand the water analysis programs

The District is also in the process of delineating risk management aquifer areas in order to apply specific rules and the AEM data will assist with that effort. The NNRD's

consultant working on the risk assessments also assisted with determining NNRD AEM flight areas to help them address data gaps. AEM data will help NNRD determine areas with development potential and help determine maximum development limitations.

The **P-MRNRD** has a Voluntary IMP (https://dnr.nebraska.gov/sites/dnr.nebraska.gov/files/doc/water-planning/lower-platte/papio-missouri-NRD/PMRNRD_IMP_20140801.pdf) dated August 2014, adopted by both the P-MRNRD Board of Directors and the NeDNR with the following Goals:

- Goal 1 is to develop and implement water use policies and practices which better protect existing surface and groundwater uses while allowing for future development. The P-MRNRD and NeDNR have adopted rules and regulations restricting the amount of groundwater and surface water development each year and the P-MRNRD is beginning the process of updating the existing GMP (PMRNRD 1994) to be more consistent with the IMP, and create new groundwater sub-areas to more effectively manage the entire P-MRNRD.
- Goal 2 is to maintain a water supply and use inventory. The P-MRNRD is in the process of determining certified irrigated acres for the IMP area and will report municipal and other documented water uses for 2015.
- Goal 3 is to implement water use education programs to promote urban and rural water conservation. This is ongoing, but additional meetings are needed with public and stakeholders.
- Goal 4 is to work with upstream NRDs to develop the Lower Platte River Basin Water Management Plan.

AEM data collected as a result of this Project will address objectives and action items that support Goals 2 and 3 in the IMP by: (1) utilizing the best available data and analysis tools to estimate consumptive water use, (2) assess the need for additional monitoring, (3) continue to gather and analyze hydrogeologic data, (4) evaluate the need to develop new rural water systems, and (5) coordinate with public water suppliers to enhance education and conservation.

In addition to the *IMP*, the P-MRNRD has an adopted *GMP* (https://www.papionrd.org/wp-content/uploads/2016/08/Groundwater-Management-Plan-1994.pdf). Results of this Project specifically meet the objectives of the *GMP* to address specific problems of groundwater quality. Groundwater quality monitoring conducted by USGS in the P-MRNRD has shown portions of the proposed Project area to have elevated levels of nitrates. Improved geologic data and interpretation will also be essential as the P-MRNRD completes the most recent update to their GMP (https://www.papionrd.org/wp-content/uploads/2017/03/2017-Draft-Groundwater-Management-Plan.pdf).

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 ENWRA 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 eastern portion of the P-MRNRD and the LPSNRD and the entire NNRD. Cross basin benefits for the ENWRA NRDs 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 ENWRA's 2014/2015 recon lines was to provide a grid-like data set to compare with NeDNR's numerical groundwater model work for the Lower Platte and Missouri River Tributaries (LPMRT) Assessment. The LPMRT Assessment is one of NeDNR's current Integrated Management projects and covers the surface area of Nebraska tributaries that drain into the Missouri and Lower Platte Rivers. The proposed Project data, along with existing data that has been collected (ENWRA NRDs have collected recon level and block level flights between 2007 and 2015), could provide the NeDNR base of aquifer and aquifer thickness information for a large continuous area along the boundaries of the two basins. This tighter grid spacing would allow for additional model input comparison purposes, thus assisting in the NeDNR'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. An example of the type of aquifer delineation that AEM can provide is included as **Attachment 10**. 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 also is 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 ENWRA NRDs' 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. Management decisions for Groundwater Management Areas (GMAs) 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 ENWRA NRDs' ability to make those management decisions and improve the sustainability of the overall water resources. Potential management decisions to utilize allocations, water use rotation, limits on development, well spacing requirements, or other groundwater controls as part of a GMP or IMP can be better tailored to protect existing users and promote sustainable use of the water resources.

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 management actions, programs, or projects, depend on that detailed information to understand the volume and distribution of available groundwater and water quality concerns (for example, LENRD will be using the AEM as the best available science to delineate their District into management areas and improve their Drought Mitigation Plan https://static1.squarespace.com/static/54be71a0e4b096702d519464/t/586fc48f6a496365d57d2c9a/1483719880310/LENRD+Drought+Management+Plan+Draft+12_21.pdf). Municipal, industrial, agricultural, and recreational water supply uses in the region will also realize benefits from the aquifer framework mapping. Improved well location and construction methods will ensure improved reliability and reduce potential water quality issues.

Continuing to allow public water supply, industrial, and agricultural uses without proper management may lead to well interference, overuse, and water quality contamination. With limited data and the risk of severe drought conditions, the tendency is to over-protect the resource for domestic purposes at the potential expense of other uses. If this occurs, a portion of the resource is going unused and becomes of no value to Nebraska. AEM data will allow NRDs to make better and more accurate management decisions to help ensure we are getting full value from the groundwater resource. It will assist the NRDs in establishing the development capability of specific aquifers, and the impact future groundwater development will have on streamflow.

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 ENWRA Project area covers a large portion of the eastern side of the state and NRDs in ENWRA represent 65% of the state's 1.9 million population. Surface water, and to a lesser localized extent, groundwater in the ENWRA Project area drain out into the Platte, Elkhorn, and Missouri River systems, and ultimately leave the state via the Missouri River. Once in the Missouri, the resource is essentially lost to Nebraska for beneficial use. Understanding the aquifer systems and their interaction with the land surface and area streams will allow the agencies tasked with managing Nebraska's water resources (Project partners) the best available information to make the best possible decisions regarding the beneficial use of the water resources. AEM data will also be used to assist public water suppliers, landowners, agricultural producers and other potential groundwater users to better select optimum locations for drilling new wells, which will help maximize use of the resource while minimizing negative impacts to the aquifer and other users (**Attachment 6**).

The beneficial use of Nebraska's water resources is established and prioritized in the Nebraska constitution with domestic use being the highest priority, and agricultural use and industrial use following from there. One of the greatest issues NRDs in the ENWRA Project face is to fairly manage groundwater so that public/domestic supplies are protected while other beneficial uses, such as irrigation and industry, have opportunities to use the resource. With limited data and the risk of severe drought conditions, the tendency is to over-protect the resource for domestic purposes at the potential expense of other uses. If this occurs, a portion of the resource is going unused and becomes of no value to Nebraska. AEM data will allow NRDs to make better and more accurate management decisions to help ensure we are getting full value from the groundwater resource. It will assist the NRDs in establishing the development capability of specific aquifers and the impact future groundwater development will have on streamflow.

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.

Please refer to Section D of this application for scope overview, specific tasks, timeline, and costs (also described in Section B #3 bullet 3 table) associated with 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.

There are no costs for construction, O/M, etc. for this Project. However, it's important to note that, even though AEM surveys are not inexpensive, 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 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 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. Individual points of information, like test holes, 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 seamless cross-section of the aquifer materials. This type of seamless cross-section cannot be collected through any other known method.

As a generic example, it would cost around $945,000 ($15 per foot of drilling, not accounting for geologist time) to produce a typical cross section along a 10-mile line using approximately 210 test holes spaced every 250 feet (drilled to typical depths of around 300 feet). Drilling 210 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 250 feet to depths around 400 to 500 feet. The $945,000 required for traditional test hole drilling and logging can be compared to a 10 mile AEM flight line at approximately $8,050 ($804.672/mile) as planned with this Project, 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 4,076 miles of cross sections (see Section B, #3, bullet 3 table) through the use of test hole drilling and logging of geologic materials, compared to two years anticipated for the proposed AEM flights and reporting. Additionally, there is no UNL-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 (see Section B, #3, bullet 3 table footage/scope discussions) 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 about 2,000 years for two full time employees to complete the work (annual salaries of $75k, totaling about $302 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 a few 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.

Federally endangered species such as the Pallid Sturgeon, Topeka Shiner, Salt Creek Tiger Beetle, and Western Prairie Fringed Orchid exist within the ENWRA NRD watersheds and are susceptible to their health and function. By better understanding the aquifer resources, the ENWRA NRDs can make responsible decisions that will reduce potential negative impacts to its local endangered species. As an example, this Project will assist the state and ENWRA NRDs in managing groundwater and surface water to meet its obligation under the instream flow appropriation permit granted to the Nebraska Game and Parks Commission for the central and lower Platte River on June 26, 1998 (with a instream flow priority date of November 30, 1993).

The Project area in the LCNRD and NNRD are each part of the Missouri Tributaries Watershed which contributes to the health of the down-gradient river. Fifty-nine miles of the Missouri River from Gavin's Point Dam to Ponca State Park were designated as the Missouri National Recreational River in 1978. A better understanding of how the geology in this area impacts the river including potential groundwater connections can assist decision making on a local, state, and/or national level, further protecting the river. The river supports abundant wildlife and is home to three species listed under the federal Endangered Species Act: the *endangered* pallid sturgeon and least tern, and the *threatened* piping plover. The work undertaken by this Project will contribute to the health and function of the Missouri National Recreational River watershed through increased understanding of the highly variable, diverse aquifers of the northern portion of Knox and Cedar Counties in the LCNRD as well as aquifer sources exiting the state through the NNRD.

Lastly, 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 Dec 2015). Water regulators and managers in compliance with the Safe Drinking Water Act, including the establishment of well-head protection areas (Part C, section 1428), use UNL-CSD data for making their decisions. UNL-CSD has immediate plans to incorporate the AEM data

(Ongoing County Atlas work and Nebraska GeoCloud WSF award #4164) into their survey and geologic data integration efforts. Additionally, 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 Untied 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.

Understanding the entire aquifer framework and focusing on WHPAs is essential to prevent future drinking water supply contamination and ensure a reliable public water supply for the future development of this Project area (**Attachments 1, 8, 9 and 10**). Private and Public Water System well owners can face drinking water contamination, especially due to nitrates, a primary long term widespread public health issue affecting the ENWRA NRDs (**Attachment 11** example). If areas are identified by the AEM indicting increased risk, the Districts can implement focused education efforts for private landowners, communities, and crop producers in the area where crop nutrients and chemicals may impact the resource. More precisely defining the aquifer boundaries of WHPAs provides the basis for improved public security by ensuring communities have the knowledge necessary to protect water quality and quantity, which in turn protects public health and safety. The knowledge gained by the work will enable the state and ENWRA NRDs to focus management efforts in specific areas where there is specific threat to groundwater quality or quantity.

Cost savings to critical infrastructure resulting from the completion of this Project may be realized in the future. 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 dependent on the type of well being replaced.

LCNRD: This Project will benefit the LCNRD by providing detailed reliable information about the limited aquifers in northern Cedar County. There are approximately 2,800 rural and community residents served by groundwater in this part of the District. There are also 3 communities and approximately 500 rural residents, whose drinking water needs are

met by the Cedar-Knox Rural Water Project (CKRWP), which serves treated surface water from Lewis and Clark Lake (intake location depicted on **Attachment 9**). The development of CKRWP in the 1970's was in response to the need of the residents in the area to find a reliable source of drinking water for the rural residents and communities in the Project area (northern Knox and Cedar Counties). As residential development continues in Cedar and Knox Counties and nitrate leaching continues to impact wells in agricultural areas, potentially leading people to CKRWP to provide drinking water, the ability of the CKRWP to serve additional customers is not guaranteed. Therefore, the knowledge of the groundwater resource is necessary for those wishing to drill new domestic or stock wells, or plan future well usages while considering the long term security of water supplies.

LENRD: Information resulting from this Project will help protect critical infrastructure, primarily the municipal and domestic drinking water wells which serve over an estimated 26,000 people including 25 WHPAs. In 2012, the LENRD experienced well interference issues, leaving some domestic water users without a water source - creating a public health/safety issue. Completion of the LENRD's AEM framework will help avoid and address future well interference issues through a more complete understanding of the complex aquifer systems in the District.

LPNNRD: Information resulting from this Project will help protect critical infrastructure, primarily the municipal and domestic drinking water wells within the majority of the restricted development areas of the LPNNRD (approximately 97% of the risk areas identified). This data can help ensure the sustainability of domestic and agricultural water supplies within these four variable aquifer system areas (**Attachment 12**) as housing development and land use expands.

LPSNRD: A primary benefit of this Project will be to obtain more detailed and reliable information regarding the limited aquifer units in the western portion of LPSNRD. This includes all or portions of eight small public water suppliers serving somewhere in the neighborhood of 2,500 people, as well as about 1,500-2,000 private registered, and an unknown number of unregistered, domestic wells serving several thousand additional residents. Due to its proximity to Lincoln, this area is under increasing pressure for development of acreages, and accurate information as to the extent and capacity of the limited aquifers in this area is essential to management of that development.

NNRD: Around 75% of the total NNRD population is served by a public water supplier. Many of the WHPAs in southeast Nebraska were delineated when data was limited and we are finding out that in some cases the accuracy may be questionable. NNRD has an example where a village has two wells 2,600 feet apart and it had been assumed they were in the same aquifer. Recent data has determined that they are in two separate aquifers that do not appear to be hydrologically connected, so the WHPA delineation is inaccurate. AEM data can help Districts and the state better delineate WHPA boundaries to ensure that management is fair and meaningful while covering the correct areas for long-term security of the resource.

P-MRNRD: The proposed project area includes an estimated 3,000 active domestic wells (including registered and unregistered wells) and 15 active WHPAs (**Attachment 9**) serving a combined population of approximately 660,000 within the P-MRNRD (not including Lincoln and Fremont). The focus of the AEM survey in the P-MRNRD is primarily to identify isolated aquifer materials and paleo-valleys in the upland area north of the Omaha metro. Identification of these materials and their depths will help prevent poor drinking water well locations and depths in the future and will enhance the sighting of replacement drinking water wells.

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.

The Project would provide information that would improve the understanding of the extent and connectedness of the groundwater resource, as well as the types of materials overlying the resource. That information can be utilized to improve or create programs or projects that directly impact water quality. As noted previously in question 8, the primary threat to groundwater quality in the Project area is nitrates, but some communities and private wells have experienced concerns over detection of additional, often naturally-occurring contaminants like arsenic. Portions of the area also have naturally occurring, elevated levels of iron, manganese, sulfates, and dissolved solids, which contribute to taste, odor staining, and other aesthetic water quality problems. Where drinking water supplies are impacted, and the owners of those wells are aware of the impacts, costly treatment systems are needed to remove these water quality problems. Creation of a hydrogeologic framework that delineates the extents, thickness, and interaction of the area aquifer systems allows the NRD boards to make science based decisions regarding the protection of the water resources, and can assist well drillers in locating and designing wells to minimize these problems. The highly variable, and in some cases limited, extent of aquifer units in several of the Project mapping areas (includes several rural water systems, restricted development areas) provides less “buffer” due to dilution effects. If groundwater does become contaminated, it is more difficult to find an alternative source in this area than in other more groundwater rich portions of the state.

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.

Natural Resources Districts (NRDs) are granted the authority to impose property tax levies to generate revenue for operational needs. The 2017 funding levies listed below for each ENWRA NRD will provide sufficient funds to provide the cash contribution necessary to complete this Project. Additionally, each NRD has planned to budget matching funds for this Project in their annual fiscal year (FY) 2018/2019/2020 budgets (finalized after July 1 each year). Commitments to ENWRA from each NRD are outlined in the letters of support in **Attachment 3**. Potential grant contracting and financial handling will be conducted under ENWRA's existing interlocal agreement (refer to ENWRA budget **Attachment 7**).

Local Sponsors	Cents per $100 Assessed Valuation	2017 Property Tax Revenue	2017 Total Budget
Lewis and Clark NRD ($500,000 project)	2.12	$933,580	$2,947,331
Lower Elkhorn NRD ($650,000 project)	2.20	$4,076,006	$7,669,250
Lower Platte North NRD ($750,000 project)	3.83	$3,480,715	$6,632,439
Lower Platte South NRD ($850,000 project)	3.35	$9,257,353	$21,887,468
Nemaha NRD ($300,000 project)	3.06	$2,189,521	$4,860,036
Papio-Missouri R. NRD ($230,000 project)	3.80	$22,828,011	$70,510,023

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 **LCNRD** would like to continue grid surveys and focus surveys in areas that warrant increased investigation as they relate to several sustainability goals and objectives identified in the LCNRD GMP and IMP (refer to Section C, Question #2, first paragraph for details). In response to significant irrigation development and drought conditions of 2012, the LCNRD enacted Groundwater Quantity Rules and Regulations, adopted by the LCNRD in August of 2014. The rules include the requirement of permits for high capacity well development and expansion of irrigated acres. The rules also establish required irrigation management in times of sustained groundwater decline. Over the last four years, LCNRD has been working with UNL-CSD advancing 35 test holes and installing 29 observation wells to establish a preliminary study of the LCNRD aquifer systems in tandem with the 2014-2016 AEM results. The UNL-CSD work along with this Project will continue to help the LCNRD evaluate the following additional target areas: areas where the geology is diverse and complicated, WHPAs at quantity and quality risk, locations where well interference occurs impacting agricultural or domestic uses, or regions where nitrate or other contaminants are impacting groundwater resources. They will also help determine if there are areas where future development may be possible. The surveys also provide insight into hydrogeologic connections between ground and surface water systems, which is poorly understood in northern Cedar and Knox Counties as well as in other areas of the district. Additionally, this Project is considered the next step to the July 2016 AEM flights conducted in southern Cedar County using grant funding from the WSF awarded in April 2016 (WSF#4143). The stakeholders for the LCNRD areas of the Project are the individual owners of domestic and agricultural water supply wells, municipal and local NRD water managers, and ENWRA partners (e.g. UNL-CSD aquifer boundary mapping efforts, USGS and UNL-CSD Nebraska GeoCloud WSF award #4164, NeDNR FAB report, NDEQ WHPAs).

The **LENRD** has an adopted GMP which details the management actions of the District regarding groundwater quantity and quality. LENRD also has a Drought Mitigation Plan (https://static1.squarespace.com/static/54be71a0e4b096702d519464/t/586fc48f6a496365d57d2c9a/1483719880310/LENRD+Drought+Management+Plan+Draft+12_21.pdf) and is developing a voluntary IMP. All of these plans promote sustainable use of groundwater resources for the District. The LENRD Board of Directors recently approved a change to the GMP which will require the installation of flow meters on ALL active high-capacity wells used for irrigation purposes by January 1, 2018, and by January 1, 2019 for high capacity wells classified for use as livestock, commercial/industrial, Public Water Supply, and any series of wells equipped to pump greater than 50 gallons per minute. The LENRD also currently does not allow installation of new high capacity wells, except in the case of replacement wells for irrigation, and new wells for livestock, commercial/ industrial, and public water supply. A permit for construction of a high-capacity well has been a requirement within the District since 1997. The LENRD has also created groundwater quality and groundwater quantity management areas when such an area is deemed necessary for protection. The LENRD is working with ENWRA and the UNL-CSD targeting all of Cuming county and portions of Dixson, Dakota, Wayne, Thurston, Stanton, Burt, Dodge, and Colfax Counties with a combined population greater than 26,000. Water in the Project area is utilized for residential, industrial, agricultural, and recreational uses.

The information from this Project will:

- Complete the plan to cover the entire District in 3-mile grid coverage with AEM
- Assist the District in the development of future groundwater management strategies and policies
- Help the District target specific areas to generate necessary improvements.

When this Project is complete, all citizens within the LENRD will benefit from the information obtained through the aquifer framework mapping. The information is an enduring source of information that supports the efforts of the LENRD and UNL-CSD to catalogue the states geology and groundwater, thus, the information will be part of the historical record, similar to the CSD test-hole database.

The **LPNNRD** has applied the following management considerations for sustainable water use:

- GMP Rules and Regulations Implemented in 1997, the District has required permitting of all water wells which exceed a pumping rate of 50 gallons per minute (gpm).
- Since 2008 flowmeters have been required on all wells that have approved permits for flowrates greater than 50 gpm.
- Cost-share is provided for soil moisture sensors and Evapotranspiration (ET) gauges with local University of Nebraska-Lincoln (UNL) Extension working directly with producers for installations.
- Cost-share provided for flowmeters in two Special Quantity Areas designated in 2015 because of concerns of in-season water decline. A rolling allocation of 27 inches in a 3-year period was implemented for these areas.
- A ranking system is utilized for well permits and expanding of irrigation acres for the Restricted Development and Hydrologically Connected Areas.

AEM data helps support test hole data submitted, thickness of the aquifer and depth to bedrock. This information will be invaluable in determining future water use as more housing development is being expanded in the restricted areas (**Attachment 12**). Demand for drinking water will continue to increase and the need to find potable water sources will be needed in the different geological formations.

The **LPSNRD** has several programs in place to support sustainable water use. Since the adoption of its GMP in 1995, the District has required permitting of all water wells which exceed a pumping rate of 50 gallons per minute (gpm). LPSNRD has required additional actions for these permits (such as water quality sampling, and, under certain circumstances, aquifer testing) to ensure that the groundwater resource is of adequate quality and quantity for the intended use. In addition, since 2011, the District has required all water wells pumping more than 50 gpm to have a properly installed water meter, and the owners of those meters are required to report their water use on an annual basis. At that same time, the District required all irrigated fields larger than one acre to be certified as irrigated with the LPSNRD. Finally, due to concerns over in-season water declines, the District designated the Dwight-Valparaiso-Brainard Special Management Area (DVB SMA) covering about 100 square miles in the northwestern portion of the District in 2013.

LPSNRD has not allowed any additional irrigated acres in that area, and portions of it are under a three-year allocation of 21 inches for sprinkler systems and 30 inches for gravity systems. All of these actions help to ensure that groundwater use in the District is managed responsibly and sustainably. Further, the LPSNRD partnered with P-MRNRD, LPNNRD and other agencies on the Lower Platte River Drought Contingency Plan (WSF Award #4151).

Since May of 2013 the **NNRD** has applied the following management considerations for sustainable water use:

- Flowmeters have been required on all 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 takes in account aquifer thickness and transmissivity, based upon the required submission of a test hole report. 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.

P-MRNRD: The P-MRNRD has an adopted GMP, last revised in 1994. This Project specifically helps carry out the objectives of the GMP to improve available hydrogeologic data used to evaluate groundwater quantity or quality problems. The enhanced geologic framework from the proposed Project will be combined with static groundwater levels, collected by the P-MRNRD since 1978. In addition, the P-MRNRD is in the process of completely updating its current GMP and the concurrent collection and interpretation of data from this Project will help to establish measurable goals and targets. The results of this Project will support sustainable water use by improving the placement, installation and long-term use of water supply wells. Local WHPA plans will also benefit from the enhanced geologic data.

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 affecting domestic, irrigation, municipal, community, commercial, and industrial usages. The NRDs in ENWRA represent 65% of the state's 1.9 million residents and have a diverse group of drinking water users: large municipalities, small and mid-size communities and towns, rural water systems, and high densities of rural domestic users (**Attachment 8** and http://enwra.org/). 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.

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 primary leverage for this Project will be to benefit local public water suppliers. 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, State Revolving Fund) when upgrading or installing new water or waste water systems. The information on groundwater occurrence, as well as near surface geology, will prove highly valuable when evaluating new facility sites, and the refined aquifer volume estimates will facilitate required aquifer analysis for establishment of new groundwater-based drinking water systems. Please refer to Section D, Project Description questions 3 and 4 for a funding matrix table and partner commitments/strategies.

The Project also builds on previous state dollar investments as it is considered a follow-up, expansion, fill-in of additional data piloted by ENWRA's initial AEM efforts and AEM reconnaissance line efforts. NeDNR was a funding partner on AEM data collection through ENWRA in 2007 with the ENWRA pilot projects (NeDNR IWMPP Contracts 294 and 359) and reconnaissance flights in 2014 and 2015 (NeDNR Contract #789), and is working on groundwater numerical models for eastern parts of Nebraska to evaluate comparisons of outputs using AEM results (LPMRT). The Project provides further detailed datasets for UNL-CSD's and USGS's AEM evaluation efforts and pending internal mission plans (WSF Nebraska GeoCloud Award #4164, County Groundwater Atlas map creation, updated water level dataset creation/mapping, deep Dakota logs for the UNL-CSD test hole database).

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 NeDNR managed basins (Missouri Tributaries and Lower Platte) 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) and covers some of the Lower Platte River Corridor Alliance (LPRCA) http://www.lowerplatte.org/ priority areas (**Attachment 13**). A more detailed knowledge of this connection will help the NRDs and state agencies like NeDNR 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. For example, the LCNRD has flight lines planned along the south side of Lewis and Clark Lake which is part of the Missouri River Recovery Program (MRRP) protecting pallid sturgeon, least tern and piping plover habitats (http://moriverrecovery.usace.army.mil/mrrp/f?p=136:1:0::NO). Additionally, Nebraska Department of Environmental Quality (NDEQ) watershed management plans are now recognizing groundwater and are allowing the inclusion of groundwater projects in the plans to qualify for EPA Section 319 funding.

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 and Plan of Work for the Nebraska State Water Planning and Review Process or FAB report (https://dnr.nebraska.gov/sites/dnr.nebraska.gov/files/doc/water-planning/statewide/FAB/2017AnnualReport/2017FinalFAB_1.docx_.pdf) lists the following objectives:

1) Maintain data, information, and analysis capabilities for water planning, including specific programs for collecting, maintaining, and distributing information on streamflows, as well as analyzing water uses and water supplies across the state
2) Provide staff and resources to support planning and implementation of water resources projects

3) Support locally developed water management plans for managing hydrologically connected water supplies
4) Provide resources to map and identify areas vulnerable to flood damage
5) Provide coordination of federal agencies, state agencies, local NRDs, and other water interests for the development of water resources programs and projects

The collection of AEM data and the incorporation of that data into an overall aquifer framework directly supplements Objective 1 through improved data, information, and analysis capabilities. The data collected provides greater understanding of the extent, thickness, and interconnectedness of aquifer systems, which is a resource staff can use to evaluate, analyze and manage streamflows in the hydrologically connected water resources of the state. Water uses and supplies are analyzed as part of the FAB Report, done annually by the NeDNR, through modeling of those hydrologically connected areas. The AEM data and the resulting interpretation and framework will be submitted to the NeDNR as the best available data for use in the FAB Report.

The ENWRA NRDs will utilize the Project data collected and the interpretation of that data to further their expertise in the local hydrogeologic framework. That expertise will be utilized by the NRD management and Boards of Directors to develop the appropriate plans, programs, and projects for the protection and conservation of the water resources. The NRDs partner with many agencies of the state including NeDNR, NDEQ, DHHS, Nebraska Game and Parks Commission (NG&PC), UNL-CSD, USGS Lincoln Water Science Center 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. 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 (public meetings, http://enwra.org/, Nebraska GeoCloud WSF award #4164). 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 ENWRA NRDs. 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 areas within those WHPAs, will help those systems evaluate and manage possible threats to their groundwater supplies. In addition, it will provide ENWRA NRDs 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.

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. For example, the LCNRD has flight lines planned along the south side of Lewis and Clark Lake near the Gavins Point Dam Project which is part of the MRRP protecting pallid sturgeon, least tern, and piping plover habitats (http://moriverrecovery.usace.army.mil/mrrp/f?p=136:1:0::NO). Please see http://conference.ifas.ufl.edu/NCER2011/Presentations/Thursday/Dover/am/1120_BThompson.pdf for a 2011 presentation regarding Federal Mandates specific to the Missouri River.

Section D.

PROJECT DESCRIPTION

1. Overview

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

The process of proactively identifying and evaluating water resources through the use of both traditional and state of the art techniques is critical to the state's water planning activities. Equipped with the best available information, state and local agencies are best able to develop the necessary plans to ensure the sustainability and protection of the state's water supply. Traditional techniques of aquifer characterization rely upon assessments of subsurface materials from numerous individually drilled borehole locations. The remote sensing technique of Airborne Electromagnetics (AEM) has the capability of collecting many thousand virtual boreholes at a fraction of the cost of traditional drilling. AEM is then combined with existing information about aquifer characteristics to provide an overall three dimensional framework of the aquifer extents and interactions. This Project seeks funding to collect supplementary AEM data across the six Eastern Nebraska Water Resources (ENWRA) Natural Resources Districts (NRDs) and interpret the results into that three dimensional framework.

2. Project Tasks and Timeline

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

The Project will map flight transects, blocks, and grids across eastern Nebraska producing approximately 4,000 miles of AEM survey (see **Attachment 1**) to extend/supplement the hydrogeologic frameworks in each of the ENWRA NRDs. The Project activities will consist of the planning of flight lines, collection of Airborne Electromagnetic (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 each ENWRA NRD. The deliverables will include a digital pdf report with individual flight lines relative to the existing test holes, select registered wells depicted in color pdf appendices, maps of the aquifer(s), and maps of potential recharge areas for each ENWRA NRD. Digital datasets and metadata files produced/incorporated in the survey will also be provided for upload to the Nebraska GeoCloud (WSF 4164).

Upon notice of award of the WSF grant, the ENWRA NRDs will contract with the Consultant to refine proposed flight lines (Proposal and Draft Contract with description of services and cost breakdown included as **Attachment 2**). Payment of $984,000 or 30% of the total contract amount will be due at the time of contract signing (anticipated around

March 1, 2018). The Consultant, working with ENWRA, will develop the flight lines, maximizing the coverage area while avoiding infrastructure that creates ground interference.

Data collection and data processing will occur in NRD fiscal year 2019 (FY19, between July 1, 2018 and December 31, 2018). Payment of $1,640,000 (50% of the total contract amount) will come due on or around the last day of the flight campaign. The report will be completed in chapters, specific to each ENWRA NRD, and will be available approximately one to two years from the end of the data collection event (NRD FY19 and/or FY20, depending on each NRD's fiscal budgeting plans). The remaining 20% of the total contract amount, or $656,000, will be paid out to the Consultant in a prorated manner based on percentage of total miles flown for the particular NRD chapter as the individual deliverables and associated digital datasets are completed. A comprehensive, all-inclusive final report (includes ENWRA meeting presentation) is anticipated by December 31, 2019. More extensive review of the data and direct implications to each of the ENWRA NRDs will be conducted by University of Nebraska Conservation and Survey Division (UNL-CSD), United Stated Geological Survey (USGS), Nebraska Department of Environmental Quality (NDEQ), the Nebraska Department of Natural Resources (NeDNR) and ENWRA in future years beyond the Project timeline.

3. Partnerships

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

This Project is being completed in cooperation with several local agencies with coordinated data collection to improve efficiency and gain economy of scale. The coordination of last year's 2016 AEM flight projects minimized mobilization/de-mobilization and logistical costs for the data collection. This allowed for approximately 300 miles of additional bonus flight lines for the ENWRA NRDs (2015 AEM flight awards WSF#: 4124, 4132, 4133, 4140, 4141, 4142, 4143, and 4144 flown in July 2016). Additionally, five of the final AEM Project reports for the July 2016 AEM surveys have been delivered ahead of schedule and on budget with only three of the eight left to deliver (WSF #4124, 4132, and 4142 – reports also anticipated to be on time or ahead of schedule).

ENWRA is the lead agency for this proposed Project and application to the WSF (**Attachment 3** includes Letters of Support from funding partners and one of the local community representatives with well-head protection and sustainability concerns within the Project area). Each of the six ENWRA NRDs (Lewis and Clark [LCNRD], Lower Elkhorn [LENRD], Lower Platte North [LPNNRD], Lower Platte South [LPSNRD], Nemaha [NNRD], and Papio-Missouri River [P-MRNRD]) are sponsoring the match dollars for the flights within their respective Districts through ENWRA (please refer to the table in the next section, Section D - #4). The planning and coordination of all flights, data collection,

processing, interpretation, and data products will be done through the use of a single geophysical consulting firm (please refer to **Attachment 2** proposal letter and draft consultant contract). The use of a single Consultant allows the ENWRA NRDs 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. This shared use reduces the overall costs for all partners. After completion of data collection, interpretation, and framework update, information about aquifer characteristics and extents will be provided to NeDNR for incorporation into existing models as the "best available" information in the FAB Report and INSIGHT Model, and provided to the UNL-CSD/ENWRA/USGS for incorporation into the Nebraska GeoCloud (WSF award #4164).

4. Other Sources of Funding

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

The total cost of the entire Project is estimated at $3,280,000 (see **Attachment 2** - proposal and table below for detailed breakdown). ENWRA NRDs are requesting $1,968,000.00 of WSF funding and have each confirmed that they are budgeting the required 40% local matching funds from their respective Budget processes (see **Attachment 3** for letters of support) with the understanding/commitment that FY19 (and/or FY20) costs outlined below will be budgeted also. If WSF funding is not obtained, the ENWRA NRDs will continue to pursue additional AEM flights through their individual annual budgeting process as well as any grant funding opportunities that might arise.

Funding Sources	**FY18 (30% by March 1, 2018)**	**FY19 (Next 50% after July 1, 2018)**	**FY19 or FY20 (Last 20% around one year after flights)**	**Total**
ENWRA NRDs				
Papio-Missouri R. NRD ($230k)	$27,600.00	$46,000.00	$18,400.00	$92,000.00
Nemaha NRD ($300k)	$36,000.00	$60,000.00	$24,000.00	$120,000.00
Lewis and Clark NRD ($500k)	$60,000.00	$100,000.00	$40,000.00	$200,000.00
Lower Elkhorn NRD ($650k)	$78,000.00	$130,000.00	$52,000.00	$260,000.00
Lower Platte North NRD ($750k)	$90,000.00	$150,000.00	$60,000.00	$300,000.00
Lower Platte South NRD ($850k)	$102,000.00	$170,000.00	$68,000.00	$340,000.00
Local Match Subtotal	**$393,600.00**	**$656,000.00**	**$262,400.00**	**$1,312,000.00**
WSF reimbursements (60%)	**$590,400.00**	**$984,000.00**	**$393,600.00**	**$1,968,000.00**
Total Project Cost	**$984,000.00**	**$1,640,000.00**	**$656,000.00**	**$3,280,000.00**

5. Support/Opposition

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

AEM data collection is supported by the numerous NRDs across the state that have utilized this type of detailed information to make improved management decisions. Over the last 10 years that the NRDs have been collecting this type of information, there have been no instances of opposition. From the earliest collection of AEM data in Nebraska until now, more agencies and organizations have supported the NRD efforts or undertaken their own AEM data collection or developed plans to use the data. With this Project, Lower Elkhorn and Lower Platte South NRDs will complete the baseline grid/block frameworks planned for their Districts and will be looking toward potential use of the data for groundwater models in their area. The remaining ENWRA NRDs will be completing several of the area objectives they each have listed in ENWRA's Long Range Plan (LRP) **Attachment 4**. NeDNR was a funding partner on AEM data collection through ENWRA in 2007 with the ENWRA pilot projects and reconnaissance flights in 2014 and 2015, and is working on a groundwater numerical model for eastern parts of Nebraska to evaluate comparisons of outputs using AEM results. The US Army Corps of Engineers collected AEM data to support their efforts at cleanup of the Former Nebraska Ordinance Plant near Mead, Nebraska. The UNL-CSD and USGS teamed with ENWRA on the Nebraska GeoCloud Project (WSF award #4164) and will incorporate this new data, thus enhancing both projects.